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Phytocenoses in the Mar Piccolo in Taranto (Ionian Sea, Southern Italy) : mesolittoral level and infralittoral fringe

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A study has been made of phytocenoses in the mesolittoral level and upper infralittoral fringe of the Mar Piccolo at Taranto (Ionian Sea - Southern Italy), an area till now scarcely studied from a botanical point of view except for some notes (PIERPAOLI,1923;1959;1960). The Mar Piccolo, which has a surface area of 20.72 Km^2 lies to the North of the city of Taranto and is divided by two promontories of land into two basins, which are called the First and the Second Inlets. It contains several submarine fresh water springs, called "citri". This study was carried out, during the months of June and September 1987, using the phytosociological method. The samples were taken from 21 squares of 400 cm^2, each square being at a different station. Twentyone Rhodophyceae, 1 Phaeophyceae and 18 Chlorophyceae in addition unclassified Cyanophyceae and Diatoms were found. It is noteworthy that Hypnea cervicornis J.Agardh which is spreading accross the Mediterranean was found there. In the mesolittoral level the predominant species are Enteromorpha prolifera (Mueller) J.Agardh and Enteromorpha intestinalis, (L.) Link (RIZZI-LONGO and GIACCONE, 1974). In highly polluted areas these species usually substitute the Enteromorphetum compressae association. As pollution increases even these species become scarcer and finally are substituted by a coating of Cyanophyceae and Diatoms in colonies. This process was observed in September at the stations near sewer outlets. In the upper infralittoral fringe the Pterocladio-Ulvetum association is well represented. From a phytosociological point of view there are the following syntaxa: Pterocladio-Ulvetum (25% of the species found); Acrochaetietalia (22.5%); Cystoseiretalia (12.5%); Rhodymenietalia (12.5%), whose presence is probably due to the increasing turbidity. A considerable incidence (27.5%) of the ubiquitous species was also observed. In particular it was noticed that Ulva rigida C.Agardh, which was predominant in June, was substituted in September by Ulva curvata (Kuetzing) De Toni (this substitution has been observed in the Venetian Lagoon by RIZZI-LONGO and GIACCONE (1974)) and by Ulva scandinavica Bliding. Similarly Enteromorpha flexuosa (Wulfen ex Roth) J.Agardh and E.intestinalis, which were dominant in June, were substituted by E. prolifera in September. In order to evaluate the environmental quality the following biological indexes (CORMACI et al., 1985) have been calculated: 1) mean total covering expressed as a percentage (June:64.3%, September:45.7%), 2) mean number of species found in the samples (4.6 in June, 4.1 in September), 3) mean diversity index (H'=1.2 in June and 0.8 in September); 4) mean Rhodophyta/Phaeophyta ratio (R/P=3 in June and 2 in September). The values found, both in June and in September, show that the system balance had been strongly altered; in fact the mean number of species for each sample and the values of mean diversity index were very low. Even if the R/P index values were apparently regular, it is necessary to consider that there was a very high percentage of samples (85.7% in June and 90.5% in September) whose R/P ratio could not be calculated owing to the lack of Phaeophyceae and even Rhodophyceae. In September the environmental conditions compared with June showed a worsening. In fact in this period, high temperatures in the surface waters (28°C) were recorded with a consequent reduction in the oxygen concentration, which was already low as a result of the effects of mineral oils and hydrocarbons that are always present on the surface. Variance analysis was carried out for the values of the above-mentioned biological indexes of each sample, in order to find out whether they varied by months and/or by the specific characteristic of the two Inlets. The results showed that only the values for total covering were influenced, but these varied only by seasons. The other three indexes were not influenced either by seasons or by the typical characteristics of the two Inlets. In order to underline the existence of real differences between the two Inlets of the Mar Piccolo, a similarity analysis was carried out using Sorensen index, for both sampling months. This analysis showed that the First Inlet stations were not homogeneous. This is probably due to the larger scale of the residential development along the coast of this basin as compared to that of the Second Basin; such developments cause variations of ecological factors along the coast, which influence the composition of the species making up the algal mantle. The stations of the Second Inlet had virtually similar results for the composition of the species. This leads to the conclusion that in this basin the environmental conditions were virtually homogeneous.

CONCLUSIONS

This research confirms that the Mar Piccolo in Taranto is a basin with typical lagoon peculiarities. This has been underlined by the general appearance of vegetation, which is typical of lagoon environments in the High Adriatic. In particular it shows many similarities with the Venice and Grado Lagoons. A typology study of vegetable associations has shown that the basin is suffering from urban development projects, which have degraded its environment.

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B-I2

Connaissances actuelles sur la flore benthique de la Sardaigne. Quelques considérations

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Ce travail a pour but de faire le point sur les connaissances actuelles de la flore benthique et surtout d'évaluer l'actualité effective d'un recensement floristique des entités algales benthique présentes en Sardaigne qui puisse être mis en rapport avec les connaissances géobotaniques de la Méditerranée. En effet, certains travaux phytogéographiques (Cormaci, 82; Furnari, 84) ne considèrent pas le contingent algal sarde-corse dont les signalisations dépassent le nombre de 600.

La flore de la Sardaigne a été extraite des travaux suivants:

BARBEY W.,1884 - Flora Sardoae Compendium. Lausanne.

BRANBATI A., CHIRARDELLI E., GIACCONE G., OREL G., VIO E., 1980 - Bionomia del Canale di S. Pietro. Nova Thalassia 4:135-171

CHIAPPINI M.,1970 - Ricerche sulle Alghe marine della Sardegna. Nota 1: Dalla Costa da Cagliari a Flumini. Morisia 2:37-45

DESSI P.,1975 - Osservazioni di algologia nel Golfo di Alghero (Tesi di Laurea in Sc. Naturali, Univ. di Sassari)

GIACCONE G., COSSU A., MUSCETTA G., e DELORENZO R. 1988 - in corso di stampa - Studio di Impatto Ambientale nella rada antistante la zona industriale di Porto Torres (Sardegna Nord-Occidentale)

MOLINIER R., 1955 - Apercu de bionomie marine sur le cotes septentrionales de la Sardaigne. Bul.Staz.Acquic.Peche, Castiglione 7:373-400

PICCONE A., 1878 - Florula Algologica della Sardegna. Giorn. Bot. Ital 10(3): 289-367

PICCONE A., 1884 - Nuovi materiali per l'algologia Sarda. Giorn. Bot. Ital 16(1): 33-49

SOLAZZI A., 1971 - Le alghe della Sardegna Gior. Bot. Ital. 105(4): 201-202

SOLAZZI A., 1974 Le alghe della Sardegna. Atti e mem. Accademia Patavina di SC. Lettere e Arti Vol LXXXVI (1973-74) P. II° Classe di Scienze Mat. e Nat.

SOLAZZI A., 1968 - flora algale della Sardegna Nord-Occidentale (I.di Tavolara , Molara e Scoglio Molarotto) - Accademia Naz. dei Lincei Ser.VIII Vol XLV fasc. 6

SOLAZZI A., 1969 - Su alcuni ritrovamenti interessanti di alghe in Puglia e in Sardegna. Gior. Bot. Ital. 103(2): 163-167.

Le contingent actuel arrive à 427 entités partagées en 103 Phaeophyceae, 240 Rhodophyceae, 57 Chlorophyceae et 27 Cyanophyceae.

Le rapport Rh/Ph est de 2,3, ce qui montre que le nombre des Rhodophyceae est certainement sous-estimé, surtout si on le compare à celui de la Méditerranée centre-orientale qui est, lui, d'environ 3,1.

Le spectre chorologique (fig. 1) est donc cohérent avec celui des principales flore méditerranéennes. Le degré de superposition floristique évalué sur les espèces sardes qui soient également présentes dans d'autres zones de la Méditerranée mais qui ne soient pas cosmopolites, nous permet de déterminer le niveau d'affinité entre la flore sarde et les autres (fig. 2).

On remarque un degré de superposition considérable entre la Corse, l'Ouest et le Nord-Est de la Sicile, alors que celui qui concerne la flore de l'Adriatique est par contre plutôt difficile à interpréter.

Il est nécessaire de préciser que: a) les travaux de Piccone et Barbey remontent au siècle dernier; b) de nombreuses signalisations sont douteuses et ne sont pas controlables du fait que les exemplaires d'herbier n'existent plus; c) a cette époque, les échantillonnages furent effectués à l'aide de bennes au lieu que grâce à l'observation directe; d) les localités examinées sont surtout celles du sud de l'île et quelques-unes d'entre elles seulement ont été examinnées selon une méthode moderne.

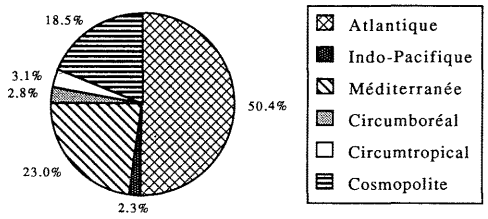

Fig. 1- Spectre Chorologique des entités algales de la Sardaigne

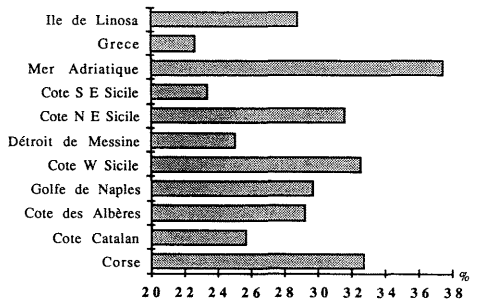

Fig. 2 - Niveau de superposition entre le contingent algal sarde et celui des autres zones de la Méditerranée

En Conclusion on peut donc affirmer que la flore algale de la Sardaigne est bien loin d'être définie surtout en ce qui concerne les Rhodophyceae. Notre objectif futur est celui de déterminer les typologies les plus caractéristiques de l'île et d'obtenir grâce à elles, avec des récoltes saisonnières sur les différents niveaux du litoral, un échantillon suffisamment représentatif pour la définition de la flore de la Sardaigne.

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B-I3

L'influence du gel et de la glace sur la végétation algale du littoral roumain de la mer Noire

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ABSTRACT: The heavy winters in periodical succession on the Romanian shore of the Black Sea bring about a very high amount of algae vegetation destruction both in the supra and in the infralitoral. This phenomenon is mainly due to the very low temperatures which cause the freezing of the coastal waters. Ice, both through its mechanical action of frictioning the rocks and through its long standing covering of vegetation is considered the most noxious agent.

De temps, en temps, à des intervalles plus ou moins longs, le littoral de la Mer Noire connait des hivers particulièrement rigoureux, la température, basse sur une longue période, fait geler les eaux côtières. Dès 1972, de pareilles températures bases (jusqu'à -20°C), suivies par des gelées cycliques se sont succédé de la mi-janvier jusqu'au début de mars.

Les facteurs défavorables lors de ces hivers rigoureux sont la température très basse et la glace qui se forme et qui a une double action destructive sur la végétation macrophyte. La première de ces actions et la plus nuisible, est l'action mécanique, la glace emportée par les vagues, polit les rochers et les fonds par un frottement prolongé. Cette action destructive est encore amplifiée par les tempêtes et les vents violents qui sont fréquents sur la côte roumaine pendant la saison froide; la deuxième est l'inhibition du processus de photosynthèse et la diminution de la respiration.

Il faut ajouter les grands glaçons arrachés, par les courants et les vents du Nord, aux eaux du golfe d'Odessa et des embouchures du Danube.

Dans le mediolittoral, toutes les associations d'algues typiques pour la saison froide, formées par Urospora penicilliformis, Bangia fuscopurpurea, Blidingia marginata, les espèces Enteromorpha, Ulothrix et Ceramium, qui ne se développent comme il faut que dans les conditions d'une humectation périodique ont été détruites par la glace qui a couvert pendant une longue période toutes les pierres et les rochers du mediolittoral. Certaines algues ont survécu pendant 7-10 jours au maximum sous la couche de glace, dans les fentes des rochers.

Parfois, l'effet nuisible de la glace s'avère être catastrophique. Ce fut le cas des associations des deux espèces de Cystoseira: C.barbata (Good et Wood) Ag et C. crinita (desf.) Bory F. bosphorica (Sauv.) A. Zin et Kalug, de la ceinture de végétation de l'infralittoral, dont 80% en ont été éliminées à la suite de l'hiver rigoreux de l'année 1972. Les champs de Cystoseira avaient été "fauchés" à 1-2 cm au-dessus du disque adhésif. Par la suite, l'année suivante, des zones entières du faciès pierreux de l'infralittoral sont restées dénudées, d'autres associations, notamment les espèces Cladophora, Enteromorpha et Ceramium, s'y installant, espèces dont l'importance écologique et économique est de moindre importance. Cystoseira - algues pérennante - dont la taille peut atteindre 1,5 m, formait l'une des associations les plus riches et les plus répandues de tout le fond rocheux de la zone infralittorale de la côte roumaine. Elle représentait une vraie zone tampon qui, par ses thalles élastiques et bien fixés contre les roches, attenuait beaucoup la force des vagues.

Sur leurs branches dont les bouts chargés d'éléments réproducteurs constituaient la nourriture des nombreuses espèces de poissons phytophages, une riche épibio se trouvait son milieu de vie idéal.

La destruction à grande échelle de ces algues a conduit et conduira dorénavant à d'importants changements dans le benthos de la zone de l'infralittoral rocheux de la côte roumaine.

Les dernières années, les germes et les plantules ne sont plus parvenus à se développer et à refaire ces associations, vu l'augmentation du degré de turbidité et de colmatage des eaux côtières, suite à de nombreux travaux hydrotechniques ou à l'écroulement des falaises argileuses pendant les tempêtes. A tout cela il faut ajouter la degré toujours plus élevé d'eutrophisation des eaux côtières suite au développement des agglomérations urbaines.

Tout cela a déterminé la destruction des nombreuses algues brunes et rouges à l'état juvénile, plus sensibles aux facteurs de milieu mentionnés ci-dessus, tout en favorisant le développement des algues vertes, dont les plantules ont une plus grande résistance.

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B-I4

Temperature requirements of several macroalgae from the Mediterranean

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The macroalgal flora of the Mediterranean Sea contains several distinct floristic elements, a consequence of its paleogeographical past (Feldmann 1937, Pérès 1967, Haritonidis 1978, Cinelli 1985). There are few investigations on the temperature requirements of Mediterranean algae (Lüning 1985), and little is known about the temperature demands characterizing algal species belonging to different floristic elements. The subject of the present investigation was, hence, to determine the upper temperature limits for survival, and temperature optima for growth and reproduction of a group of selected, unialgally cultivated Mediterranean algae.

The majority of the algae investigated was isolated in the Gulf of Thessaloniki, from January to May 1986. The remaining species were obtained by courtesy of Prof. D. G. Müller (Konstanz) from his culture collection, and had originally been isolated near Villefranche, southern France. The algae were propagated in unialgal laboratory culture. For determination of the survival temperature the algal material was treated for two weeks in waterbaths equipped with thermostats, at intervals of 1°C in the critical temperature range. Growth and reproduction was followed in constant temperature rooms.

The species tested belonged to the following groups of floristic elements: Atlantic, endemic or "Mediterranean", circumtropical, and cosmopolitan elements.

The upper survival limit of species belonging to the Atlantic element ranged at 28-29°C (e.g. Porphyra leucosticta, Stictyosiphon soriferus, Kuckuckia spinosa). Choristocarpus tenellus, which is counted to the endemic or "Mediterranean" elements, survived 27°C as uppermost temperature, whereas Cystoseira barbata, belonging to the same group, survived 29°C (30°C and higher temperatures not tested in this case). Circumtropical species exhibited a strikingly higher uppermost survival temperature, i.e. 34°C (e.g. Gracilaria sp., Gracilaria dura). Upper survival temperatures for cosmopolitan species were 30°C in Colpomenia peregrina, 31°C in Bangia atropurpurea, and 32°C in Enteromorpha linza.

Optimum temperatures for growth (i.e. >80% of maximal growth rates observed) were found in the range 15-25°C for most of the warm-temperate species, whereas species with tropical affinities ranged at 25-30°C. Temperature optima for reproduction were observed to follow rather closely the growth optima.

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B-I5

A note on the chemical composition of some common benthic algae from a polluted area in the Northern Adriatic (Rovinj)

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Environmental parameters exhibit pronounced influences on the chemical composition of seaweeds. Organic pollutants, excess nutrients and heavy metals dissolved in the sea alter the metabolic processes and hence the chemical composition of marine plants (Munda,1974,1982).

With this in mind the protein and mannitol content of some common brown algae was studied . The algae were collected in differently polluted habitats. The protein content of some common red and green algae was studied simultaneously. Results indicated relatively high protein and mannitol contents in Fucus virsoides , which was found only in relatively unpolluted sites. Observations carried out on Cystoseira species (C. compressa and C. stricta) have revealed a general trend of increased protein and decreased mannitol content under unfavourable growth conditions, such as pollution impact or conditions in rock-pools.Brown algae , other than fucoids were collected in polluted sites near the Rovinj hospital and Lone Bay i.e. sites where fucoids were absent. These samples revealed a rather high protein content , whereas the mannitol content was low, with exception of Punctaria latifolia and Dictyopteris membranacea.

In the red algae, collected in the unpolluted Faborsa Bay, the protein content was high.The highest value was found for Catenella caespitosa, which grows under stress conditions in the level of the littoral fringe. Most of the red algae avoid heavily polluted habitats, with exception of Gelidium spinulosum, which was prolific near the Rovinj hospital. Among the green algae the highest protein content was found in Cladophora ruchingeri cf. from a heavily polluted site.

Protein and mannitol content (g/100 g dry weight) in seaweeds from Rovinj.

PHAEOPHYTA	protein	mannitol
Fucus virsoides- Faborsa	10.2	7.6
Cystoseira compressa - Faborsa	8.7	10.1
- Figarola	10.0	7.8
- Sturago	8.1	6.4
- Catarina	9.7	6.0
- rock-pool	13.1	5.8
C. barbata- Faborsa	8.7	9.9
- hospital	14.0	4.6
C. stricta- Faborsa	10.0	9.7
- Catarina	9.4	7.5
- Figarola	9.8	6.0
- rock pool	11.7	6.6
Halopteris scoparia-Catarina	10.0	6.4
- -Sturago	11.3	5.3
Dictyota dichotoma-Catarina	13.7	7.7
Dictyopteris membranacea - Catarina	14.3	9.2
Padina pavonica -Sturago	5.6	4.2
Cutleria multifida-Lone Bay	10.0	4.3
Colpomenia sinuosa-Lone Bay	6.2	5.4
Punctaria latifolia-hospital	10.0	9.3
Scytosiphon lomentaria-hospital	15.6	3.2
Stictyosiphon adriaticus-Lone	8.7	5.6
Ectocarpus siliculosus- hospital	13.5	11.3

RHODOPHYTA -Faborsa	protein	CHLOROPHYTA	protein
Ceramium ciliatum	14.2	Ulva rigida- Catarina	9.3
Polysiphonia furcellata	11.9	Cladophora dalmatica- Sturago	8.3
Lomentaria clavellosa	15.0	Cl.ruchingeri- hospital	22.5
Laurencia obtusa	18.2	Enteromorpha clathrata- Figarola	3.5
Alsidium corallinu m	15.6	E.intestinalis-Catarina	9.0
Corallina officinalis	9.3	-hospital	10.0
Gelidium spinulosum-hospital	8.7	Codium vermilara- Lone Bay	11.2
Catenella caespitosa - Sturago	20.6		
Gelidium pusillum-Sturago	6.3		
Porphyra leucosticta- Lim	15.6		

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B-I6

Seasonal variations in biomass and floristic diversity in benthic algal associations from the Northern Adriatic (Piran)

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In the heavily polluted area around Piran,northern Adriatic,the benthic algal vegetation was impoverished both in terms of biomass and floristic diversity.Different algal associations were found if comparisons with less polluted areas were drawn.

Sampling was carried out monthly between February and November in the rocky eulittoral and sublittorally at depths 1m, 3m and 7m. The substratum is flysch and limestone and locally concrete walls. Bellow 7m the slopes are sandy and bare of macroalgae. The tidal range is in average 95 cm. Temperature minima were found in February at all depths and maxima in August, with a range from 7.9°C to 25.5°C at the surface. During February and March the temperature increases with depth.The opposite was found from April to October. The surface salinity ranged from 34.6 ‰ to 37.8 ‰ , with a minimum in June and increase towards autumn and winter. Salinity values increased notably with depth between February and April.This increase was less conspicuous during summer and even less in autumn.

The benthic algal vegetation of this area is exposed to a combination of environmental stresses.In the eulittoral perennial settlements of the endemic Fucus virsoides (Don.) J.Ag. were rare.Spring annuals dominated at this level(Scytosiphon lomentaria (Lyngb.) Link.,Bangia atropurpurea (Roth.)C.Ag., Porphyra leucosticta Thur.,Ceramium spp.) along with mats of diverse green algae,which appeared during the year in several subsequent generations(Ulva rigida C.Ag., Blidingia minima(Näg.ex Kütz.)Kylin,Enteromorpha spp, Ulothrix spp.) .Locally turf-like mats of diverse Gelidium and Gelidiella species were conspicuous. At this level the biomass was low with a maximum in April , which coincided with the highest species diversity. Biomass values ranged between 4o and 612 g per m2 during the seasons.

In the sublittoral Cystoseira species were association-forming and dominated in the biomass (C.barbata(Good.et Wood.)J.Ag. and C. compressa (Esper)Gerloff et Nizamuddin at the upper levels and C. crinita(Desf.)Bory and C. corniculata (Wulf.)Zanard.ex Hauck between 3 m and 7 m). Seasonal variations in biomass were mainly due to the growth, fruiting and partial decay of the Cystoseira thalli and their epiphytic cover. Dense settlements of Dictyota dichotoma(Huds.) Lam.,Halopteris scoparia (L.) Sauv. and Halopitys incurvus (Huds.)Batt. were characteristic for this area. Seasonal variations in biomass and floristic diversity were also due to the appearence and disappearence of diverse tiny Ceramiaceae (e.g. Antithamnion plumula(Ellis) Thur., A. tenuissimum(Hauck)Schiffner , Callithamnion corymbosum(Smith)Lyngb., Ceramium tenuissimum (Lyngb.)J.Ag.,C. gracillimum (Griff.ex Harvey)G. Feldmann,C. codii(Richards)G.Feldmann, C. diaphanum (Roth)Harvey, C. rubrum (Huds.) C.Ag.,Pleonosporium borreri (Smith)Näg.,Ptilothamnion pluma(Dillw.)Thur.,Spermothamnion flabellatum Born.,Griffithsia spp., Compsothamnion thuyoides(Smith) Näg., Spyridia filamentosa(Wulf.)Harvey) along with diverse Polysiphonia species and considerable quantities of Nitophyllum punctatum(Stackh.)Grev. These species were prolific in the upper water layers during spring. Padina pavonica(L.) Lamouroux,Laurencia obtusa (Huds.)Lam. and Wrangelia penicillata C. Ag. were outstanding in summer. The algal biomass was highest between 1 m and 3 m depth. At 1 m depth the maximum biomass was found in April, whereas it was transfered to June at 3 m and 7 m. Pronounced seasonal variations in biomass and floristic diversity were found between 1m and 3 m depth. Biomass values ranged from 3oo to 4200 g per m2 at 1m and from 480 to 6000 g per m2 at 3m. The number of species of these intermediate depths was notably higher than in the eulittoral. At 1 m peaks in species diversity were observed in April and October, and in April and June/July at 3 m.

Further species which contributed to the algal biomass in notable quantities were Codium vermilara (Olivi) Chiaje,Pterocladia capillacea (Gmel.) Born .et Thur.,Jania rubens (L.)Lam.,Cladophora rupestris (L.)Kütz. and locally Corallina officinalis L. At 7 m the floristic composition was changed and seasonal variations in biomass and the number of species less conspicuous. Zanardinia prototypus Nardo,Peyssnnelia squamaria (Gmel.)Decne, Lithothamnion spp.,Pseudolithophyllum expansum (Phil.)Lemoine were conspicuous at this depth and were joined by some tropic floristic elements (e.g. Halimeda tuna (Ellis et Sol.)Lam., Udotea petiolata (Turra) Börgesen,Anadyoneme stellata (Wulf.)C.Ag.).

It is notrworthy that the spring maximum in biomass of the upper water layers was due to spring annuals , whereas it was transfered to June at 3 m and 7 m depth mainly on account of the fully grown Cystoseira thalli.

At 7 m depth conditions are more stable and crustose floristic elements dominate in the vegetation. By this reason seasonal variations in biomass and floristic diversity were inconspicuous at this depth.

B

Nouvelles données biogéographiques sur 49 espèces récoltées au Maroc

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Dans le cadre de la bionomie benthique, de l'écologie et de l'impact de la pollution sur la dynamique des peuplements littoraux des côtes atlantiques et méditerranéennes du Maroc, procédé à l'étude qualitative et quantitative de plusieurs peuplements appartenant à quatre types de biotopes: biocénose des algues photophiles (Corallines, Moulières, Cystoseires, *Asparagopsis armata* et *Pyura stolonifera*), herbier de *Cymodocea nodosa*, biotopes portuaires et biocénose Coralligène (BITAR, 1984, 1987; MONNIOT et BITAR, 1983). Ces peuplements se répartissent sur une vingtaine de stations (voir localités *in* BITAR, 1987).

La faune totale récoltée et identifiée compte 646 espèces dont 197 sont nouvelles ou très mal connues au Maroc. Parmi ces espèces, 49 sont trouvées en dehors de leurs localités reconnues jusqu'à présent. Elles sont classées en sept groupes selon leurs origines et leurs localités dans nos récoltes.

1- Treize espèces endémiques méditerranéennes trouvées dans le Détroit et (ou) en Atlantique:
Spongiaires: (*Crambe crambe*+, *Aplysina cavernicola*+):
Cnidaires: (*Eudendrium motzkossowskae*+, *Synthecium tubulosum*+, *Sertularia perpusilla*+, *Astroides calycularis*).
Nématode: (*Thoracostoma montredonense*+).
Bryozoaire: (*Haplopoma bimuconatum*+).
Crustacés: (*Atylus massiliensis*+, *Lissa chiragra*).
Ascidies: (*Phallusia fumigata*+, *Halocynthia papillosa*+, *Molgula bleizi gravellophila*+).

2- Treize espèces du nord-est atlantique trouvées au Maroc en Alantique et (ou) dans le Détroit et (ou) en Méditerrannée:
Cnidaires: (*Ectopleura dumortierii*, *Eudendrium capillare*+, *Orthopyxis caliculata*+, *Kirchenpaueria pinnata*, *Diphasia pinaster*+, *Eunicella gazella*+, *Lophogorgia sarmentosa*).
Mollusque: (*Littorina saxatilis*).
Amphipodes: (*Amphithoe rubricata*+, *Aora spinicornis*+).
Ascidies: (*Sidnyum argus*+, *S. elegans*+, *Stolonica socialis*+).

3- Douze espèces présentes au nord-est de l'Atlantique et en Méditerranée trouvées au Maroc en Atlantique et (ou) au Détroit:
Spongiaires: (*Clathrina clathrus*+, *Cliona celata*+, *Ulosa stuposa*+, *Dictyonella incisa*+, *Halicona mediterranea*, *Petrosia ficiformis*+, *Spongia nitens*+, *Ircinia fasciculata*+).
Bryozoaires: (*Callopora dumerilli*, *Escharina vulgaris*+).
Echinodermes: (*Ophidiaster ophidianus*+ (espèce nouvelle pour le Maroc mais existant aussi en Atlantique depuis le Portugal jusqu'à Sainte Hélène).
Poisson: (*Ophisurus serpens*).

4- Sept espèces subtropicales (ouest africaines) trouvées au Détroit et (ou) en Méditerranée:
Mollusques: (*Patella nigra*, *Littorina punctata*, *Siphonaria algesirae*, *Modiolus stultorum*).
Ascidies: (*Distaplia bermudensis*+, *Polycarpa goreensis*+, *P. pomaria*+).

5- Une espèce d'Afrique du sud (Mozambique) trouvée au Maroc près de l'entrée du Détroit (Ras Achaccar):
Ascidie: (*Pyura stolonifera*).

6- Une espèce signalée par AMOUREUX en 1976 à Cap Spartel et trouvée dans nos récoltes près de l'entrée de la Méditerrannée:
Polychète: (*Nereis maroccensis*).

7- Deux espèces exotiques importées trouvées au Détroit et (ou) en Méditerranée:
Polychète: (*Spirorbis marioni*).
Ascidie: (*Styella plicata*+).

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\+ Espèce nouvelle pour le Maroc.

Affinité qualitative des peuplements superficiels de la biocénose des Algues photophiles du Maroc avec ceux des différents secteurs de la Méditerranée et de l'Atlantique

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La faune des peuplements infralittoraux supérieurs ayant été étudié par plusieurs auteurs aussi bien en Méditerranée qu'en Atlantique, il est intéressant de voir les assinités des mêmes peuplements installés dans différentes localités géographiques où les masses d'eaux ont des caractéristiques contrastés (tempérées, froides et chaudes). Pour cela cous avons comparé nos résultats du Maroc (BITAR, 1987) avec ceux de SOURIE (1954) à Dakar (Sénégal), SALDANHA (1974) et MARQUES *et al.* (1982) dans deux localités des côtes atlantiques du Portugal: côtes d'Arrabida et celles situées entre Cap Carvoeiro et le nord de la lagune d'Obidos, BALLAN-SANTINI (1963) en Manche (France), BITAR (1980) à Marseille (France) et KOCATAS (1978) à Izmir (Turquie). L'Indice d'affinité calculé est celui de JACCARD ($J = \frac{Nab}{(Na+Nb)Nab}$); qui est un indice de parenté qualitative exprimé en % (Nab est le nombre d'espèces communes aux peuplements a et b; Na et Nb représentent respectivement le nombre d'espèces des peuplements a et b).

Nous considèrerons cette comparaison comme purement indicative, conscient des différences qui existent entre les travaux comparés et dont, les principales sont:

- Date à laquelle les travaux ont été faits et impact que cela peut avoir sur le niveau de détermination de certains groupes zoologiques qui ont pu subir d'importantes révisions.
- Nombre de peuplements étudiés, méthode de récolte, surface prélevée.
- Conditions locales de l'étude; celles-ci n'étant pas homogènes et pouvant même être très différentes en dehors de la seule situation géographique.

La richesse spécifique est plus importante en Atlantique (Tab. 1) et précisément au Sénégal (386 espèces) ou sur les Côtes d'Arrabida (363 espèces) par rapport è la Méditerranée. Toutefois, le Maroc s'est montré le plus riche avec 401 espèces recensées dans les peuplements de la biocénose des algues photophiles en question. Ceci est tout à fait normal, tenant compte d'une part de la situation géographique privilégiée du Maroc, où se rencontrent des masses d'eaux d'origines diverses, et de l'arrivée d'espèces exotiques par les transports maritimes d'autre part. En conséquence, des espèces boréales, subtropicales et tempérées s'y ont installées (BITAR, 1987). Ces espèces sont pour la plupart nouvelles, pour le Maroc, et signalées pour la première fois en dehors de leurs limites de sistribution reconnues jusqu'à présent (BITAR, 1988).

En ce qui concerne leur affinité, les peuplements de la Méditerranée nord-occidentale (région de Marseille) présentent les plus grand degré d'affinité avec ceux du Maroc (24%) (Tab. 1); ils sont suivis par ceux de la côte d'Arrabida de Portugal avec 21%.

D'après les valeurs d'affinités ainsi enregistrées on remarque des gradients d'affinité croissants dans la même direction vers le Maroc, aussi bien en Méditerranée qu'en Atlantique.

Tab. 1 - Degré d'affinité des peuplements du Maroc avec ceux des différents secteurs de la Méditerranée et de l'Atlantique. CM ou CE: *Corallina mediterranea* (= *C. elongata*); CO: *C. officinalis*; MG: *Mytilus galloprovincialis*; ME: *M. edulis*; CT: *Cystoseira tamariscifolia*; CG: *C. granulata*; CS: *C. stricta*; BB: *Bifurcaria bifurcata*; AR: *Asparagopsis armata*.

	Peuplements étudiés	Surface (cm²) /prélèvement	Richesse spécifique	Espèces communes	Affinité (%) avec le Maroc
Sénégal (SOURIE)	Faune intercotidale	Récoltes qualitatives	386	84	12
Portugal (SALDANHA)	GM-MG-AR	25×25	363	134	21
Portugal (MARQUES *et al.*)	CE-MG-CT+BB	25×25	135	71	15
Manche-France (BELLAN-SANTINI)	CO-ME-CG	20×20	90	49	11
Marseille (BITAR)	CM-MG-CS	20×20	240	124	24
TURQUIE (KOCATAS)	CM-MG	20×20	217	94	18

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B-I9

Variabilité de l'abondance des cellules à tanin dans les écailles de Posidonia oceanica

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Les écailles (pétioles persistants), insérées le long des rhizomes de Posidonia oceanica (Linnaeus) Delile, présentent des variations cycliques de leur épaisseur, en fonction de leur rang d'insertion. Des travaux récents (PERGENT, 1987) ont montré l'existence d'une corrélation entre ces cycles d'épaisseur et les fluctuations de certains paramètres anatomiques : (i) nombre de couches de cellules de certains tissus (sclérenchyme, parenchyme), (ii) forme ou aspect des cellules du sclérenchyme ventral et du parenchyme mésophylle, (iii) présence d'îlots de sclérenchyme dorsal, (iv) nombre de "cellules à tanin". Seul ce dernier paramètre sera pris en compte ici.

D.	Rhizome N°7 Nb. couples	r	Rhizome N°15 Nb. couples	r
0	106	0.55	74	0.42
1	105	0.60 M	73	0.52 M
2	104	0.24	72	0.30
3	103	-0.18	71	-0.02
4	102	-0.54	70	-0.25
5	101	-0.62	69	-0.23
6	100	-0.43	68	-0.08
7	99	0.06	67	0.20
8	98	0.50	66	0.43 M
9	97	0.58 M	65	0.31
10	96	0.24	64	0.14

Tableau I : Corrélation croisée unissant l'épaisseur des écailles à l'estimation du nombre de "cellules à tanin" pour deux rhizomes récoltés à Port-Cros (- 3 m) en Janvier 1982. D. : décalage; Nb. : nombre; r : coefficient de corrélation; M : valeurs maximales du coefficient de corrélation.

L'estimation du nombre de "cellules à tanin" a été effectuée sur les écailles d'une quarantaine de rhizomes orthotropes, prélevés à Port-Cros, en janvier 1982, à différentes profondeurs (- 0.5 à - 23 m). Les "cellules à tanin" sont dénombrées sur 1000 um de large, dans la partie médiane de coupes transversales effectuées à 10 - 12 mm de la base des écailles; leur abondance est codifiée selon une échelle variant de 0 à 1. Cette étude laisse apparaître de grandes variations dans la distribution des "cellules à tanin" d'un rhizome à l'autre, au sein d'une même station. Totalement absentes dans les écailles de certains rhizomes, elles sont bien représentées chez d'autres (jusqu'à 42 écailles sur 106). Lorsqu'elles sont présentent, deux facteurs semblent influencer leur répartition :

- L'épaisseur des écailles : l'emploi de corrélations croisées montre qu'il existe une forte corrélation entre les cycles d'épaisseur des écailles et les cycles de répartition des "cellules à tanin", et que ces derniers sont en phase (Tableau I).
- L'âge des cycles : le nombre moyen de "cellules à tanin" augmente lorsque l'âge des cycles croît, c'est à dire en s'éloignant de l'apex végétatif (Figure 1). Cette répartition a pu être vérifiée sur l'ensemble des stations de l'île de Port-Cros. De plus, l'analyse d'échantillons récoltés à proximité du rejet en mer de l'émissaire de Marseille, sur le plateau des Chèvres (MARCHADOUR, 1986, et examen de données inédites), semble traduire une évolution similaire, ce qui confirmerait l'action de ce facteur.

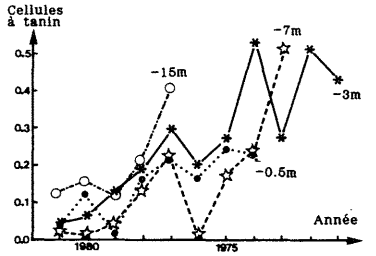

Figure 1 : Evaluation de l'abondance des "cellules à tanin", en fonction de l'année dans différentes stations de Port-Cros.

Dans ce dernier secteur, un autre facteur paraît intervenir dans la distribution des "cellules à tanin". En effet, à profondeur égale, l'abondance des "cellules à tanin" dans les écailles diminue avec la pollution; c'est dans les stations les plus proches de l'émissaire que l'on en trouve en abondance (Figure 2).

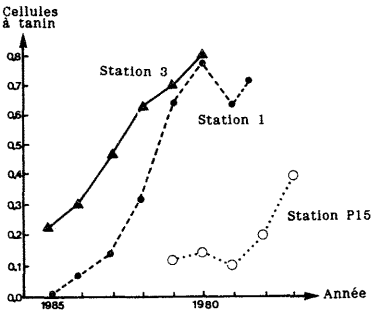

Figure 2 : Variation de l'abondance des "cellules à tanin" en fonction de l'année dans trois stations présentant une pollution croissante : les stations P15 (Port-Cros, - 15m) 1 et 3 (Marseille, -10 m, in MARCHADOUR, 1986).

Les "cellules à tanin", mises en évidence par PHOUPHAS (1962), sont en fait des cellules à phénol riches en acide chicorique (CARIELLO et al., 1979). Ces cellules pourraient jouer un rôle répulsif vis à vis des herbivores, et traduire une activité métabolique intense (CARIELLO et ZANETTI, 1979). Les variations, au cours de l'année, de l'abondance des "cellules à tanin" pourraient donc traduire des fluctuations parallèles du métabolisme de la plante.

La décroissance générale du nombre de "cellules à tanin", de la base vers l'apex d'un rhizome orthotrope, pourrait matérialiser le vieillissement du point végétatif. Toutefois, afin d'exclure une action éventuelle des conditions du milieu (fluctuation à long terme liée aux paramètres de l'environnement), il conviendrait d'étudier des rhizomes orthotropes dont la base (raccord avec un rhizome plagiotrope) est connue.

L'augmentation du nombre de "cellules à tanin" dans un site pollué, si elle se confirmait, pourrait constituer un indicateur précieux du taux de pollution global dans le milieu.

Du fait du caractère préliminaire de cette étude, les hypothèses avancées doivent être considérées avec la plus extrême prudence. Notre principal objectif est avant tout, ici, d'attirer l'attention sur les fluctuations d'un paramètre dont l'étude pourrait se révéler très prometteuse (métabolisme, conditions du milieu).

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B-I10

Actual state of the lepidochronological analysis in Posidonia oceanica

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The term lepidochronology regroups the study of cyclic variations in the thickness of the scales (persisting petiole), present along the Posidonia oceanica rhizomes and the main related phenomena (PERGENT et al., 1983; BOUDOURESQUE et al., 1983). Since its discovery (CROUZET, 1981), this method of investigation has much improved. Recent research has improved the knowledge of significance and origin of these cycles.

The analysis of a great number of rhizomes (around 4000) has led firstly to the establishment of a standardized approach of the phenomenon and secondly to the definition of the application area of this method.

Scales are detached from the rhizome, according to their insertion rank, from the older (toward the base) to the more recent (toward the living leaves). For each scale, the thickness is determinated by using cross sections that are always localized at 10-12 mm above the base of the scale. This cross section is measured under a microscope with ocular micrometer. Some anatomical characters are also observed (number and aspect of cells, particular tissues).

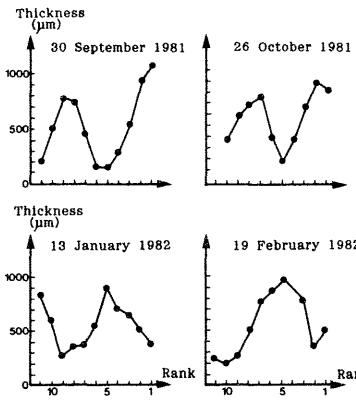

Figure 1 : "Inversion points" of thickness scales in a site of Port-Cros island (- 3 m). A : maxima point, B : minima point. Dates corresponding to the rhizome gathering.

These variation cycles of the scale thickness, are observed on all the rhizomes studied (orthotropic and plagiotropic). The great number of studied localities (Port-Cros and Banyuls-sur-Mer in France, Izmir in Turkey, Kerkennah and Zembra islands in Tunisia), the large gathering period (April 1981 to January 1987), and depth (- 0.5 m to - 32 m) range, attest to the universal character of these cycles for Posidonia oceanica in the Mediterranean Sea.

The evolution, along the time, of the thickness of the last formed scale, shows two periods, up line and down line period. There are two "inversion points" during a year and for a same site, these "inversion points" occurred every year at the same date (Figure 1). That demonstrates the chronological significance of cycles, each cycle corresponding to a one year period. The term "lepidochronological year" is used to define the period of passing time between two minima inversions (Table I).

Sites	Inversion date of minima	Lepidochronological year 1985
P1	January	January 85 - January 86
P2	February	February 85 - February 86
P11	June	June 85 - June 86
P23	July	July 85 - July 86
P32	July	July 85 - July 86
B1	March	March 85 - March 86
B2	May	May 85 - May 86
B12	June	June 85 - June 86
B19	June	June 85 - June 86

Table I : Inversion dates of cycles minima thickness and lepidochronological year in different sites of Port-Cros (P) and Banyuls-sur-Mer (B). Numbers (1, 2, 11, 12, 19, 23 and 32) reffer to the depth (in meters).

The different parameters characterizing these cycles have been submitted to modulations having either an endogenous (rhizome) or an exogenous (water movement, light, temperature) origin.

The amplitude and the mean thickness of scales increase when depth and hydrodynamism grow. In superficial sites, the scale thickness also seems influenced by the temperature of surface water.

The period (number of scale per cycle) corresponds to the number of shed leaves, during one year. Increase of water depth and turbidity result in a reduction of the cycle period.

The fluctuations observed in scale thickness, along the rhizomes, originate in the variation of the number of dorsal sclerenchyma cells or parenchyma cells, and in the shape of the ventral sclerenchyma cells (more or less palisadic) and the shape of parenchyma cells ("squashed" cells).

Along rhizomes showing a large number of annual cycles, cycle periodicity longer than one year and of undetermined origin may appear. In a same site, particular modulations may appear on synchronous cycles (formed during the same year). Although it seems too early to speak of characteristic years, a significative correlation between mean air temperature and mean scale thickness has been observed in superficial sites for the year following the presumed causal phenomenon (Figure 2).

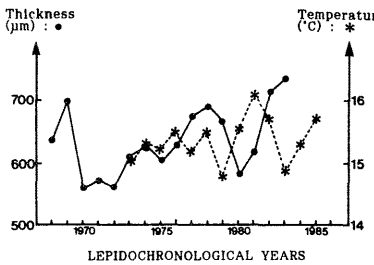

Figure 2 : Evolution of mean air temperature and mean scale thickness in a superficial site of Port-Cros island.

Even if these results allow important applications, the lepidochronological analysis appears to be quite powerful and could be useful to develop dealing with Posidonia oceanica beds investigations.

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Caulerpa prolifera (Forsskal) Lamouroux growth dynamics in the Mar Menor Lagoon (SE Spain). First results

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INTRODUCTION

The Mar Menor is a 135 km^2 hypersaline coastal lagoon located on the SE Spanish coast. Its average depth is about 3-4 m, reaching 7 m at some places. *Caulerpa prolifera* is the main macrophytobenthic producer in the lagoon, forming meadows which cover more than 85 % of bottom surface. Thus, knowledge of growth dynamics and production of this stoloniferous green algae is essential in the understanding of lagoon production.

First data on annual biomass evolution and primary production have been reported recently (BALLESTER, 1985; TERRADOS, 1986). Ongoing investigations first results are presented in this work.

MATERIAL AND METHODS

A sampling station in the north basin was selected firstly (ST1). Because of different meadow growth pattern, another sampling station (ST2) was chosen not far from the former. Samples (n = 4) were obtained monthly with a Van Veen grab, being washed aboard using a .5 mm sieve. After drying the material at 105 $_{-2}$C for 24 h in a stove, macrophyte biomass was expressed as g dw m^{-2}. In order to know meadows structure, changes in number, biomass and dimensions of different meadow elements (stolons, primary fronds, proliferous primary fronds,...) are recorded similarly to MEINESZ (1979).

SOURCE	TB	(TB/MB)100	(EB/TB)100	(PPF/PF)100	(PR/PPF)100	PFL
	G DW M^{-2}					MM
	49,2 - 149,1	31,8 - 100				
1	25,6 - 133,5	19,2 - 100				
2	87,2 - 223,2	39,1 - 100	23,5 - 53,1	28,5 - 50,0	166 - 317	3,1 - 5,3
3	0,0 - 156,7	0,0 - 100	13,2 - 24,3	14,3 - 95,8	92 - 263	3,8 - 15,6
4	77,0 - 157,0	49,1 - 100	23,9 - 52,1	26,6 - 57,9	104 - 183	2,8 - 4,9

SOURCE : 1, TERRADOS, 1986 ; 2, MEINESZ, 1979 ; 3, THIS WORK, ST1 ; 4, THIS WORK, ST2 .

TB , MEADOW BIOMASS ; MB , ANNUAL MAXIMUM BIOMASS ; EB , STOLON BIOMASS ; PF , PRIMARY FRONDS NUMBER ; PPF , PROLIFEROUS PRIMARY FRONDS NUMBER ; PR , NUMBER OF PROLIFERATIONS ; PFL , MEAN PRIMARY FRONDS LENGTH .

RESULTS

Annual biomass maxima reached in the Mar Menor are clearly smaller than the one found by MEINESZ (1979) in Crouton (Alpes maritimes - France): 157 vs 223 g dw m^{-2}. These maxima are reached in autumn in both areas. Annual minima, however, show a greater variation, being reached between the end of spring and the beginning of summer.

In most of lagoon sampling stations studied, percentages of annual biomass change are bigger than in Crouton (see table).

One of the dredging stations (ST1) shows a complete decay of meadow biomass during 4 months, a fact not reported in the Mar Menor till now. AUGIER & ROBERT (1981) relate these decays with winter water temperatures colder than 12 C. Although Mar Menor water temperature in the coldest months may be about 8-9 C, decays are not found or they are restricted to certain areas.

Stolons constitute a meadow element of similar importance in ST2 and Crouton (23.9-52.1 % and 23.5-53.1 %, respectively). However, its maximun development is not reached at the same time : april in ST2, july in Crouton. Stolons are a less important fraction of *C.prolifera* meadow in ST1 (13.2-23.2 %), without distinct maxima.

Proliferous primary frond frequencies are bigger in the Mar Menor than in Crouton (table). On the other hand, number of proliferations is smaller in Mar Menor sampling stations than in Crouton.

Primay fronds are larger and longer in ST1 than in ST2. Frond lengths are similar in ST2 and Crouton. These differences may be related with different ligt environments.

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Note sur l'Inflorescence de Posidonia oceanica (L.) Delile (Potamogetonaceae)

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ABSTRACT

Flowers of P. oceanica sampled from Saronikos Gulf, Greece, (37 44'N, 23 23'E) have been examined and compared with other relative data. The results do not support the hypothesis of the existence of different varieties within the species P. oceanica.

INTRODUCTION

Une floraison de Posidonia oceanica (L.) Delile, dans le Golfe Saronikos en 1985 (Panayotidis et al., sous presse) nous a permis d'apporter quelques éléments sur la morphologie de l'inflorescence de la plante et de comparer nos resultats avec la description proposée par Den Hartog, 1970 et les données récents de Gay et Meinesz, 1984 et Pergent, 1987, provenant d'autres secteurs de la Mediterranée.

MATERIEL ET METHODES

Deux lots de faisceaux de P. oceanica portant des fleurs ont été recoltés en plongée autonome le 1/11/85 et le 19/11/85, vers 5 m de profondeur. Le cite de prélèvement se trouve dans les parages de l'îlot Métopi, situé à 37 44'N, 23 23'E. Les deux lots comprenaient 33 et 30 faisceaux avec 266 et 280 fleurs respectivement.

La phénologie des faisceaux a été étudiée suivant le protocole proposé par Giraud, 1979. Pour la descrirtion des différents éléments de l'inflorescence nous avons suivi la terminologie proposée par Gay et Meinesz, 1984.

RESULTATS ET DISCUSSION

La position de la hampe florale (h. f.) a été examinée dans les faisceaux de P. oceanica recoltés le 1/11/85. La h.f. se trouvait toujours en position centrale, entourée par 3 feuilles intermediaires (de 14, 18 et 25 cm de longueur) et 6 feuilles (de 27, 27, 40, 28, 24 et 24 cm de longueur). Les différances observées entre nos resultats et ceux de Gay et Meneisz, 1984 sont, à notre avis, dues à la differante saison de prélèvement.

Dans le lot de 1/11/85 le 1er, 2eme et 3eme épillet était présent au 100% des inflorescences, tandis que le 4eme épillet était présent seulement au 9%. Par contre, dans le lot de 19/11/-1985 seulement le 1er épillet était présent au 100% des inflorescences, tandis que le 2eme le 3eme et le 4eme épillet étaient présents au 83%, 67% et 0% des inflorescences respectivement. L'ensemble des épillets que nous avons examinés portaient 4 et tréés rarement 5 fleurs, qui étaient 80% a 90% hermafrodites et 10% a 20% males. Ces resultats sont bien dans les marges données par Den Hartog, 1970 (1-4 épillets pat epis, 3-5 fleurs par épillet). Les différences observées entre les deux lots que nous avons examinées sont dûes, selon nous, au différent stade de maturitée de l'inflorescece.

Les inflorescences du lot de 1/11/1985 présentait les caractéristiques suivants (en mm):

-axe de l'inflorescence: 147.2 +/- 4.0
-feuille axillante exterieur: 53.9 +/- 1 0
-feuille axillante interieur: 32.8 +/- 0.8
-1er épillet: axe 28.9 +/- 0.9 , bractées 24.2 +/- 0.6 , gynécée 6.1 +/- 0.2, 6.0 +/- 0.2, 5.4 +/- 0.2, 5.0 +/- 0.0 (au 1er, 2eme, 3eme et 4eme fleur respectivement), androcée 5.9 +/- 0.1, 5.5 +/-0.1, 4.7 +/- 0.1, 5.0 (au 1er, 2eme, 3eme et 4eme fleur respectivement).
-2eme épillet: axe 25.0 +/- 0.6, bractées 18,6 +/- 0.7 gynécée 6.3 +/- 0.4, 6.1 +/- 0.2, 4.5 +/- 0.4 (au 1er, 2eme et 3eme fleur respectivement), androcée 5.3 +/- 0.1, 5.2 +/- 0.1, 4.9 +/- 1.0 (au 1er, 2eme et 3eme fleur respectivement).
-3eme épillet: axe 26.0 +/- 1.0, bractéees 23.0 +/- 0.9 gynécée 6.2 +/- 0.1, 5.9 +/- 0.1, 5.5 +/- 0.3, 5.0 +/- 0.0 (au 1er, 2eme, 3eme et 4eme fleur respectivement), androcée 5.6 +/- 0.1, 5.4 +/- 0.1, 4.6 +/- 0.1, 5.0 +/- 0.0 (au 1er, 2eme, 3eme et 4eme fleur respectivement)
-4eme épillet: axe 19.2 +/- 5.7, bractées 12,1 +/- 5.4 gynécée 6.3 +/- 0.3, 6.0 +/- 0.0 (au 1er et 2eme fleur respectivement), androcée 5.6 +/- 0.3, 5.0 +/- 0.0, 4.0 +/- 0.0 (au 1er, 2eme et 3eme fleur respectivement).

Les caractères mentionées ci-dessus ainsi que la taille de l'androcé, du gynécée et des bractées des fleurs étudiés sont compatibles à ceux decrites par les auteurs antérieurs, et ne supportent pas l'hypothèse de l'existance de différentes variétés de l' espèce P. ocaenica.

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B-I13

Classification and biogeographical affinities of marine algae in the Ionian Sea

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RESUME: La flore marine des côtes occidentales de la Grèce a été etudié dans le cadre d'explorations scientifiques par Bory de Saint Vincent, 1832, 1838 et Giaccone 1968. Tsekos et Haritonidis (1977) ont effectué une étude de la flore marine des îles de la mer Ionième. Aussi sur les côtes occidentales de la Grèce, Haritonidis et Tsekos (1978) ont etudié la flore marine sur 11 biotopes. Une recherche similaire a été effectué dans le cadre du programme de l'étude ecologique de la region sur 14 stations

Studies on the marine flora of the West Greek coasts have been occasionally conducted in the wake of more general exploratory and scientific expeditions (Bory de Saint Vincent 1832, 1838, Giaccone 1968). Tsekos and Haritonidis (1977) have also contributed with relative research work on marine flora of the west coasts in 11 biotopes. Similar researches are also encouraged by a general programm of N.C.M.R. (National Centre for Marine Research) concerning the marine ecological survey of the area and cover 14 stations (Fig. 1).

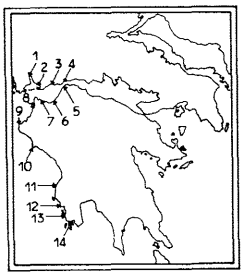

Fig.1. Map of Greek West coasts showing the investigated localities.

Systematic classification, geographical as well as seasonal distribution of marine macrophyceae developing in photophile and sublittoral regions of hard substrates have been studied as regards the West Greek coasts. Apart from its systematic and phytogeographical character this study also aims at the classification of marine plant taxa into ecological groups and biogeographical elements. Samples were taken from an area of 400 cm and from depths ranging between 0.5 and 1m. All marine plant organisms were extracted by means of a hammer and chisel in the frame. Sample collection were done in 14 stations along the coasts of West Peloponnese and central Greece in the summer. During sample determination, 178 algal species were found belong to the following large systematic groups: 33 species to Phaeophyceae 9 to Chlorophyceae, 25 to Bryopsidophyceae and 109 to Rhodophyceae. 3 Spermatophytes have also been defined

Having compared many phycological papers, we classified the defined algae to 7 biogeographical elements. Any alga, which due to luck of bibliography, could not take a place in some floristic element.

In the region of our interest the ratio R/P=3.30 shows its subtropical character. These results are in agreement with the study on the biogeographical affinity between species of the area where the largest number of them belongs to the Atlantic tropical, Atlantic subtropical and Mediterranean chloristic element.

Based on a good deal of papers, we were able to find the ecological groups most of the determined algae belong to. Those which could not fall into an ecological group on account of missing evidence were considered as different. Seven ecological groups or supergroups have been observed to which species belong.

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B-II1

Accumulation of fouling organisms relevant to the water conditions of Alexandria Eastern Harbour

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B

Rate of accumulation of fouling organisms formed on PVC substrate immersed in Alexandria eastern harbour water were investigated during 1987 and the common fouling organisms present were recorded. Also, the relation between the fouling and hydrography of the water are discussed.

Introduction: Little attention was given to the problems of the ecological conditions of marine fouling organisms in the water harbour since Megally (1970). The harbour receives huge amounts of untreated sewage and waste water through many outfalls, which change its water composition. The increase of oxidizable organic matter together with high temperature, salinity and nutrient salts over the year make the region favorable for the preponderance of fouling organisms.

Material and Methods: Twelve water samples were collected seasonally from four stations at the surface, 1.5 m and at the bottom during 1987. The parameter pH, temperature, transparency, oxidizable organic matter salinity, and the nutrient salts: phosphate, nitrite, nitrate and ammonia were determined according to standard method of oceanography. The accumulation of fouling organisms was followed by panel exposure test: PVC panels were hanged in frames and immersed horizontally and vertically to 30 and 150 cm below the water surface and the wet weight of fouling were recorded every one or two months according to the accumulation of organisms.

Results and Discussion: The increase of bulk of the fouling depends on the rate of growth of the attached individuals which differ from species to species and is controlled by the temperature of water availability of suitable food, salinity, pollution and distance from shore.

The oxidizable organic matter in the E.H. ranged between (1.46-3.92 mg O_2/l) during spring and reached an average of 1.3 mg O_2/l during winter as a result of sewage pollution and self purification process (El-Awady and Ghanem 1975). The annual surface water temperature was 21.9°C and ranged between a minimum of 16.1 and maximum of 28.2°C. This condition is essential for growth of common components of fouling organisms as algae and tube worms which are present in the harbour water during most of the year. The average salinity 38‰ enhances the presence of barnacles. Presented values of all nutrients exceed those in the open sea. They are of the basic links in the feeding chain of marine biota. An increase in nutrient quantities causes intensified biological production by which primary organic matter may be formed through photosynthesis and serves as food source of marine animal. Low nitrite and rather high ammonia values are indicative of their fast bioregeneration owing to the intensive primary production in these area.

Table (1). Seasonal average value of different studied parameters in Alexandria eastern harbour (1987).

Season	Transparency cm	Temp °C	S‰	Oxidizable org. matter mg $O_2 l^{-1}$	DO m $l O_2 l^{-1}$	PO_4-p	NO_3-N	NO_2-N	NH_3-N
						µg. at l^{-1}			
Winter	283	16.1	38.12	1.30	7.09	0.67	0.23	0.24	0.84
Spring	188	23.3	38.05	1.79	1.79	0.88	0.55	0.71	6.42
Summer	69	28.3	37.26	0.16	3.03	0.68	0.55	0.34	2.05
Autumn	178	15.5	37.17	0.022	3.50	0.08	6.80	0.90	0.12

Table (2). Common fouling organisms, settlement period and weight of accumulated organisms.

Common fouling organisms					Settlement period	Wet weight mg/cm²/day	
Tube worms	Barnacles	Ascidians	Bryozoans	Algae		H	(V)*
"	--	--	--	Ulva lactuca Enteromorpha compressa, Enteromorpha linza	5.04.1987 5.05.1987	4	
"	"	"	"	Ulva lactuca Enteromorpha intestionalis	5.04.1987 7.06.1987	86	(52)
"	"	"	"	Ulva lactuca	5.04.1987 12.07.1987	41	(58)
"	"	--	Bugula neritina	Ulva, Entero-morpha linza	12.07.1987 3.10.1987		(31)
"		--	Bugula neritina		3.10.1987 10.11.1987		(32)
"	"	--	Bugula neritina		10.11.1987 8.12.1987		(21)

*H = horizontal plate, V = vertical plate

Only the identifiable plant and animal fouling organisms are mentioned in Table (2). The untreated sewage and waste water flow into the harbour cause the disappearance of ascidians most of the year.

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B-II2

Feeding habits on Aristeus antennatus (Risso, 1816)

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B

The continental slope in the Western Mediterranean, ranging in depth between 400 and 1700 m, supports shoals of penaeid decapod crustaceans, of which A. antennatus is one of the most abundant, holding out particular interest to fisheries.

Its long-term fluctuations and local, seasonal migrations reflect a complex ecological behavioural pattern characterizing the benthic communities dwelling at those depths. The feeding habits and intraspecific competition in this species have been studied in an attempt to determine the causes responsible for shoal movement. A comparative analysis of the diet of three main size classes has also been carried out, taking into account sex, season and moulting as factors exerting a possible influence on diet. Overlap and resource partitioning are discussed using traditional methods, and dietary diversity has been evaluated.

Analysis of stomach contents indicates that the diet consists chiefly of bivalves, macrurous crustaceans, polychaetes, amphipods and ophiuroids. These five taxonomic categories account for more than 50 % of the diet of this species. Results have been presented as percent frequency of occurrence and number of prey items.

A. antennatus has been observed to prey upon the bottom-dwelling community, and there are significant differences in the composition of the diets of the various size classes, which exploit different resource levels, albeit with relatively high overlap. Larger individuals root deeper into the substratum when feeding, whereas the activity of smaller males and females is confined to the surface layer of the substratum. There is a significant relationship between size class and the depth of foraging in the substratum but no relationship between size class and prey size. There is also a significant relationship between foraging depth and the pronounced sexual dimorphism present in this species. This is probably reflected in the internal population structure and probably also plays a role in the local bathymetric migrations taking place during the year.
There exist significant differences in composition of the diet in the different seasons, with a gradual decrease between spring and winter in the proportion of prey items that live buried in the substratum.

The moult cycle in these especies is much less pronounced than in other decapod crustaceans, and it does not seem to have any appreciable influence on the diet.

The study is basically intended as a contribution to our understanding of food webs in the deeper regions on the continental slope. It brings to light the importance of the activity of deeper-water penaeids in the bathyal communities in the region between the continental shelf and the abyssal zone and points up as yet unresolved issues for future research.

B-II3

An uncommon recruitment of A. antennatus (Risso) (Crustacea Decapoda Aristeidae) in the Gulf of Genoa

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Resumé:

Durant l'année 1987, un recrutement a complètement modifié la structure du stock pêché, qui était plus ou moins stable depuis quinze ans environ. Ce phénomène a réactualisé d'anciennes coutumes de pêche et pose le problème d'éventuelles fluctuations pluridécennales parmi les populations d'*Aristeus antennatus*.

The biology of *Aristeus antennatus* (Risso) (Crustacea Aristeidae) is at present being studied in both Mediterranean and Atlantic countries which have specific fisheries for this species and is being monitored by the CIESM Working Group on deep water shrimps (Sardà 1987). A common topic of particular interest is the structure of the fished stocks in terms of sex-ratio, sizes and maturity stages. Having observed an evident modification in the length/frequency distributions of the shrimps fished in the Gulf of Genoa in summer 1987, we here give some details on this subject.

Length.frequency distribution of the red shrimps living on bathyal bottoms at about 700 m on the Portofino area (Eastern Ligurian Riviera) have been recorded since 1972. In the trawl catches the females are invariably dominant and it is only on these (which generally constitute 90% of the total shrimps) that the comparison of sizes is based. From 1972 to 1980 in the Portofino area females were distributed in two main groups approximately separated by the carapace length of 50 mm. In terms of age this size was supposed to divide the shrimps of age 0+ to 1 from those of age 1 to 2+ (Orsi Relini and Relini 1985). The second group was always more abundant that the first (two exemplas are shown in fig. 1).

After summer 1980 the shrimps were absent on the same fishing grounds and fishing ceased. A recovery began in summer 1985 and the first catches of the recently reappeared shrimps were composed almost totally of large-sized females (Orsi Relini and Relini 1986). The same structure (fig. 1) was recorded in summer 1986. Finally, in 1987 a large number of small females appeared in the catches (fig. 1). At the time of writing (March 1988) the small shrimps still represent an important fraction of the fished stock of this sector in the Gulf of Genoa.

As a result of this new situation fishing activities have increased. Trawling for shrimps did not stop in December as in the previous years (in the Seventies and at the recovery in 1985 the fishing season lasted a maximum of six months) and during the winter the shrimps were found in high concentrations on bottoms deep only 500m. In other words we are now facing a situation similar to that registered in the Forties by Brian (1942) in the same area; and it is also similar to the fishing activities recently observed on the Catalan Coast (Sardà and Demestre 1987) and in Portuguese waters (Arrobas and Ribeiro-Cascalho 1987).

Data recently collected by the Working Group showed that the shrimps fished in the Western Mediterranean increase in size from East to West; a similar gradient of sizes was found in the direction from South to North comparing catches in the Italian seas (Orsi Relini and Relini 1979, 1987). The present massive recruitment on the Ligurian bottoms has at least eliminated the S-N differences (in terms of size-composition of the catches) while it would be of great interest to ascertain what is happening along the longitudinal gradient.

In our area a spatial and temporal distribution of red shrimps comparable to the present one was to be found, as already noted, more than twenty years ago. If the size-composition of the catches then was the same as now (something which it is impossible to verify, as there is a lack of specific data in the literature), the population of *A. antennatus* is possibly subject to cyclical changes lasting several decades. A general trend of catches (consisting of a peak and a progressively reducing series over a period of thirty years) has been registered independently both in the Gulf of Genoa on the basis of oral reports from fishermen (Orsi Relini and Relini 1985) and in the Spanish region of Tramontana on the basis of fishery statistics (Tobar and Sardà 1987). A parallel series of values was registered during a period of eighteen years for the red shrimps trawling of the Balearic Islands (Oliver 1983).

In Spain a new rising phase apparently began in the eighties; it cannot be excluded that this present recruitment in the Gulf of Genoa indicates the same phenomenon.

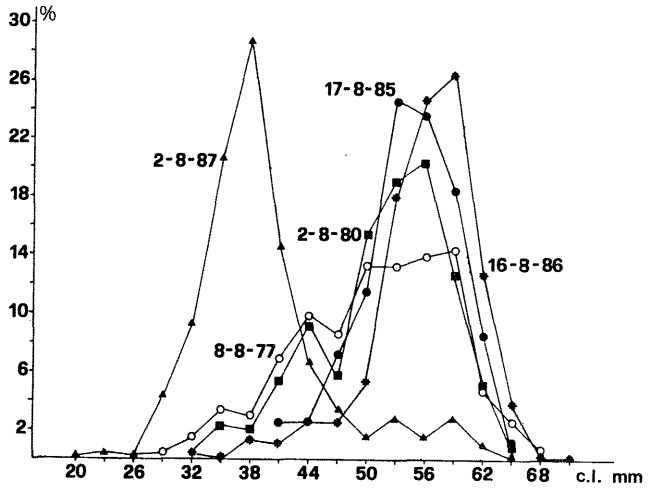

Fig. 1 - Length/frequency distributions of females forming the fished stock in Portofino area. The 1987 recruitment is evident.

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B-II4

Ecological spectrum of the Spiny Spider Crab (Maja squinado)

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RESUME'

Dans cette communication le spectre écologique du crabe Araignée de mer (*Maya squinado*) est considéré. Ses limites de tolérance par rapport à la température, la salinité, la profondeur, le substrat, la communauté et la nourriture sont analysés.

Having carried out long-term autecological investigations of the spiny spider crab (*Maja squinado*) this is a good occasion to make out a synthesis of all results related to its environment in the ecological spectrum form. The ecological spectrum (according to Stankovic, 1962) includes an assemblage of all tolerance limits (niche breadth by American authors or ecological valence by European ones), i.e. ranges of ecological factors within which the species can exist. Each ecological valence includes "cardinal points of life" (Vouk, 1939), i.e. minimum, maximum and optimum. Knowledge of the ecological spectrum enables the understanding of the presence and spatial-temporal distribution of the species in a given environment. During the study of the spiny spider crab relationships of the following ecological factors were analyzed.

Temperature. The spiny spider crab tolerates a temperature range between 4 and 35 °C (Stevcic, 1971). It is also an eurythermic species. Judging from distribution and maximal density near the northern boundaries of its area (Channel Islands, west Istrian coast), as well as opposite trends between migrations and temperature (Stevcic, 1973), it can be concluded that it is a microeurythermic species, i.e. its optimum lies in colder waters.

Salinity. Physiological studies suggest that the species is poikoloosmotic, while isoosmotic with sea water. Consequently, it is a strictly marine organism, not entering brackish or hypersaline waters. In relation to salinity it is also a mesostenohaline species.

Depth. The spiny spider crab lives between 0 and 170 m depth, being also an eurybathic species (Stevcic, 1969). However, the depth minimum varies seasonally since it exhibits inshore-offshore migrations so that its optimum is different in various seasons.

Substrate. *Maja squinado* occurs in various types of bottom such as rock, sand, mud and mixed substrates (Stevcic, 1968). Accordingly, it is an eurysubstratic species. However, it prefers harder substrates and avoids mud, in particular silt. Its tolerance to various bottom types is a consequence of its seasonal displacements.

Communities. Being a migratory species it crosses various community types, and it is more frequent in communities developed on harder bottoms than in muddy ones, as, for instance, it was rarely sampled in the "*Nephrops norvegicus - Thenea muricata*" community. Respectively, it is an eurycoenose species.

Food. The species feeds on different food items such as sedentary and motile organisms (algae, shells, crustaceans, brittle stars, sea urchins, etc.) (Stevcic, 1967). It is a typical euryphagic species.

The above data show that the spiny spider crab has a wide tolerance range to a majority of analyzed ecological factors and only a narrow salinity range. In constant salinity conditions it is also an euryoecious species, i.e. tolerant to a wide range of habitats and environmental conditions. These features explain its wide distribution in the area.

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B-II5

Morphometric characters in Nephrops norvegicus (L.) from Adriatic (Vinodol Channel) : growth differences in male and female Chelipeds

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RESUME: Caracteristiques morphometriques du Nephrops norvegicus (L.) de l' Adriatique (Chenal de Vinodol), differences de croissance des chelipedes masculines et feminines. Les etudes sur la taille des chelipedes du Nephrops norvegicus (L.) ont montre que les differences signifiantes de cette taille - parmi les sexes - ont apparu avec les longeurs du corps depassant 8.5 cm et que les chelipedes en sont evidemment plus longues chez les males et evidemment plus largues chez les femelles.

INTRODUCTION. The Norway lobster, Nephrops norvegicus (L.) is commercially remarkable in many coastal countries of Europe, and therefore one made the studies on the correlations of its body length/weight (FONTAINE and WARLUZEL 1969, GIBSON 1967), and recently also for its sexes separately (FARMER 1974). HOSSAIN et al. (1987) intended to find the differences in the weight/length of its sexes, with and without the chelipedes, expecting a significant difference by the elimination of chelipeds. Thus our studies intended to detremine the differences of the cheliped sizes in correlation to the lobster body size and its sex, and to find why in the papers of FARMER (1974) and of HOSSAIN et al. (1987) was not presented a significative difference of the weight/length correlations in lobster sexes, although the male chelipeds were evidently major.

Our morphometric studies have been carried out on the lobsters from north-eastern Adriatic Sea (Vinodol Channel). The parameters measured were the body length, and the lengths and widths of the chelipeds separately for the each sex. The statistical processing of the significance of differences in the length and width of chelipeds between both sexes, under and above 9 cm of body length, we carried out after WARDLAW (1985).

RESULTS. These studies demonstrated that the length of chelipeds (Fig. 1) is minor, and their width (Fig. 2) is major in males than in females up to their body length of approximately 8.5 cm, but these differences are not significative. Since this, the length growth in the male chelipeds is significantly major, and in the female ones the width growth became more significative (Table 1). These changes in the cheliped growth appear by their lengths above 4.5 cm and this is correlated with the lobster body length above 9 cm.

After the obtained results one concluded that the chelipeds in N. norvegicus may be a typical morphometric indicator of sexes also from their early ages, and that the correlation of cheliped length/width in both sexes persist subequal to 8.5 - 9 cm of body length, and that above this body size in N. norvegicus of NE Adriatic appear the characteristic sex differences. The minor chelipeds in the early age of males may be perhaps interpreted as a biological adaptation useful for the conservation of the female part of its population in a canibalistic struggle for existence. The significantly longer and also significantly narrower chelipeds of the males, probably are but not significantly heavier than the female chelipeds, and thus they do not essentially contribute to the general body weight of the males.

Comite du Benthos, C.I.E.S.M.

TABLE 1. Significance of the differences in the cheliped size between the sexes of Nephrops norvegicus

Body length of lobster	Body length under 9 cm	Body length above 9 cm
Length of chelipeds	t = 1.08558 df = 8 10% > P	t = 3.7833 df = 7 1% > P > 0.1%
Width of chelipeds	t = 0.00635 df = 8 10% > P	t = 3.31775 df = 7 2% > P > 1%

LEGEND OF FIGURES:

Fig. 1. Correlation between the lengths of body and chelipeds
Fig. 2. Correlation of the length of body and width of chelipeds

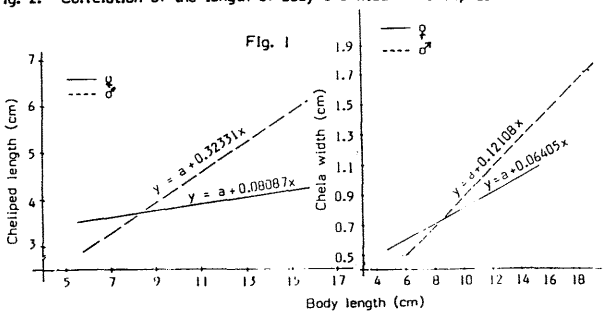

Fig. 2

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Structure des populations d'Invertébrés benthiques devant le delta du Po

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B

ABSTRACT - The size-frequency structure of some species of marine macrobenthos in the area of the Po Delta is investigated. The different reproductive and growth strategies of bivalves, gastropods and decapods account for the cyclic stability of the community structure.

Les fluctuations saisonnières des communautés benthiques marines face au Delta du Po ont été déjà illustrées pendant divers cycles annuels (Bedulli *et al.*, 1983; Bedulli *et al.*, 1983-84). On peut rappeler qu'en général de fortes densités se retrouvent pendant l'été, accompagnées par une augmentation de la richesse spécifique; pendant l'hiver on assiste à une réduction très marquée de l'abondance totale et du nombre d'espèces. Néanmoins la meme structure de la communauté tends à se reproduire chaque été, en montrant une sorte de stabilité de type cyclique (adjustment stability: Gray *et al.*, 1985). Dans cette note on a voulu, de façon préliminaire, en examinant individuellement les stratégies reproductives et de croissance des espèces, dégager certains mécanismes grace aux quels se réalise la stabilité de la communauté.

On a observé la répartition en classes de taille des espèces les plus abondantes, pendant un cycle annuel. Les prélèvements ont été éffectués à la drague dans trois stations aux profondeurs respectives de 2,5, 5 et 8 mètres. Les specimens mesurés avec un pied à coulisse ont été regroupés en classes de 1 mm. Les campagnes ont été effectuées en 6 occasions à partir de novembre 1985 jusqu'à octobre 1986. Seuls les Mollusques et les Crustacés Décapodes ont été pris en considération, puisqu'ils sont échantillonnés avec succès par la drague (Ambrogi et Bedulli, 1983).

Les cycles vitaux des Bivalves sont très synchronisés du fait que toutes les espèces les plus abondantes (*Spisula subtruncata* (Da Costa), *Corbula gibba* (Olivi), *Abra alba* (Wood), *Mactra stultorum* (Linneo) et *Venerupis aurea* (Gmelin)) se recrutent à la fin du printemps et paraissent dans les prélèvements de juillet. L'accroissement est rapide pendant l'été jusqu'à octobre. La majorité des espèces chute dramatiquement en automne et très peu d'exemplaires survivent pendant l'hiver et le printemps. Une étude parallèle sur *Lentidium mediterraneum* (Gmelin) a montré un cycle semblable. La seule exception est *C. gibba*, ayant aussi au printemps densités notables d'individus des tailles supérieures. Pour les Gastropodes (*Cyclope neritea* (Linneo), *Hinia reticulata* (Linneo) e *Nassarius mutabilis* (Linneo)) on observe des abondances considérables au début des observations (novembre et mai) avec la présence de plusieurs classes d'age. Le recrutement a lieu pendant l'été: les individus plus petits coexistent avec un certain nombre d'individus plus agés. Sauf pour *N. mutabilis* on ne remarque pas une chute remarquable de l'abondance en octobre. L'analyse des données concernant les Crustacés Décapodes est compliquée, a cause du dimorphisme sexuel et des migrations cote-large. Les espèces considérées sont *Liocarcinus vernalis* (Risso), *Crangon crangon* (Linneo) et *Brachinotus gemmellari* (Rizza). Les deux premières espèces montrent une majorité d'individus des tailles inférieures pendant l'été et sont représentées par des individus de plus grande taille surtout au printemps. *B. gemmellari*, au contraire, montre la prédominance des tailles plus grandes au mois d'aout. Les fluctuations de densité sont cependant très accusées meme pour des prélèvements voisins dans le temps. On a l'impression d'un étalement des périodes de recrutement soit avant l'été (*L. vernalis* et *C. crangon*) soit après (*B. gemmellari*).

Bien que basées sur un seul cycle d'observations, ces données permettent de mettre en evidence quelques traits de l'écologie benthique dans la zone étudiée. Une période d'observation de 5 ans pour *S. subtruncata* a confirmé le recrutement printanier de cette espèce, tout en montrant des variations interannuelles importantes des densités et du taux de survie pendant l'hiver (Ambrogi et Occhipinti Ambrogi, 1987). Le cycle vital prédominant porte en général sur une durée de vie très limitée et une croissance très rapide, ce qui permet une grande flexibilité pour s'adapter aux conditions très variables de l'environnement. La dynamique accélérée des espèces des sables infralittoraux mediterrannéens par rapport aux mers septentrionales avait déjà été évoquée par Massé (1972); l'influence des eaux du Po, qui entraine une augmentation de la température pendant l'été, peut expliquer une accélération encore plus marquée des cycles vitaux dans cette zone.

La stabilité cyclique du peuplement résulte de divers types de comportements des différentes populations. Pendant l'été les Bivalves repeuplent les fonds massivement, d'une façon assez synchrone, en dépit de très fortes diminutions pendant l'hiver; parmi les Gastropodes et les Crustacés, au contraire, plusieurs classes d'age coexistent, grace à des cycles plus longs. Le décalage des maximums de densité entre filtreurs (Bivalves) et prédateurs-nécrophages (Gastropodes et Crustacés) peut etre lié à la plus grande mobilité de ces derniers (possibilité d'échapper à des crises dystrophiques localisées) et aux disponibilités alimentaires de differentes natures suivant la saison.

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Production secondaire du Bivalve Lentidium mediterraneum (O.G. Costa)

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ABSTRACT

The secondary production of the marine bivalve Lentidium mediterraneum (O.G. Costa) has been estimated in a shallow water marine station in front of the Po river delta.

In spite of low numbers and biomass during the first half of the year, a very high value of production, 161 g m^{-2} $year^{-1}$, has been found, with a P/$\bar{B}$ of 11.5.

On a estimé le taux de production somatique de L. mediterraneum dans une station à la profondeur de 2.5 m près des embouchures du delta du Pô. Cette espèce est largement dominante dans la biocénose des Sables Fins de Haut Niveau, établie à faible profondeur dans ce secteur de la Haute Adriatique.

Les prélèvements ont été effectués à l'aide d'une benne Van Veen, pendant 8 campagnes à partir de novembre 1985 jusqu'à décembre 1986. Les individus de L. mediterraneum retenus sur tamis de maille 0.5 mm ont été dénombrés et mesurés avec un appareil pour l'analyse des images (Kontron IBAS 1).

On a construit des histogrammes de fréquence des tailles avec une amplitude de 0.5 mm et, faute d' interprétation univoque de la répartition en cohortes, on a utilisé la méthode de la cohorte moyenne (Hynes et Coleman, 1968; Hamilton, 1969) pour estimer la production secondaire.

La formulation de l'équation de calcul est la suivante:

$$P = \left[\sum_{j=1}^{i-1} i \, (\hat{N}_j - \hat{N}_{j+1}) \cdot (\bar{W}_j \cdot \bar{W}_{j+1})^{1/2} + \bar{N}_j \cdot \bar{W}_j \right] \frac{12}{CPI}$$

i = nombre de classes de taille;

$\hat{N}_j$ = moyenne pesée par intervalle de temps des individus de la classe;

$(\bar{W}_j \cdot \bar{W}_{j+1})^{1/2}$ = moyenne géométrique du poids sec;

CPI = "cohort production interval", durée de la vie de la cohorte en mois. Pour cette population on a considéré un CPI de 6 mois (de juillet à décembre).

Le cycle biologique du bivalve pendant la période considérée a montré une faible densité au début de l'étude, en novembre, mars et mai, avec respectivement 676, 660 et 42 ind. m^{-2} et 0.17, 0.15 et 0.01 g m^{-2} (poids sec décalcifié libre des cendres).

En juillet on a enregistré le recrutement le plus important, plus de 100000 ind. m^{-2} avec une biomasse de presque 30 g m^{-2}. Dans les prélèvements suivants, à l'exception du mois d' août, les densités demeurent très élevées (46000 - 89000 ind. m^{-2} et 7.1 - 41.6 g m^{-2}).

La valeur de production secondaire a été estimée à partir des données d'abondance moyenne de 16 classes de taille (de 0 à 8 mm, ampleur 0.5 mm) et du poids moyen individuel correspondant; elle est de 161 g m^{-2} an^{-1}.

Avec une biomasse moyenne de 14 g m^{-2}, le rapport P/$\bar{B}$ est de 11.5 .

La méthode de Hynes, développée pour le benthos des eaux courantes, a récemment été appliquée à une espèce de bivalve marin, démontrant une bonne correspondance avec des estimations parallèles (Cornet, 1986).

Dans notre cas, la comparaison a été faite par la méthode traditionnelle de Crisp (1984), qui considère la somme des accroissements pondéraux de chaque cohorte. En reconnaissant 4 différentes cohortes recrutées en juillet, août, septembre et octobre la valeur de production résulte égale à 123 g $m^{-2}an^{-1}$.

Ces résultats apportent une nouvelle contribution à la connaissance de la productivité benthique à proximité du delta du Pô, soit lagunaire (Ceccherelli et Rossi, 1984; Mistri et al., 1988), soit marine (Ambrogi et Occhipinti Ambrogi, 1987).

La Haute Adriatique se range donc parmi les régions les plus productives, non seulement en Mer Méditerranée, mais par rapport aussi aux côtes Nord-Atlantiques, qui sont les plus étudiées.

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B-II8

Etude de la distribution de la taille des Moules (Mytilus galloprovincialis Lam.) du Bosphore, du point de vue exploitation commerciale

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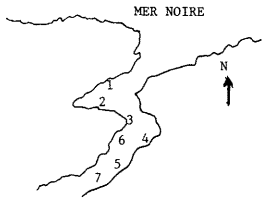
RESUME': Dans ce travail, on observe la taille des moules dans differentes stations du Bosphore, on a déterminé les lieux ou les moules atteignaient la taille de 70 mm admis comme un standard pour la pêche. On a vu que les tailles de moules sont inferieures à 70 mm dans 5 stations. La taille optimum d'exploitation dout être 70 mm et la croissance pour atteindre cette taille necessite 17 à 18 mois. Cette dimension permet de maintenir une équilibre bio-économique.

La moule de Turquie est Mytilus galloprovincialis, c'est une espèce que l'on trouve sur toutes les côtes de la mer Noire, de la Mer de Marmara et du Bosphore.En mer Egeé on les trouve jusqu'a Karaburun-İzmir. A cause de la haute salinité et pour la même raison, elles sont absentes de la côte Turque de Méditerranée. Le but particulier de ce travail est déterminer les stocks de moules du Bosphore et leur caractéristiques biometriques.

Le matériel est Mytilus galloprovincialis qui est connue sous le nom de moule Marinière. On a effectué des prélèvement entre Octobre et Novembre 1985 avec un bateau de Recherche (GÜRÜR). Les échantillons ont été prélévés à l'aide d'une drague et pendant cette étude la vitesse du bateau etait de 1.5 mille par heure, les prélevements ramenés sur la bateau, ont été triés.

Les échantillons ont été pesés et les valeurs pour chaque stations ont été mesurées à partir d'une échantillon de 100 individus prélévés au hasard dans chaque station. Tous lesindividus ont été mesurés avec un pied à coulisse, on a mesuré la longueur, la largeur et l'épaisseur de la coquille.



Les Stations dans le Bosphore

Les dimensions de la moule du Bosphore se situent entre 20 mm et 110 mm et d'après les résultats des mesures biométriques la dimension moyenne varie 52 mm entre 75 mm. L'épaisseur varie entre 17 mm et 23 mm, lalargeur entre 19 à 24 mm, les variations de standard se situent entre 0.18 à 0.48. Voir le tableau 1.

Station	Individus	Taille Moy. (mm)	Var. Standard	Epaisseur (mm)	Longueur (mm)
Kavak	100	68	0.47	23	22
Tarabya	100	67	0.30	19	21
Yeniköy	100	74	0.27	18	24
Cubuklu	100	52	0.46	17	19
Kandilli	100	56	0.18	18	20
Emirgan	100	64	0.32	21	23
Beylerbeyi	100	75	0.38	18	24

Tab. 1: Mesures biométriques des Moules dans le Bosphore.

Les résultats des recherches effectuées dans le Bosphore ont permis de déterminer que la station la plus rentable est la station n° 7 avec une taille des moules de 75 mm.

D'autre part, nous avons déterminé que la taille de 70 mm est un bon repère de pêches de vente en Turquie et c'est en même temps, une dimension pour maintenir le stock de pêche. Comme on peut le noter 2 stations sur les 7 échantillonnées présentent une rentabilité économique.

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B-II9

Données préliminaires sur l'extension des peuplements de Scapharca inaequivalvis (Brugulère) dans les eaux roumaines de la mer Noire

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Pénétré récemment en mer Noire, le bivalve Scapharca inaequivalvis a été signalé pour la première fois dans le bassin pontique sur le littoral roumain (GOMOIU, 1984).

Le travail présente les premières observations sur la distribution de cette espèce, basées sur les recherches effectuées en 1985-1987 sur un réseau de 50 stations aux profondeurs de 5, 10, 15, 25 et 30 m, entre la limite nord (les embouchures du Danube) et la limite sud du littoral roumain.

Les données obtenues indiquent la situation ci-dessous:

- on a identifié des peuplements de S. inaequivalvis tout au long du littoral roumain sur des substrats sableux, sableux-vaseux et même vaseux, jusqu'à 30 m de profondeur; au-delà de 30 m, les prélèvements réalisés n'ont pas mis en évidence, pour le moment, la présence du bivalve;

- la fréquence de l'espèce a augmenté de 22% en 1985 à 28% en 1986 et à 56% en 1987;

la densité des peuplements a légèrement augmenté en 1986 (par rapport à 1983), pour réaliser une considérable croissance quantitative en 1987 (tableau 1); la moyenne de la densité a été de 165 ex/m^2 en 1985, 187 ex/m^2 en 1986 et 786 ex/m^2 en 1987; les valeurs maximales de la densité ont connu la même évolution - 960 ex/m^2 en 1985 (Constantza, 10 m de profondeur),1100 ex/m^2 (Sulina, 5 m) et 4760 ex/m^2 en 1987 (Chituc, 10 m);

Tableau 1

Valeurs moyennes, par profondeurs, des densités (D=ex/m^2) et des biomasses (B=g/m^2) du bivalve Scapharca inaequivalvis

Profondeur/ Année	5 m		10 m		15 m		20 m		25 m		30 m	
	D	B	D	B	D	B	D	B	D	B	D	B
1985	80	0,04	224	0,37	180	0,09	508	0,25	0	0	0	0
1986	554	0,13	300	7,36	0	0	190	0,11	80	0,01	0	0
1987	340	62,80	1620	84,68	282	5,93	376	5,85	823	11,37	1280	0,64

- les peuplements identifiés sont formés en majorité d'individus très jeunes, de telle facon que les biomasses sont faibles (tableau 1), la plus grande moyenne de la biomasse étant enregistrée en 1987 - 129 g/m^2; la biomasse maximale a été enregistrée toujours en 1987 - 321 g/m^2;

- parallèlement au développement quantitatif des peuplements de S. inaequivalvis, la dominance de l'espèce au rang des populations de bivalves a augmenté elle-aussi (tableau 2), particulièrement en ce qui concerne la densité (en moyenne entre 13% et 33%), en prevoyant le rôle toujours plus important qu'aura l'espèce parmi les communautés benthiques où elle s'installe; dans ce sens, mentionnons que dans les conditions où les peuplements des autres espèces de mollusques ont considérablement diminué à la suite des puissantes floraisons déroulées au cours de l'été des années 1986 et 1987, Scapharca inaequivalvis a été le seul bivalve dont l'abondance ait augmenté, grâce à la résistance plus grande de cette espèce aux conditions d'hypoxie (GOMOIU, 1984).

Tableau 2

Dominance (%) du bivalve S. inaequivalvis comme densité (D) et biomasse (B)

Profondeur/ Années	5 m		10 m		15 m		20 m		25 m		30 m	
	D	B	D	B	D	B	D	B	D	B	D	B
1985	0,9	0,1	2,0	0,4	5,8	0,1	68,6	0,3	0	0	0	0
1986	18,0	0,1	8,0	14,1	0	0	15,2	0,5	35,6	0,1	0	0
1987	1,8	9,3	43,0	17,3	17,2	1,8	31,1	5,9	19,0	1,9	86,4	1,3

Il résulte, des données présentées, que S. inaequivalvis est pleinement acclimaté et installé en mer Noire, où l'espèce grandit et se reproduit intensément (comme le prouve le grand nombre des jeunes trouvés), ses peuplements ayant une extension et une prolifération accrues d'une année à l'autre.

Pour d'évaluer par la suite les populations de ce bivalve, des recherches spécialisées, éventuellement à l'aide du scaphandre autonome, sont nécessaires pour mettre en évidence aussi l'habitat des exemplaires de grande taille qui existent certainement puisqu'on les trouve dans la thanatocénose de la plage (GOMOIU, 1984).

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B

Potentiel productif d'une communauté épibionte "insulaire" formée sur fonds meubles

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Abstract: The paper presents data about the epibiotic system on the walls of an artificial concrete "island" built on the sandy bottoms with Corbula at Mamaïa - the Black Sea.

Poursuivant la série des recherches pour la connaissance des associations d'organismes épibiontes sur substrats artificiels (2), au cours de l'année 1987 nous avons etudié le potentiel écologique du système épibionte formé sur une "île" en béton (base d'accostage) construite il y a plus de 20 ans, à 6 m de profondeur, sur les fonds sableaux de Mamaïa. "L'île", pratiquement un monobloc, se trouve installée dans la zone la plus typique de l'association psammobionte dominée par Corbula mediterranea (Costa).

En plongée on a prélevé 12 échantillons (quantitatifs) et l'on a fait les observations suivantes: a. tout autour de "l'île", une bande vert-noire (zone d'alternance) de 25-30 cm est entièrement dépourvue de toute épibiose macroscopique; b. les formes les plus caractéristiques du systeme épibionte sont les moules et les algues rouges (Ceramium); et c. le système épibionte semble généralement bien développé, mais sa distribution quantitative n'est pas uniforme.

On a identifié 23 types d'organismes, dont seulement 7 formes sessiles (Tableau 1). La structure qualitative de la communauté d'espèces typiquement épibiontes semble pauvre, ceci est du à l'absence des spongiaires, des actinies, des polychètes encroûtantes, ainsi que des tuniciers, etc. existante jadis, mais les formes qui s'y trouvent sont celles sélectionnées par les rigueurs des nouvelles conditions dues à l'eutrophisation (1; 3).

La faible diversité spécifique est compensée par un assez bon développement quantitatif des formes présentes, ayant en moyenne presque 150.000 ex.m^{-2} et 21 kg.m^{-2} (Tableau 1) et des maxima voisins des valeurs des zones les plus productives. La domination numérique (57% - 71%) appartient généralement aux formes vagiles méiobenthiques; les formes sessiles Mytilus et Balanus ont un taux de densité de 17-41%. La biomasse des moules représentent généralement plus de 90% du poids de tout le système épibionte; Mytilus à côté des autres formes sessiles, donne 97,42-99,46% de la biomasse générale. La plus grande production potentielle du système épibionte analysé - presque 60 kg.m^{-2}.an^{-1} - peut être réalisée dans l'horizon 1-2 m.

La communauté épibionte analysée joue un rôle important dans la biofiltration de l'eau; les moules, Mytilaster et Balanus peuvent filtrer environ 50-150 m^3 eau.$jour^{-1}$. Si l'on a en vue que dans l'eau de mer de la zone étudiée la quantité moyenne du phytoplancton est de 5,6 $g.l^{-1}$, cela signifie que les peuplements de moules d'une superficie de 1 m^2, elles seules, filtrent et sédimentent chaque jour, par pseudoféces, environ 280-840 kg de substance organique.

L'épibiose de "l'île" en béton, par rapport à celle formée sur les stabilopodes de la digue de Constantza (2), ne diffère pas qualitativement, mais a un plus faible développement quantitatif, du à la structure monobloc de l'île qui diffère de celle alvéolaire ou perméable réalisée par les stabilopodes.

Par rapport à la biocénose des sables fins à Corbula qui entour "l'île" en béton, l'association épibionte nouvellement formée est beaucoup plus riche du point de vue quantitatif, au moins 15 fois. Les indices de densité (la racine carrée du produit entre la fréquence et la biomasse) des cinq premières espèces de l'association de "l'île" et celle avoisinante ont eu les valeurs suivantes:

Association épibionte			Association psammobionte	
1. Mytilus	10 mm	1385,4	1. Cardium lamarcki	188,7
2. Balanus		227,3	2. Mya arenaria	112,5
3. Ceramium		206,7	3. Corbula mediterranea	99,5
4. Mytilus	10 mm	197,6	4. Ampelisca diadema	76,5
5. Mytilaster		106,3	5. Cyclope neritea	56,8

La comparaison des deux communautés benthiques, formées dans la même zone, dans les mêmes conditions du milieu et soumises aux mêmes pressions écologiques confirme une fois de plus le grand potentiel écologique du substrat dur par rapport à celui sédimentaire. Les données enregistrées nous confèrent en même temps la certitude d'une réussite totale dans nos actions de redressement écologique par la construction de récifs artificiels dans les écosystèmes déréglés.

Tableau 1

Fréquence (f%), densité (D-ex.m^{-2}) et biomasses (B-g.m^{-2}) maximales (max) et moyenned (med) des organismes enregistrés sur "l'île" en béton de Mamaïa en 1987.

Organismes	f%	Dmax	Bmax	Dmed	Bmed
Ceramium rubrum (Huds.)Ag.	91,7	+	666,67	+	427,27
Mytilus galloprovincialis Lam.	100,0	12222	28857,78	4404	19194,64
Mytilus - jeunes (< 10 mm)	100,0	78933	789,33	39049	390,64
Mytilaster lineatus Gmelin	100,0	3689	995,56	947	113,02
Chiton marginatus Pennat	25,0	267	1,33	32	0,16
Balanus improvisus Darwin	100,0	34444	1460,00	3357	568,52
P r o t o z o a	66,7	+	+	+	+
H y d r o z o a	50,0	5867	4,69	1030	0,03
Total formes sessiles	-	85377	31340,08	48819	20267,81
Mya arenaria L.	66,7	800	60,00	222	19,30
Scapharca inaequivalvis (Brug.)	91,7	2222	27,67	718	7,86
Hydrobia ventrosa (Montagu)	50,6	533	1,33	150	0,36
N e m e r t i n i	16,7	89	0,31	15	0,06
Leptoplana tremellaris (O.F.M.)	50,0	444	13,33	56	1,68
T u r b e l l a r i a	100,0	14933	0,60	5445	0,22
N e m a t o d a	100,0	76711	0,13	34791	0,06
P o l y c h a e t a	100,0	14800	8,90	8380	4,83
O l i g o c h a e t a	8,3	89	0,02	10	0,00
C o p e p o d a	100,0	66133	0,38	20026	0,39
A m p h i p o d a	100,0	66889	26,76	32518	12,59
Tanais cavolinii M.-Edw.	91,7	11289	4,52	2292	0,77
Idotea baltica Pallas	33,3	3067	92,00	432	13,08
Palaemon elegans Rathke	33,3	356	71,11	24	1,95
D e c a p o d a var.	100,0	489	117,35	208	47,05
Total formes vagiles	-	149155	249,35	105287	110,20
TOTAL GENERAL	-	212532	31470,09	154106	20805,28

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Quelques données sur les populations des sables à Corbula mediterranea Costa, de Mamaïa (Constantza, mer Noire)

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Abstract: The author shows the prosperous state of the Corbula community at Mamaïa in 1985: high specific diversity, increasing densities and biomasses of populations. This stage could be considered transient under the conditions of eutrophication in the Black Sea.

Les recherches des années soixante effectuées à Mamaïa (Constantza) ont confirmé le fait que la biocénose des sables fins à Corbula représente l'une des associations benthiques les plus productives de la mer Noire (1). Les nouvelles conditions écologiques ont influencé aussi cette biocénose (2,3). A la suite des phénomènes toujours plus fréquents de marées rouges et des mortalités en masse des organismes benthiques (où l'on n'exclut point l'influence néfaste des processus actifs d'érosion des plages), lors du contrôle effectué en 1982, la biocénose infralittorale de Mamaïa était extrêmement appauvrie, réduisant évidemment son rôle trophique et écologique (4).

La nécessité de connaître l'évolution ultérieure de l'état de l'association des sables à Corbula, en condition de persistance de l'eutrophisation des eaux, nous a déterminé à effectuer un nouveau contrôle écologique. On a prélevé en octobre 1985, 32 échantillons quantitatifs, à l'aide de la benne Van Veen (1/20 m^2). Les résultats obtenus nous permettent une évaluation générale de l'état actuel du zoobenthos de la zone Mamaïa, comme suit:

1. L'association des sables à Corbula à une structure qualitative améliorée. On a identifié 35 types d'organismes, presque trois fois plus que lors de dernier contrôle écologique d'il y a trois ans. Les espèces les plus fréquentes (Tableau 1) sont: Corbula mediterranea (Costa),Mya arenaria L.,Cardium edule lamarckii Reeve, Scapharca inaequivalvis (Brug.),Mytilus galloprovincialis (Lam.) jeunes, Hydrobia ventrosa (Montagu), Rissoa splendida (Eichw.), Cyclope neritea (L.) parmi les mollusques, et aussi Ampelisca diadema Costa,Balanus improvisus Darwin,Pseudocuma ciliata G.O.Sarsa, Iphinoe maeotica (Sov.), Periodulodes longimanus (Bate & Westwood) parmi les crustacés. Les formes fortuitement rencontrées, avec une fréquence au-des sous de 25%, pas inclues dans la liste, sont: les mollusques Spisula subtruncata triangula (Renier),Chione gallina L.,Abra ovata (Philippi),Tellina tenuis Costa et Retusa truncatula Brug., les vers Leptoplana tremellaris (O.F.M.),les crustacés Bathyporeia guilliamsoniana (Bate),Tanais cavolini M.-Edw.,Paramysis baeri bispinosa Mart., ainsi que d'autres groupes, tels que Hydrozoa, Halacarida, Phoronida (Phoronis euxinicola S.-Long.) et Bryozoa.

Certaines espèces, autrefois communes (Chrisallida,Nassarius,Biogenes,Pacropipus, etc.) manquent encore.

2. Du point de vue quantitatif, en 1985 le zoobenthos est très abondant - en moyenne presque 360000 ex.m^{-2} et 870 g.m^{-2} (Tableau 1), valeurs proches de celles des années soixante (1). Mais l'abondance maximale des peuplements benthiques peut dépasser, en certains endroits, 1 million ex.m^{-2} et 2,7 kg.m^{-2}.

Il faut relever la grande quantité des foraminifères (1,92 mil.m^{-2} en moyenne, avec des maxima de 5,05 mil.m^{-2}), mais à cause des difficultés de reconnaissance rapide des exemplaires vivants, on ne les a pas pris en considération.

3. Dans les sables à Corbula, les peuplements de vers (surtout nématodes) et de mollusques sont les plus abondants du point de vue numérique. Du point de vue pondéral, les associations sont dominées par les mollusques (93% - dont Corbula - 20%, Mya - 20% et Cardium - 41%); les vers et les crustacés ont des biomasses réduites - environ 30 g.m^{-2} (3% - 4%).

Le rapport général macrobenthos/méiobenthos (1:11,9 comme densités et 2,29:1 comme biomasse) prouve la dominance numérique du méiobenthos ou du pseudoméiobenthos (les formes juvéniles des organismes macrobenthiques, par exemple les mollusques).

4. L'indice de diversité (la racine carrée du produit entre la fréquence et la biomasse d'une espèce), calculé pour les formes les plus importantes indique la hiérarchie biocénotique suivante pour les espèces de la biocénose des sables à Corbula: 186,5 - Cardium, 131,7 - Corbula, 131,5 - Mya, 52,0 - Polychaeta, 51,2 - Ampelisca, 28,7 - Scapharca, 28,7 - Cyclope, 20,6 - Chione, 18,5 - Hydrobia et 15,7 - Rissoa. Toutes ces espèces sont typiquement psammobiontes; de même, Scapharca, espèce récemment introduite dans la mer Noire, s'est assez bien rangée dans l'association des fonds sableux.

Tableau 1. Fréquence (f%), densités (D-ex.m^{-2}) et biomasse (B-g.m^{-2}) maximales (max) et moyenne (med) des organismes enregistrés en 1985 dans les sables à Corbula (MZ - pourcentage de macrobenthos)

	f%	Dmax	Bmax	Dmed	MZ%	Bmed	MZ%
Corbula	100,0	103320	468,53	42249	31	173,58	55
Mya	96,9	56110	646,98	12394	44	178,48	51
Cardium	96,9	18800	1381,60	2602	52	358,88	97
Scapharca	56,2	1680	102,64	456	2	14,66	64
Mytilus	43,8	1510	29,08	312	4	4,30	31
Véliconques	62,5	329740	32,97	42906	-	4,29	-
Hydrobia	59,4	9650	24,12	2298	7	5,74	7
Rissoa	43,8	10160	50,80	1128	-	5,64	-
Cyclope	40,6	500	155,00	75	83	20,22	80
Gastropoda jeunes	28,1	20320	0,61	1382	-	0,04	-
MOLLUSCA	-	508310	2711,69	106080		808,64	
Nemertini	84,4	320	0,79	108		0,16	
Nematoda	100,0	617200	1,07	201212		0,35	
Polychaeta	100,0	74150	58,91	28085	7	27,00	42
Oligochaeta	90,6	27680	8,49	7976	7	2,66	44
VERMES	-	647980	48,94	240744		31,82	
Copepoda	53,1	12400	0,25	3462	-	0,07	-
Balanus	68,8	2880	6,74	432		1,71	
Ampelisca	96,9	15360	89,02	5757	73	27,05	94
Pericculodes	31,2	320	0,06	32		0,01	
Pseudocuma	46,9	13540	0,81	2944		0,18	
Iphinoe	34,4	1280	0,19	202		0,03	
CRUSTACEA		32770	92,23	+12883		+29,12	
VARIA		620	0,50	+85		+0,10	
ZOOBENTHOS		1088930	2758,49	359792		869,68	

5. En conclusion, le benthos de la zone Mamaïa a eu en 1985 une situation surprenante - diversité spécifique élevée, grandes densités et biomasses; ceci signifie que son rôle écologique de base trophique et de biofiltre (8 - 64 m^3 eau.$jour^{-1}$.m^{-2}) a augmenté jusqu'aux niveaux des années soixante. Mais cette situation doit être considérée comme transitoire, étant donné que les conditions actuelles crées par l'eutrophisation peuvent déterminer des changements imprévisibles dans la biocénose.

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B-II12

On the origin and biogeography of the recent benthic foraminiferal fauna of the N.E. Levantine Sea

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Resumé: Etude détaillée des peuplements de Foraminifères récents. On à étudié 128 prélèvements, de la côte jusqu'à 2200 m dans le bassin de Cilicie. 75% des espèces présentes ont été signalées dans l'Océan Atlantique et le bassin occidental de la Méditerranée. Beaucoup d'espèces bathyales sont boréales et Atlantiques. Environ 20% de la faune totale parait être limitée à la province Est-Atlantique-Méditerranée (Lusitanienne). La majorité de ces formes est constituée d'espèces en place et cette proportion d'endémiques est comparable avec celle d'autres groupes d'Invertébrés. La faune des hauts niveaux (<100 m) inclut des espèces indo-pacifiques (4% de la faune totale), excepté Edentostamina ssp et Amphistegina, elles sont connues du Quaternaire d'Egypt et d'Israël et des sédiments récents du golfe d'Aqaba. La migration de ces espèces par l'isthme de Suez est discutée.

A detail study of the dead assemblages of Recent benthic Foraminifera from 128 sample localities extending from the nearshore zone to a depth of about 2200 m in the Cilician Basin (N.E. Levantine Sea) revealed that 75% of all of the identified species (383) have been previously recorded throught the Atlantic Ocean and the Western Mediterranean Sea (Alavi,1980). Most of the bathyal species are known from the Boreal Province of the Atlantic and about 20% of the whole fauna seem to be restricted to the Eastern Atlantic-Mediterranean (Lusitanian) Province (Ekman,1953). The majority of these forms are shelf-dwelling species and this proportion of foraminiferal endemism is comparable with those reported for most groups of invertebrates in the same province (Briggs,1974, p.203-205). Some of them are widely known from the Neogene of the Mediterranean region.

The shallow water (<100 m) faune include a number of Indo-Pacific species representing about 4% of the whole fauna. These are *Clavulina angularis* d'Orbigny, *Edentostammina cultrata* (Brady), *E. milleti* (Cushman), *Peeudomassilina cf. australis* (Cushman), *"Quinqueloculina"phoenicia* (Martinotti), *Nodophthalmidium antillarum* (Cushman), *Spiroloculina communis* Cushman and Todd, *Bolivina africana* (Smitter), *Loxostomum limbatum* (Brady), *L. karrerianum* (Brady), *Sigmavirgulina tortusa* (Brady), *Heterostegina depressa* d'Orbigny, *Amphistegina lobifera* Larsen, and *Cymbaloporetta dradyi* (Cushman). Except for *Edentostamina spp.* and *Amphistegina*, they are all reported to occur in fossil assemblages from the marine Quaternary deposits of Egypt and Israel (Said and Kamel, 1955; Shukri *et al.*,1956, and Reiss and Issar,1961) and Recent shallow water sediments from the Gulf of Aqaba (Elat) and off the coast of Levant and Egypt (Said,1950; Reiss *et al.*,1961; Moncharmont Zei,1968, and Kafescioglu 1976). As the decendent of the Paleogene tropical stock seem to have become extinct by the end of the Miocene in the region (Adams,1967 and Said and Kamel,1955), these species probably entered the Mediterranean Sea during the Plio-Quaternary phases of shallow-water connections between the Mediterranean and the Red Seas across the Isthmus of Suez (Shukri *et al.*,1956; Abdel-Gawad,1970; Por,1975, and Gvirtzman and Buchbinder,1978). This interpretation lends support to the proposed eastern Mediterranean *Amphistegina* province, erected on the basis of the stratigraphic and biogeographic distribution of *A. lobifera* Larsen (1976 and 1979). So far there is no evidence to suggest the migration of any of these species from the Red Sea via the Suez Canal.

There are only three species which appear to be restricted to the eastern Mediterranean Basins. These are *Anomalinoides minimus* Vismara-Schilling and Parisi, *Pararotalia sp.*, and *Discorbinella sp.*. The latter two are probably new taxa.

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B-II13

Reproduction, biométrie et indices de condition chez Venus verrucosa L. (Mollusca, Bivalvia) du golfe de Trieste

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Abstract In Venus verrucosa the reproductive activity occur in April-September.The sex-ratio is 59.47 + 2*3.26 for females. The growth is allometric and condition indices are discussed.

Venus verrucosa vit sur des substrats détritiques-sableux du Golfe de Trieste où elle est péchée. LE PENNEC (1981) rapporte que Venus verrucosa, des côtes atlantiques françaises, est mûre ou elle est en émission pour une période assez longue (février-août) avec les émissions plus importantes en juillet et août. VALLI et CESTER (1980) ont observé, préliminairement, que Venus verrucosa du Golfe de Trieste se reproduit de décembre à septembre tandis qu'en octobre et novembre les gonades sont presque vides. Selon MARANO et al. (1980, 1983) Venus verrucosa de l'Adriatique Méridional émet les gamètes de juin à décembre mais le maximum est compris de juin à octobre. Dans le but d'approfondir l'étude de la reproduction, de la biométrie et, en particulier, de suivre les variations des indices de condition en relation au cycle reproductif chez Venus verrucosa du Golfe de Trieste, on a recueilli de novembre 1982 à janvier 1984, tous les mois, une cinquantaine d'exemplaires. On a mesuré, avec un compas à coulisse, la longueur, la hauteur et l'épaisseur de la coquille et puis le poids total, celui des parties molles et de la coquille de tous les animaux. Les parties molles de 20 exemplaires, choisis au hasard, ont été fixées au Bouin, coupées (6 µm) et colorées à l'hematoxyline-eosine. Les gonades ont été classées selon une échelle de 6 Stades: Stade 0 (repos sexuel), Stade 1 (début de la gamétogénèse), Stade 2 (développement), Stade 3 (maturité), Stade 4 (émission), Stade 5 (fin du cycle). Sur les animaux restants on a déterminé le poids sec de la chair (étuve a 105°C), le poids des cendres (four a 550°C) et, par différence, le poids sec sans cendres. Au cours de 1982-84, Venus verrucosa s'est reproduit surtout d'avril à septembre. En octobre on remarque une période d'arrêt mais on n'observe pas des animaux en repos sexuel et la gamétogénèse recommence, avec une phase prépondérante jusqu'en avril.En effet l'indice gonadique de SEED (1980) qui synthétise l'évolution des gonades (sa valeur est 0 lorsque tous les individus sont en repos sexuel et 3 s'ils sont tous mûrs) est supérieure à 2, de mars à septembre, et est 1, ou un peu plus, dans la période suivante: en confirmation d'une intense activité gonadique, favorisée par des conditions optimales de température, salinité, oxygène, nourriture du Golfe de Trieste (FONDA-UMANI et Alii,1985). Pour ce qui concerne la biométrie, l'intervalle général de la longueur est: 3.6 - 6.5 cm, avec une moyenne de 5.1 cm. Les coefficients mensuels d'assymétrie de la longueur sont presque toujours négatifs, à savoir: la distribution de la longueur présente un nombre plus grand d'observations plus grandes de la moyenne. Cette situation est dûe au fait que les animaux provenaient de la pêche professionelle qui emploie des engins qui ont une sélectivité propre et, par conséquent, ne pêchent pas normalement les animaux inférieurs à 3.6 cm. Avec le coefficient de variation pourcentage (CV%), paramètre indépendant de l'unité de mesure, il a été possible de comparer la dispersion de variables non homogènes. On a pu observer que les variables linéaires présentent une moindre dispersion à l'égard des pondérales mais, parmi les linéaires, l'épaisseur présente la plus grande dispersion. Pour ce qui concerne les variables pondérales, c'est le poids de cendres qui a la plus petite variabilité. Ce résultat est d'un certain intérêt car, en principe, c'est tout à fait le contraire.et cela pourrait être dû à une faible présence de sable chez Venus verrucosa et/ou à un contenu plus régulier de métaux. Ensuite on a calculé des régressions fonctionnelles (Modèle II) qui sont, partiellement, reportées ici:

Dep./Ind.	n.	r^2	a	b	interv. de b à 95%
H/L	571	0.91	-0.0684	1.0092	0.9850-----1.0335
E/L	572	0.66	-0.3787	1.2523	1.1925-----1.3120
PT/L	616	0.79	-0.6428	3.3177	3.1969-----3.4384
PV/L	573	0.69	-1.0829	3.6533	3.4857-----3.8209
PPM/L	574	0.83	-1.5398	3.4352	3.3188-----3.5517
PS/L	329	0.75	-2.4027	3.6880	3.4879-----3.8882
PSSC/L	329	0.74	-2.5395	3.7952	3.5841-----4.0063

(où: H=hauteur,L=longueur,E=épaisseur,PT=poids total,PV=poids valves, PPM=poids parties molles,PS=poids sec,PSSC=poids sec sans cendres; intervalle de b à 95% pour tester l'allométrie de l'accroissement. Données logarithmiques).

On peut observer que, relativement aux intervalles de mesure effectués (de 3.6 à 6.5 cm de longueur), il y a une relation d'allométrie pour toutes les variables. Après ça on a étudié 21 indices de condition: il s'agit de rapports qui dérivent des variables linéaires, pondérales, etc., avec pour but de repérer lequel ou lesquels sont à préférer pour suivre les fluctuations saisonnières des parties molles. Pour cette raison on a comparé la variabilité intérieure des divers indices, avec l'aide de tests non paramétriques (test de Friedman et test de Wilcoxon), et on a pu ainsi ranger les indices en ordre croissant de variabilité (les indices les meilleurs ont une petite variabilité). Après on a examiné (test de Kruskal-Wallis) la sensibilité des indices, à savoir la propriété d'élever les différences dans divers mois. Enfin on a mis en évidence (test de Spearman) les indices qui présentaient des corrélations significatives avec l'indice gonadique de SEED. De l'intégration des résultats obtenus, on a isolés 5 indices: PPM/(L*H*E), PPM*100/L^3, PPM/PTOT, PS*100/(L+H+E)^3, PS*100/(L*H*E) qui ont révélé les plus petites variabilités intérieures, les plus grandes sensibilités et les meilleures corrélations avec le cycle reproducteur. Certains de ces indices peuvent être pris dans un but pratique: en effet PROU et Alii (1986) rapportent qu'en France on a adopté (en 1985) l'index PPM/PTOT pour Crassostrea gigas. En tout cas les résultats obtenus ici, même s'ils dérivent d'une analyse statistique complète, n'autorisent pas une généralisation sans des études spécifiques.

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Microrépartition de la macrofaune benthique de substrat meuble en milieu perturbé

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B

MATERIEL ET METHODES : Bakalem et al (1986 b) ont établi pour la période de juin 1983 la cartographie, et défini la zonation, des peuplements macrobenthiques du port d'Alger. Ces auteurs ont mis en évidence que le port d'Alger est un milieu perturbé.
Deux stations au niveau de ce port : la station P10 et la station P21 ont été prospectées en février 1985. Pour chaque station, dix prélèvements soit 1/10 de m2 chacun, distribués au hasard sont réalisés à l'aide d'une benne type Van Veen c'est-à-dire un mètre carré de sédiment prélevé pour chaque station. Les prélèvements d'une même station sont traités individuellement.
La station P10, profondeur 19 m, est localisée dans le bassin de Mustapha, milieu extrêmement perturbé comprenant une vaste zone azoïque et une zone polluée perturbée. En février 1985 lors des prélèvements la station P10 appartient à une zone polluée. Le sédiment de cette station est en grande partie constitué de vase à laquelle viennent s'ajouter des sablesetgraviers.
La station P21 de profondeur 15 m se trouve dans le bassin du Vieux Port dans un secteur occupé par une zone subnormale. Le sédiment est de nature vaso-sableuse renfermant un grand nombre de coquilles vides de Mollusques et des débris divers (verre, plastique, etc...).
La méthodologie relative aux traitements des données a été exposée dans un précédent travail sur la microrépartition des espèces macrobenthiques des sables fins de la baie d'Alger (Bakalem et al., 1986a).

RESULTATS : - Station P10 : 14 espèces au total dont 13 Polychètes ont été inventoriées. Les Polychètes ont une densité élevée : 1347 ind/m2 soit une dominance de 99,47 %. Cette forte dominance est due essentiellement à deux espèces : Capitella capitata, "leader" du peuplement, et Scolelepis fuliginosa. Ces 2 espèces caractéristiques des milieux pollués, sont des indicatrices de pollution. De ce fait le stock écologique regroupant les indicatrices de pollution est le plus important, et de loin, du peuplement de la station.
Le peuplement de la station P10 est pauvre qualitativement et très nettement dominé par deux indicatrices de pollution : Capitella capitata et Scolelepis fuliginosa. Sur le plan quantitatif la répartition spatiale est très hétérogène.
Les indices indiquent une tendance à la contagion pour six espèces parmi lesquelles nous retrouvons les 2 espèces caractéristiques et dominantes de la station : Capitella capitata et Scolelepis fuliginosa. Pour les espèces non adaptées aux milieux perturbés, ou présentes dans un ou deux prélèvements, comme Glycera convoluta et Nereis caudata, les valeurs de leur indice de Morisita sont élevées.
L'hypothèse d'une répartition au hasard n'est retenue que dans 2 cas : Staurocephalus rudolphii, et Holothurie indéterminée.
- Station P21 : Au total 24 espèces sont inventoriées pour cette station dont le plus grand nombre appartient au groupe des Polychètes, suivi de celui des Mollusques, les Crustacés venant en dernier. Cependant sur le plan quantitatif les Mollusques dominent largement le peuplement de la station, et les Crustacés viennent en seconde position.
Les espèces à large répartition écologique sont le groupe écologique dominant de la station. Corbula gibba et Lumbrineris latreilli sont les principales espèces du peuplement.
L'étude de la microrépartition des espèces montre une répartition contagieuse dans 17 cas et une répartition au hasard dans 11 cas.
Les espèces dominantes, pour lesquelles le milieu est favorable : Corbula gibba, Apseudes africanus, Audouinia tentaculata, Tharyx marioni, Lumbrineris latreilli et Nereis caudata ont une répartition contagieuse.
La contagion est maximale pour Nephthys hombergii, présente seulement dans un prélèvement avec un effectif de 5 individus. La répartition au hasard concerne les espèces dont la densité est inférieure à 10 ind/m2 sauf pour 3 espèces : Glycera convoluta (24 ind/m2), Capitella capitata (18 ind/m2) et Phascolosoma sp (13 ind/m2).

DISCUSSION - CONCLUSION : La répartition spatiale des individus est très hétérogène au niveau des stations étudiées de ce fait très peu d'espèces sont représentées dans tous les prélèvements.
Le peuplement du port d'Alger pris dans sa globalité serait réparti en taches. Le calcul de l'indice de Morisita donne les valeurs 1,19 et 2,34 pour respectivement les stations P21 et P10. Les peuplements ont une répartition contagieuse à l'échelle du m2. Pour la station P10 la contagion est la plus forte, cela semble être dû à l'hétérogénéité du sédiment de cette station.
Comme l'ont déjà signalé Bakalem et al. (1986a) il y a une relation étroite entre la densité et les indices d'agrégation. Les indices montrent l'existence d'une répartition au hasard quand la densité est faible sauf pour les espèces représentées par un petit effectif dans un seul prélèvement, comme c'est le cas de Glycera convoluta, Nereis caudata à la station P10, et Nephthys hombergii, Eunice oesterdi à la station P21.
Pour le port d'Alger les peuplements sont répartis en taches à l'intérieur desquelles les espèces dominantes ont une répartition contagieuse. Ces espèces dominantes s'approprient tout l'espace où les conditions leur sont favorables.
La variabilité des effectifs dans les prélèvements est lié à l'aspect du sédiment, et elle l'est d'autant plus quand le sédiment est très hétérogène comme c'est le cas à la station P10. Pour le port d'Alger cette variabilité est importante étant donné la grande hétérogénéité des fonds meubles de ce port.

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Les peuplements benthiques du port d'Alger : 1 - Les Mollusques

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METHODOLOGIE : Dans le port d'Alger nous avons effectué pendant une année (novembre 81-novembre 82) des prélèvements mensuels au niveau d'une station. La profondeur de la station est de 7,5 m. Chaque prélèvement représente une surface de 0,5 m2, correspondant à 6 coups de benne "Orange-Peel".
RESULTATS : Au total 50 espèces de Mollusques, soit 32 Bivalves, 18 Gastéropodes, ont été inventoriées: le maximum d'espèces (21) en automne (novembre 1981) et au printemps (mai 1982), et le minimum (10 espèces) en hiver.
Les variations annuelles de la densité des Mollusques mettent en évidence des pics : printanier (densité maximale de 810 individus/m2 en mai), estival et automnal (moins importants que le précédent) ; et également une période hivernale où les Mollusques sont peu abondants dans le milieu.
La prépondérance des Bivalves est due à certaines espèces : Abra alba, Corbula gibba, Venerupis aureus, V. rhomboides et Cardium exiguumayant des fréquences, des densités et des dominances élevées. A ce groupe d'espèces nous pouvons ajouter Dosinia lupinus et Venus verrucosa dont les fréquences sont élevées mais les dominances faibles.
Pour les Gastéropodes seule Nassa reticulata est bien représentée. Cependant, il est à noter des espèces comme Murex trunculus (Fréquence = 92.30%) et Cerithium vulgatum (Fréquence = 69.23%) présentes régulièrement dans les prélèvements mais dont les dominances sont faibles.
Abra alba est considérée par Bellan (1967) comme une vasicole tolérante. Hily (1983) la considère comme une espèce tolérant une surcharge du milieu en matières organiques. En baie d'Alger, Bakalem (1979) signale l'abondance d'Abra alba au niveau des fonds sablo-vaseux et vaso-sableux, fonds riches en matières organiques.
Avec une fréquence égale à 100, elle est une espèce constante, son abondance élevée lui conférant une forte dominance. C'est l'espèce principale du groupe des Mollusques. L'évolution annuelle de la densité d'Abra alba nous permet de relever : - les valeurs maximales en novembre 1981 (74 individus m-2 soit une dominance de 22,29 %), au printemps (mars, avril, mai) où les densités et les dominances sont les plus élevées du cycle, et en été (juillet, août).
- les valeurs minimales en hiver (décembre à février) et en septembre et octobre c'est-à-dire à la fin de l'été et au début de l'automne. En hiver, bien que la densité diminue, la dominance de l'espèce au sein des Mollusques reste élevée, ces deux paramètres ne chutent vraiment qu'en février (densité = 2 individus m-2 et dominance = 1.75 %).
Les maxima de densité automnal, printanier et estival d'Abra alba correspondent à ses périodes de recrutement et aux conditions du milieu favorables à l'espèce. Lors de l'hiver et de la période fin été-début automne, les conditions défavorables ne permettent pas à Abra alba de se maintenir et de se développer dans le milieu.
Corbula gibba est classée comme espèce à large répartition écologique par Picard (1965). Bourcier et al., (1979) la considèrent comme une espèce indicatrice de la zone subnormale, c'est-à-dire prolifèrant là où il y a une quantité modérée de matières organiques.
L'évolution annuelle de Corbula gibba est identique à celle d'Abra alba. En hiver (janvier, février) Corbula est mieux représentée dans le milieu qu'Abra qui domine les autres mois ; cela laisse supposer qu'Abra supporte moins bien les conditions défavorables du milieu. Corbula gibba, se classe, selon ses densités et dominances, en 2ème position, en certains mois (janvier et novembre 1982) c'est l'espèce principale du peuplement de Mollusques.
Venerupis aureus : Bellan (1967) signale son abondance relative dans le port de Marseille dans la zone polluée. Venerupis disparait du milieu quand les conditions sont très défavorables (avril et octobre). Le cycle annuel de Venerupis aureus suit le même schéma évolutif que celui d'Abra alba et de Corbula gibba. Il en est de même pour Venerupis rhomboides.
Cardium exiguumconsidérée par Bellan (1967) comme une indicatrice de pollution est présente dans tous les prélèvements mensuels sans cependant être dominante sauf en juin où sa dominance (22,06 %) est la plus forte de son cycle et aussi du prélèvement de juin.
L'évolution annuelle de Abra alba, Corbula gibba, Venerupis aureus et V. rhomboides et Cardium exiguum, est à l'origine des variations observées lors du cycle global des Mollusques tant sur le plan des effectifs (abondance) que représentatif (nombre d'espèces, dominance).
Nassa reticulata est le seul Gastéropode très abondant. En baie d'Alger, elle se rencontre surtout sur les fonds sableux, et semble être une espèce sabulicole (Bakalem, 1979). Nous la trouverons dans les prélèvements tout au long de l'année.
L'évolution annuelle de Nassa reticulata diffère de celle des Bivalves. Contrairement à ces espèces, Nassa présente un pic hivernal (abstraction faite de janvier) où les effectifs sont élevés et les dominances parmi les plus fortes des Mollusques. Nous avons également pour ce gastéropode un pic printanier (mai, juin) et un pic en septembre-octobre. Les minima enregistrés se situent aux mois de janvier, avril et juillet.
DISCUSSION-CONCLUSION : l'étude du cycle annuel des Mollusques d'une station du port d'Alger fait ressortir les poins suivants : - richesse qualitative du milieu en Mollusques (50 espèces) comparativement à des milieux ouverts comme la baie d'Alger : 45 espèces (Bakalem, 1979) ou la baie de Bou-Ismail : 14 espèces (Bakalem et Romano, 1983) ou à des milieux similaires : Bellan (1967) ne récolte que 28 espèces dans le port de Marseille, Ergen et Onen (1983) dans leur étude du port d'Urla (Turquie) n'ont recensé que 32 espèces de Mollusques. - richesse quantitative du peuplement de la station en Mollusques. Les densités enregistrées en certains mois sont supérieures aux densités maximales trouvées en baie d'Alger (235 individus m-2) et baie de Bou-Ismail (Bakalem, 1979 ; Bakalem et Romano, 1983). - Richesse qualitative et quantitative du peuplement en Mollusques en été où pour un tel milieu fermé les conditions écologiques sont des plus défavorables. - Dominance des espèces comme Corbula gibba, Abra alba tolérant une surcharge du milieu en matières organiques ou Cardium exigum, indicatrice de pollution.

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Les peuplements benthiques du port d'Alger : 2 - Les Crustacés

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MATERIEL ET METHODES : Les détails concernant la méthodologie ont été exposés dans une première note (3) portant sur les Mollusques du port d'Alger.

RESULTATS : Les 59 espèces de Crustacés recensées se répartissent ainsi : 30 Décapodes, 11 Amphipodes, 8 Isopodes, 4 Cirripèdes et 2 Mysidacées. Le maximum d'espèces se rencontre en été et en automne.

Les maxima de densité s'observent au printemps (4262 individus m-2 en avril), en été (1450 individus m-2 en juillet) et à un degré moindre en automne. Les minima tant qualitatif que quantitatif sont enregistrés en hiver et au mois d'août.

Les Décapodes, présents toute l'année, ont leurs maxima d'espèces en été et en automne ; le restant de l'année correspond aux minima hivernal, printanier et du mois d'août. Les maxima de densité de Décapodes sont enregistrés en automne (octobre : 84 individus m-2), en juin et juillet avec des valeurs plus fortes (108 et 150 individus m-2). Les minima de densité se trouvent en hiver (4 à 12 individus m-2) ; au printemps,en août (24 individus m-2) et septembre (30 ind.m-2).

Les Amphipodes viennent en seconde position, en nombre d'espèces, Les variations du nombre d'espèces d'Amphipodes sont identiques à celles des Décapodes. Les Amphipodes, en hiver (janvier, février) et en août, sont absents du milieu ; le maximum d'espèces (5) est noté en juin et octobre. Sur le plan quantitatif, il apparait très nettement un pic printanier, le plus important, débutant en mars et s'achevant en juin, le maximum de densité est 964 individus m-2 confèrant aux Amphipodes la dominance la plus forte (65,92 %) de mai. Et un pic automnal où le maximum d'individus se trouve en octobre (82 individus m-2). Les minima de densités et du nombre d'espèces sont enregistrés en hiver (0 à 4 individus m-2) et en août (0 individus m-2).

Les Isopodes sont présents toute l'année. Les fluctuations de leur abondance présentent un maximum fin hiver - début printemps : avril 4158 individus m-2, mars 1306 individus m-2 ; de ce fait, leur dominance est très nette (94,21 et 97,54 %) ; un maximum début été (juin-juillet) moins important ; et un minimum hivernal (janvier et février) et estival (août) avec des densités faibles, mais conférant toujours aux Isopodes des dominances élevées (63,49 à 85,75 %). Les Isopodes, peu représentés qualitativement sont quantitativement plus importants. Les variations annuelles quantitatives des Crustacés sont surtout la résultante de celles des Isopodes, principalement Apseudes africanus et à un degré moindre Apseudes latreilli mediterraneus. La fréquence d'Apseudes africanus est maximale (F = 100). C'est l'espèce principale du peuplement carcinologique de la station. Le cycle annuel d'Apseudes africanus sur le plan de l'abondance, de la dominance est identique à celui des Isopodes. La densité (4 individus m-2) et la dominance (7,14 %), les plus faibles ont été enregistrées en janvier. Les fluctuations de la densité d'Apseudes africanus au cours de l'année sont généralement élevées, comme par exemple de mars à avril elle passe de 1300 à 4132 individus m-2. Contrairement A. latreilli mediterraneus est peu abondant : densité maximale 74 individus m-2, d'où ses faibles dominances, sauf en janvier (42 individus m-2) il est l'espèce principale du peuplement (dominance de 75 %). En novembre 1981, décembre et octobre 1982 il est inexistant dans les prélèvements.

Les principaux Amphipodes sont : Corophium acutum , C. acherusicum, et Phtisica marina ; cette dernière très abondante et fréquente est responsable des fluctuations annuelles des Amphipodes. Le pic printanier des Amphipodes est du à un "bloum" printanier de Phtisica marina (964 individus m-2, dominance = 65,92 %). Phtisica marina est absente du milieu en hiver et en août, elle est abondante en automne comme l'est également Corophium acutum

Upogebia tipica, espèce principale des Décapodes, est associée à tout un cortège d'espèces accompagnatrices d'importance secondaire : Pagurus cuanensis, Macropipus arcuatus, Sirpus zariquieyi, Galathea bolivari, Galathea strigosa et Pagurus callidus, qui, certains mois, renforce l'importance du groupe des Décapodes. Upogebia tipica, bien que ses effectifs restent assez faibles, voit ses dominances augmenter jusqu'à atteindre un maximum en hiver et en août ; ses faibles densités se rencontrent au printemps, et plus particulièrement en été et automne. Xantho pilipes est fréquent dans les prélèvements ; il constitue avec Upogebia tipica les espèces prépondérantes du groupe des Décapodes ; son abondance reste relativement faible tout au long de l'année, excepté en été et en octobre où elle augmente ainsi la dominance. Les maxima de densité et de dominance sont 30 individus m-2 et 5,57 % en octobre.

DISCUSSION-CONCLUSION : L'étude dynamique des Crustacés a permis de mettre en évidence : - la richesse qualitative et quantitative de ce peuplement portuaire en Crustacés : 59 espèces inventoriées, alors qu'en milieu ouvert comme les fonds de sables fins de la baie d'Alger, seulement 35 espèces ont été recensées (1). Cette richesse qualitative est comparable à celle des fonds de graviers envasés de la baie de Bou-Ismail (62 espèces) (2) et également à celle des fonds du port d'Urla (Turquie) (61 espèces) (5). Bellan (1967) signale la pauvreté qualitative (7 espèces) des fonds meubles du port de Marseille, en Crustacés. Sur le plan quantitatif, les densités sont élevées comparés aux maxima de densités trouvées en baie d'Alger (50 individus m-2) et de Bou-Ismail (189 individus m-2) (2).

- Un développement maximal tant en nombre d'espèces qu'en individus des Crustacés de février à juillet ; en août, la densité et le nombre d'espèces sont à leurs valeurs les plus faibles.
- Les principales espèces sont Apseudes africanus et A. latreilli mediterraneus, Phtisica marina, Upogebia tipica, Xantho pilipes, Pagurus cuanensis, Corphium acutum et C. acherusicum. La signification écologique de ces espèces est inconnue ou peu connue. Il semblerait que certaines de ces espèces soient caractéristiques des milieux riches en matières organiques ou légèrement pollués, notamment Corophium acutum, déjà signalée comme une espèce dominante dans les milieux pollués, (6) et C. acherusicum considère comme tolérante à la pollution (7).

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B-II17

Corbula gibba (Olivi) as a time recorder of environmental stress. A first contribution

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Resumé

On propose la détermination des classes d'âge de Corbula gibba à l'aide de l'analyse des "spawning breaks" pendant l'accroissement de la coquille. C. gibba, espèce pionnière dans la recolonisation des fonds meubles défaunés, pourrait donc être utilisée comme "time recorder" du processus de recolonisation.

Corbula gibba (Olivi) is one of a few long- and wide- ranging species of Corbulidae, assumed to appear in Oligocene times (Robba, 1968). Its morpho-functional characteristics make it is well adapted to live in unstable mixed muddy bottoms. Morpho-functional studies on the conchiolin layers (Levy & Samtleben, 1979) have shown the presence of an elastic gasket around the margins of the left valve permitting hermetic closure of the valve under condition of high environmental stress. This allows the animal to remain isolated and survive environmental stress that may prove lethal to other species of the community. The inner layer of conchiolin protects the animal from the attack of boring gastropods. Indeed, biological surveys of muddy bottoms often produce samples of C.gibba having perforated shells but still alive; the inner layer is not attacked by the acid secretion of its predators.

The peculiar characteristics of C.gibba allow it to adapt to sub-terminal conditions of organic enrichment (Ghirardelli & Pignatti, 1968; Pearson & Rosenberg, 1978; Salen-Picard, 1981). They are the first to recolonize dredged areas, when excessive turbidity precludes the recruitment of other species (Specchi & Orel, 1968; Bonvicini-Pagliai et al., 1985).

Thus, we were prompted to study the shell growth patterns of C.gibba in order to obtain information about the ecological impact of environmental stresses in polluted areas.

Thin sections and acetate peels of C.gibba shell reveal a very complex microgrowth pattern and have very marked spawning breaks, that generally correspond to the June-September time interval. The spawning period may extend into October at the higher latitudes (Rasmussen, 1973; Jorgensen, 1946; Muus,, 1973; Fosshagen, 1965, Yong, 1946).

This first research phase was limited to studying the spawning breaks in order to define the age classes of C.gibba in biological surveys of previously defaunated areas, using a relatively easy and reproducible technique. This permits dating of the start of macrobenthic succession. The interpretation of microgrowth patterns may provide more precise information on the suitability of C.gibba for dating defaunation events and also on the validity of this bivalve as a time recorder of stress linked to environmental instability and to anthropic impact on marine environments.

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Etude bionomique comparative de la zonation verticale des Polychètes le long d'une falaise littorale en Méditerranée nord-occidentale

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ABSTRACT - COMPARATIVE BIONOMICAL STUDY OF THE POLYCHAETE VERTICAL ZONATION DOWN A LITTORAL CLIFF IN THE NORTH-WESTERN MEDITERRANEAN.

The polychaete vertical zonation from 0 to 6 m depth, described by the community method, is consistent with the main zonation models used in the Mediterranean (hydrodynamical, biocoenotical and phytosociological). This favours the integration of such models.

L'étude de la zonation verticale des Annélides Polychètes le long d'une falaise rocheuse (ABBIATI, 1987; ABBIATI et al., 1987) nous a donné l'opportunité de comparer différents critères bionomiques et d'en discuter de façon critique les résultats. La falaise étudiée se situe à quelques kilomètres au sud de Livourne (Toscane, Italie) et s'étend jusqu'à 6 m de profondeur. Les échantillons ont été prélevés en plongée autonome par grattage de 400 cm^2 aux profondeurs suivantes: 0, 0.1, 0.5, 1, 1.5, 2, 3, 4, 5 et 6 m. L'échantillon de 0 m a été effectué juste au dessus du "zéro biologique" (BOUDOURESQUE et CINELLI, 1977).

D'après l'analyse quantitative de la distribution des 97 espèces récoltées au total dans les différents échantillons, on peut reconnaître trois peuplements de Polychètes se succédant avec la profondeur: le premier dans le mediolittoral (0 m), le second dans l'infralittoral supérieur (0.1 à 1 m), le troisième dans l'infralittoral "inférieur" (1.5 m jusqu'au fond). Ces peuplements ayant été distingués sur la base de données quantitatives, on les a assimilés à des communautés sensu PETERSEN (1913) et nommés d'après l'espèce dominante: on a donc, dans l'ordre, une communauté à Syllis amica, une communauté à *Platynereis dumerilii* et une à *Sphaerosyllis hystrix*.

Cette zonation a été ensuite comparée avec celle qui pouvait être prévue d'après quelques approches bionomiques dont l'usage est courant en Méditerranée, à savoir:

- Zonation hydrodynamique selon RIEDL (1964): le long de la falaise on a reconnu, au dessous du "niveau des eaux calmes", la zone à "mouvements multidirectionnels" suivie par la zone à "mouvements oscillatoires", les deux étant separées par la "première profondeur critique".
- Zonation des biocoenoses selon PERES et PICARD (1964): on a distingué les deux biocoenoses-type de la Roche Mediolittorale Inferieure (R.M.I.) et des Algues Photophiles (A.P.); la dernière embrasse les deux communautés annélidiennes infralittorales, ce qui ne justifierait pas leur distinction. Cependant, BELLAN et MARINOPOULOS (1981), toujours en travaillant sur les Polychètes, avaient déjà supposé l'existence d'une biocoenose des Algues Photophiles "Profondes".
- Zonation des associations algales: suivant GIACCONE (1973) on a bien distingué, lors des prélèvements, le *Neogoniolitho-Lithophylletum tortuosi* dans le mediolittoral, le *Cystoseiretum strictae* dans l'infralittoral supérieur (frange infralittoral des phytosociologues?) et le *Cystoseiretum crinitae* au sens large dans le reste de la falaise.

Cette comparaison est reportée de façon synoptique dans le tableau suivant: on voit qu'il y a une très bonne correspondance générale, malgré les différences conceptuelles entre les critères considerés.

Etages	MEDIOLITTORAL	INFRALITTORAL SUPERIEUR (frange?)	INFRALITTORAL INFERIEUR
Profondeur	"zéro biologique"	0.1 à 1 m	1.5 à 6 m
Communautés de polychètes	à *Syllis amica*	à *Platynereis dumerilii*	à *Sphaerosyllis hystrix*
Zones hydrodynamiques	Ruhewasserspiegel	BRANDUNGSZONE	SCHWINGUNGZONE
Biocoenoses	R.M.I.	A.P.	A.P. profondes?
Associations algales	*Neogoniolitho-Lithophylletum tortuosi*	*Cystoseiretum strictae*	*Cystoseiretum crinitae* s.l.

Ce résultat nous permet trois considérations: d'abord il nous démontre que les Polychètes sont des "descripteurs efficaces" de la zonation benthique sur substrat dur, reflétant fidèlement les modifications du milieu ambiant; en outre, il souligne encore une fois que la zonation benthique est en relation avec plusieurs facteurs différents (hydrodynamisme, lumière, couverture algale, etc.) et que les approches dites "monofactorielles" sont par trop simplificatrices; enfin, il suggère qu'un modèle de synthèse, intégrant les différentes approches dont on vient de vérifier la cohérence, pourrait être développé. Cet effort d'intégration sera, à notre avis, le défi pour les bionomistes méditerranéens dans les prochaines années.

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Structure of a Red Coral population

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RÉSUMÉ - ON A ANALYSÉ LA STRUCTURE D'UN PEUPLEMENT À CORALLIUM RUBRUM INSTALLÉ SUR UN CONCRÉTIONEMENT ORGANOGÈNE. LA PRÉSENCE DE NOMBREUSES JEUNES COLONIES PRÈS DES INDIVIDUS MORTS DÉNOTE UNE HAUTE CAPACITÉ DE RENOUVELLEMENT DE CE PEUPLEMENT.

A STUDY ON A RED CORAL (CORALLIUM RUBRUM L.) POPULATION DWELLING ON A ROCKY, SEMICIRCULAR CLIFF, FROM NNW TO S, LOCATED BETWEEN 22 AND 40 M IN DEPTH IN THE LIGURIAN SEA (43°30' LAT.N, 10°20' LONG.E) WAS CARRIED OUT BY SCUBA DIVING. THE DATA HERE ANALYZED DIFFER FROM THOSE IN THE FAO FISHERIES REPORT ON RED CORAL RESOURCES (1984) AND IN THE WORK OF GARCIA-RODRIGUEZ AND MASSO (1986) THAT REFERS TO COLONIES SELECTIVELY COLLECTED BY PROFESSIONAL FISHERY.

THE TEMPERATURE IN THE SAMPLING SITE, RECORDED DURING THE WHOLE YEAR RANGED, AT 35 M IN DEPTH, BETWEEN 20°C IN OCTOBER AND 13°C IN MARCH.

A PREVIOUS PHOTOGRAPHIC SURVEY SHOWED THE SETTLEMENT OF CORAL ON THE VAULT OF ALL THE CAVITIES VARIOUSLY ORIENTED; A SUCCESSIVE ANALYSIS OF THE POPULATION PERFORMED ON PHOTOGRAPH WAS NOT POSSIBLE BECAUSE THE HIGH DENSITY OF SPECIMENS DID NOT ALLOW TO DISTINGUISH EACH COLONY (SANTANGELO & ABBIATI, IN PRESS).

IN ORDER TO ANALYSE THE STRUCTURE OF THE POPULATION NINE 0.2X0.2M QUADRATS LOCATED IN THE KNOTS OF A DISCONTINOUS GRID AT 31, 33, 36 METERS OF DEPTH AND ORIENTED AT 50°(A), 90°(B), 140°(C) WERE SCRAPED. ON THE BASIS OF A FIRST ANALYSIS OF FOUR SAMPLES (A31, A33, B36, C31: FIG.1) AN AVERAGE DENSITY OF 1050M^{-2} (SD 7,39), LIVING COLONIES AND OF 212,5M^{-2} (SD 10,38), DEAD COLONIES WERE FOUND. THE BASAL PART OF THE COLONIES IS SETTLED ON BIOGENIC CONCRETION IN WHICH POLYCHAET TUBES ARE THE MAIN AND MOST COMMON COMPONENT (76% OF THE SPECIMENS) PATCHED WITH PORIFERA (23%), DEAD CORAL COLONIES (12,5%) AND BRIOZOA (12,5%).

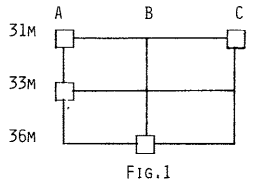

FIG.1

THE MEAN WEIGHT, BASAL DIAMETER AND HEIGHT OF THE COLONIES WERE OF 0.39 GR (SD 0.37), 3.28 MM (SD 1.36), 31,81 MM (SD 14,32) RESPECTIVELY. THE DISTRIBUTION OF THE VALUES OF THESE THREE PARAMETERS ARE REPORTED IN FIG.2.

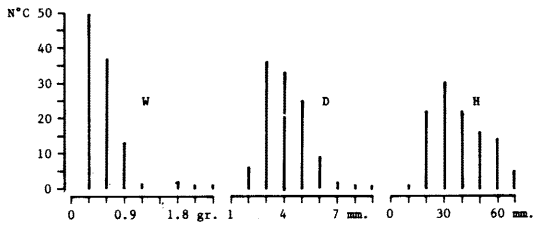

FIG.2 - DISTRIBUTION OF WEIGHT (W), DIAMETER (D) AND HEIGHT (H) OF THE COLONIES.

THE CORRELATION COEFFICIENTS OF WEIGHT (W), DIAMETER (D) AND HEIGHT (H) WERE FOUND TO BE HIGHLY SIGNIFICANT P<0.001 (TAB.1). THE SMALLEST SIZE CLASS, COMPOSED OF SPECIMENS SHOWING 1-3 POLYPS, AMOUNTS TO ABOUT 15% OF THE POPULATION. THE HIGH PERCENTAGE OF THESE YOUNG COLONIES, WHICH ARE LIKELY NEW SETTLED, SUGGESTS A HIGH RECRUITMENT CAPARILITY FOR THIS POPULATION.

	W	D	H
W	-		
D	0.756	-	
H	0.761	0.698	-

TAB.1

THE NUMBER OF BRANCHES AND KNOTS SEEMS TO BE REGULARLY DISTRIBUTED ALONG EACH COLONY ON THE BASIS OF A CONSTANT DISTANCE UNIT, 0.5 CM, OR A MULTIPLE OF IT.

TO SUMMARIZZE THIS POPULATION IS SETTLED ON A BIOGENIC CONCRETION, IN ALL THE SHADED CAVITIES AND IN EVERY DIRECTION. THE SMALL SIZE OF THE COLONIES AND THE PRELIMINARY OBSERVATIONS OF THE GROWTH RINGS (UNPUBLISHED DATA) PERMIT US TO SUPPOSE THAT MAXIMAL AGE OF THE CORALS DOES NOT EXCEED 7 YEARS. THE HIGH NUMBER OF YOUNG AND DEAD COLONIES INDUCE US TO BELIEVE THAT THIS POPULATION RENOVATES AT A HIGH RATE.

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B-II20

Distribution du macrobenthos du delta de l'Ebre (NE Espagne)

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INTRODUCTION

Les baies littorales du Delta de l'Ebre sont des extensions d'eau marine semifermees placees au Nord et au Sud de la plaine du Delta. Celle du Sud, "Els Alfacs", est l'objet du travail. Elle a 50 Km² et 4m de profondeur moyenne, une bouche de 3 Km et une capacite de 200 millions de m³ (CAMP et DELGADO, 1987).

Cette baie reçoit des apports d'eau douce provenant de beaucoup de chenaux d'egout qu'on peut trouver à la droite de l'Ebre. Le gradient de salinite dans la baie est tres fort: zones avec plus d'un 35‰ et d'autres avec moins d'un 23‰ on ete trouvees. Le flux moyen mensuel est de 38 millions de m³, pendant l'ete (CAMP et DELGADO, 1987).

Dans ce travail la distribution du macrobenthos en relation avec differents facteurs du milieu est etudiée.

MeTHODOLOGIE

Juillet 1987, un échantillonnage sur 24 stations du Delta (Fig. 1) a ete realise. Dans chacune d'elles, des carottes (Cores) de différents diamètres ont ete prelevées et le macrobenthos, le pourcentage de matière organique totale et la granulometrie ont été étudiées

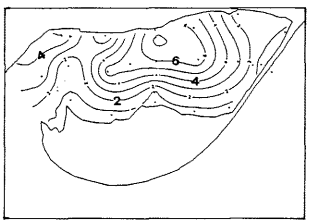

FIG. 1.- Pourcentages de matière organique total.

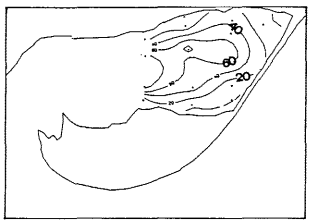

FIG. 2.- Granulometries (% fines).

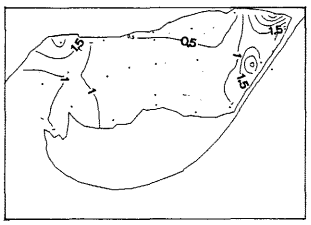

FIG. 3.- Nombre d'exemplaires x cm⁻².

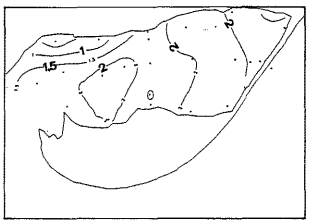

FIG. 4.- Diversité (Index Shanon-Weber).

Pour la caracterisation des communautés macrobenthiques on a considéré le nombre total d'exemplaires et la Diversité (Index de Shannon-Wever).

RESULTATS ET DISCUSSION

Les groupes du macrobenthos étudiés, sont resumés dans le Tableau I.

La distribution du pourcentage de matière organique totale, du pourcentage de fines, du nombre d'exempaires et de la diversité sont synthétisées dans les Fig. 1, 2, 3, et 4, respectivement.

GROUPES	$\bar{X}$	f(24)	GROUPES	$\bar{X}$	f(24)
Polychetes	108.25	24	Harpacticoides	2	7
Gasteropodes	1.8	8	Tanaidaces	16.5	8
Bivalves	15.87	23	Ostracodes	2.67	6
Amphipodes	29.35	23	Dentalium	1	1
Phoronidiens	40.5	18	Nematodes	1	1
Holoturies	2	2	Isopodes	6.11	9
Cnidaires-1	1.75	4	Oligochaetes	31	3
Nemertes	2	6	Briozoaires	1	1
Ophiures	8.14	7	Larves Decapode	1.67	3
Cumacees	4	11	Mysidaces	3.5	2
Éponges	2.71	7	Hydrozoaires	3	1
Sipunculides	1	6	Cnidaires-2	2.67	3
Ascidies	5	5			

TABLEAU I.- *Groupes de Macrobenthos.* X: Nombre moyen d'exemplaires par echantillon (200 cm²). f(24): Fréquence (nombre d'echantillons).

La zone où la sédimentation est la plus grande et celle où le nombre d'exemplaires est le plus petit coincident; les deux suivent le gradient des apports d'eau douce. A la périphérie de l'aire d'influence de ces apports on trouve deux zones où les apports de matière organique n'arrivent pas directement et, en même temps, la concentration du nombre d'exemplaires est la plus haute. On peut définir deux aires de distribution du macrobenthos: une centrale, en relation avec la sortie vers la mer (milieu plus instable), où les populations avec une haute densité de macrobenthos ne peuvent pas se développer; l'autre à une stabilité plus élevée, qui permet de maintenir des populations plus nombreuses (probablement avec aucune espèce particulièrement abondante). On peut voir encore une troisième zone plus restreinte, à droite de la baie, où on trouve des valeurs de densité de macrobenthos très élevées. Elle ne peut pas être comparée au modèl précédent car la diversité est aussi élevée (il n'y a aucune espèce dominante).

La zone centrale de la baie est la plus profonde et elle a les sédiments les plus fins. Elle correspond aussi à la zone avec les plus grands dépôts de matière organique totale. On y trouve des populations avec un peu moins d'exemplaires du macrobenthos, mais on peut y observer un léger accroissement de la diversité. Le milieu n'est pas si strict, il n'y a pas des populations specifiques, et celà permet l'établissement d'autres populations avec une grande variété d'organismes . Par conséquent, la diversité est plus élevée.

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Etat actuel des connaissances sur la faune benthique du secteur Bulgare de la mer Noire

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En résultat des recherches faunistiques dans le secteur bulgare de la Mer Noire, effectuées au cours des 80 dernières années on a identifié au total 2259 espèces animales. Parmi eux la plupart sont des invertébrès et seulement 166 espèces appartiennent au groupe des Chordés (Tableau 1).

Tableau 1

Groupes taxonomiques	Valkanov (1957)	Valkanov & Marinov (1964)	Marinov & Golemansky (1988)	TOTAL
Protozoa	348	35	292	675
Porifera	29	--	--	29
Coelenterata	39	1	1	41
Plathelmintes	36	5	17	58
Nemathelmintes	33	--	83	116
Annelides	107	16	17	140
Rotatoria, Nemertini, Gastrotricha, Kynorhyncha etc.	77	22	19	119
Bryozoa	12	--	8	20
Mollusca	122	17	3	142
Arthropoda	415	43	288	746
Echinodermata	3	1	--	4
Chaetognatha	3	--	--	3
Chordata	151	12	83	166
TOTAL	1375	152	731	2259

Parmi les 675 espèces de protozoaires environs, 22% sont des formes benthiques. Il s'agit plus exactement de foraminifères (43 espèces), de thécamoebiens psammobiontes (45) et d'infusoires mésopsammiques (60), habitant surtout le littoral et les eau souterraines du sable supralittoral.

Les Porifères habitent, en général, le littoral rocheux. La forme typique du fond vaseux c'est Sycon ciliatum (biocénose de Modiola phaseolina). Parmi les Coelenterés (41 espèces) les plus abondants on trouve les Hydrozoaires. Il est intéressant de noter l'observation de Lucernaria campanula dans les champs de Cystoseira avec une abondance de 600-700 ex/m².

Dans le benthos littoral les vers sont assez abondants (433 espèces au total). Ils sont répandus du supralittoral jusqu'à la zone du H_2S. L'abondance dé Nematodes est de plus d'un million ex/m².

Le groupe des Mollusques (142 espèces) représente plus de 90% de la biomasse du zoobenthos. La biomasse de l'espèce dominante Mytilus galloprovincialis s'est progressivement réduite au cours des dernières années à cause du gastropode carnivore importé Rhapana thomassiana. Mya arenaria et Cunearca cornea sont de nouveaux mollusques benthiques dans le secteur bulgare avec une abondance qui augmente. C. Cornea a été signalée pour la première fois dans notre secteur en 1983 et maintenant son abondance atteint 4000 ex/m², avec une biomasse de 4280 g/m². Au-delà de 60 m prédomine Modiola phaseolina (plus de 11000 ex/m² et une biomasse d'environ 710g/m²).

Dans le groupe des Crustacés prédominent les Harpacticoïdes (204 espèces). Leur abondance dans la biocénose de Cystoseira barbata dépasse 850.000 ex/m². Les Amphipodes (Pleonexes gammaroides, Amphithoe ramondi, Stenothoe monoculoides etc.) atteignent plus de 80.140 ex/m² avec une biomasse d'environ 1.4 g/m².

Parmi les Echinodermes,on trouve 4 espèces. La plus commune est Amphiura stepanovi, habitant le fond vaseux à une profondeur de 50-60 m (environs 400 ex/m²). Dans les même conditions vit l'espèce Leptosynapta inchaerens.

Branchiostoma lanceolatum, considérée il y a une dizaine d'années comme un élément rare du littoral bulgare est trouvé maintenant en plusieurs endroits à une profondeur allant jusqu'à 25 m avec une abondance de 1130 ex/m².

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B

Etude morphologique et croissance de Pinna nobilis L. (Mollusque Eulamellibranche) dans le parc national sous-marin de Port-Cros (Var, France)

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La protection quasi-totale des eaux du Parc National de Port-Cros (Var, France) permet à certaines espèces menacées de prospérer ou simplement de s'y maintenir. C'est le cas du Mollusque Eulamellibranche *Pinna nobilis* L. A L'orée de l'anse de la Palud, une population de cette espèce est suivie depuis dix ans (Vicente, et *al.*, 1980). En 1969 ce sont 122 individus qui ont été recensés sur le champ. La zone étudiée couvre un hectare environ. Originellement le fond devait être occupé par un herbier de *Posidonia oceanica*, celui-ci est actuellement très dégradé, voire inexistant. Par la suite, la prospection s'est élargie permettant d'étendre la zone d'étude de de l'isobathe - 10 à l'isobathe - 35 mètres.

L'étude porte sur des mesures faites in situ à l'aide du scaphandre autonome. Cette technique, bien que contraignante, est la seule qui permette d'épargner l'espèce.

1. MORPHOMETRIE DE *PINNA NOBILIS* L.

Pour chaque individu numéroté, des mesures ont été effectuées au mètre-ruban et au compas. Pour deux dimensions (largeur maximum L et largeur au niveau du sédiment l -voir Figure 1) les deux méthodes ont été utilisées. On obtient ainsi L_m et l_m pour les mesures faites au mètre-ruban et L_c et l_c pour les mesures faites au compas. Outre ces mesures, la hauteur totale au-dessus du sédiment H_s et la distance entre le sommet de la charnière et le sommet des valves D sont notées.

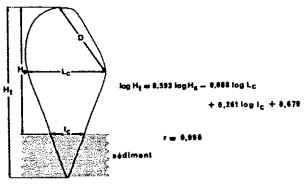

Figure 1. Morphométrie de la coquille de Pinna nobilis L.

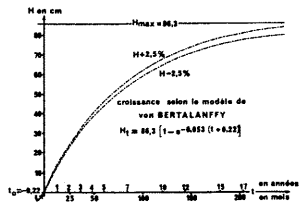

Figure 2.

La hauteur H_S varie en fonction de l'enfoncement de la coquille dans le sédiment. Elle ne peut donc être utilisée comme mesure de la taille de l'animal. A l'aide de valves mortes récoltées au cours des diverses plongées, nous avons pratiqué les mesures citées et cherché la meilleure relation qui les liait à la hauteur totale H_T. La relation finale retenue est :

(1) $\log H_T = 0,593 \log H_s - 0,088 \log L_c + 0,361 \log l_c + 0,679$ avec un coefficient de corrélation de $r = 0,996$.

2. CROISSANCE

Bien que le suivi de la hauteur totale ait été fait durant 10 ans, les mensurations faites sur chaque *Pinna* ne permettent pas de calculer directement la croissance. En effet, la fragilité des coquilles et l'abondance des épibiontes rendent difficile une estimation de la croissance uniquement mise en évidence à partir de l'évolution de la taille totale (Moreteau et Vicente, 1980). De plus, tous les animaux étant de grande taille, donc probablement en fin de croissance, les variations de taille sont souvent masquées par les variations aléatoires.

L'utilisation des valves mortes permet d'observer l'histoire de l'animal. En effet, celles-ci présentent les empreintes successives du muscle postérieur. Il existe une bonne corrélation entre H_T et la distance qui sépare la pointe de la coquille de la dernière empreinte P :

(2) $\log P = 0,864 \log H_T - 0,091$ avec $r = 0,927$

Puisqu'il s'agit de valves, c'est la hauteur totale vraie qui est utilisée et non la hauteur totale calculée selon l'équation (1). On postule que la relation est la même pour chaque empreinte et qu'il s'est écoulé le même laps de temps entre deux empreintes consécutives. En transformant toutes les valeurs de P en H_T, on peut appliquer la méthode de Ford-Walford (Walford, 1946). On obtient :

(3) $H_{T(t+1)} = 0,949\ H_{T(t)} + 4,41$ avec $r = 0,995$.

La pente et l'ordonnée à l'origine de cette droite permettent de calculer les paramètres du modèle de von Bertalanffy (von Bertalanffy, 1938).

$H_{max} = 4,41/1 - 0,949 = 86,3$ cm, $k = -\log 0,949 = 0,0525$

$t_o = 0,222$ en prenant l'hypothèse d'une taille de ponte de 1 cm.

Par ailleurs, l'observation de très jeunes individus, dont nous connaissions l'âge, nous a permis de corréler le facteur temps du modèle avec l'âge vrai en mois. Le modèle retenu pour décrire la croissance de *Pinna nobilis* est donc :

(4) $H_T = 86,3\ (1 - e^{-0,053\ (t\ -\ 0,222)})$ avec $t = 4,35$ mois.

Comme l'établissement de ce modèle a nécessité de faire un certain nombre d'hypothèses, il est indispensable de vérifier qu'il s'ajuste bien aux observations. Pour un animal donné on calcule à l'aide de l'équation (1) la taille H_T initiale et la taille H_T après un certain nombre de mois. A partir de la taille initiale, on calcule la taille théorique que cet animal devrait avoir après le nombre de mois considérés par application du modèle de von Bertalanffy, soit H_{Th} (fig. 2).

Ce calcul n'est fait que pour les animaux ayant présenté une croissance aussi faible soit-elle. Les intervalles de temps considérés vont de 6 à 85 mois ce qui nous permet de considérer une grande part de la durée de vie théorique de l'espèce.

On obtient la relation suivante :

(5) $H_{Th} = 1,02\ H_T - 2,81$ avec $r = 0,0904$.

Une comparaison de la pente obtenue avec la pente théorique de 1 ne montre pas de différence significative. L'ordonnée à l'origine, qui devrait être égale à 0, peut être considérée comme étant de l'ordre de l'approximation admise. Le modèle théorique s'ajuste donc aux données observées.

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Observations on growth and sexual maturity of Balanus amphitrite (Darwin) and Balanus eburneus Gould in field and laboratory

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Resumé - Le delta du Po est un milieu plus favorable pour la croissance de Balanus amphitrite que pour celle de B.eburneus. Au contraire la maturité sexuelle et le développement des embryons est plus rapide pour la première espèce dans le port de Gênes et auprès du laboratoire.

The growth and development of embryos of two common Barnacle species has been studied for short periods in two different environments: the port of Genoa and a lagoon of the Po river delta. Data were compared with those obtained from the two species reared in the laboratory under controlled conditions of salinity, temperature, settlement density and diet (Romairone et al. 1988).

In the period July-September, when the fastest growth rate of both the Barnacle species was observed in the port of Genoa (Relini and Relini-Orsi 1969) and in the Po river delta (Relini and Fasciana 1982), monthly and trimestrial panels were collected.

The analysis of the Barnacle populations, during July and July-September (fig.1) shows that on the trimestrial panels of the Po river delta the dimensional class of maximum frequency for B.amphitrite is 12 mm of rostro-carinal basal diameter, while for B.eburneus is about half, also if for longer times this species, better adapted to the lagoon environment, becomes larger and overcomes the size of the first one. Moreover B. eburneus settles more abundantly and for à longer period (Fasciana et al. 1988). On monthly panels of the port of Genoa B.eburneus does not succeed in reaching 6 mm while B.amphitrite exceeds 9 mm. Trimestrial panels in the same environment, confirm the best B. amphitrite growth rate. In the Po river delta, an environment with more remarkable aline change and higher temperatures, it is possible to record the most important growth rates: B. eburneus, during one month, shows a growth rate double to that in the port of Genoa.

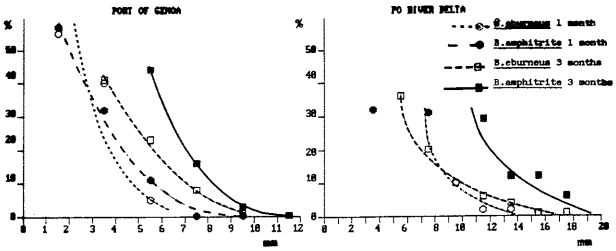

Fig.1 B.amphitrite and B.eburneus in Genoa port and in the Po river delta. Settlement percentages on monthly and trimestrial panels, beginning from the class of maximum frequency to that of maximum size.

During the three months, the maximum diameter is 17 mm for the two species, also if numerically B.amphitrite is by far less abundant.

Barnacle species growth differences on the three months panels are less important in the port of Genoa also if B.amphitrite is always the fastest growing species.

In fig.2, where Barnacle of the two natural environments are compared with those reared in the laboratory, one can notice that B.eburneus, in the Po river delta, grows better during the first month, when intra or interspecific substratum competition has not yet established. In the laboratory, where substratum competition is avoided, growth is continous and regular for all the three months although this species never achieves sexual maturity. B.amphitrite, on the other hand, shows in the Po river delta a continous growth which is more important than in the port of Genoa and in the laboratory cultures.

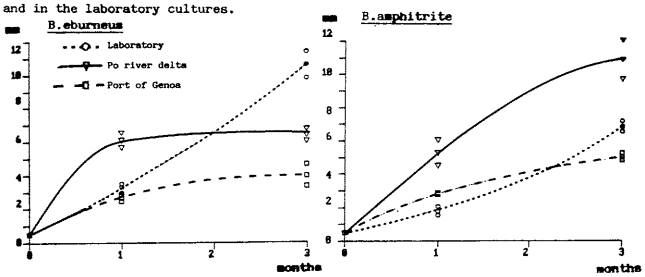

Fig.2 B.amphitrite and B.eburneus growing curves after one and three months in Genoa port, in the Po river delta and in the laboratory cultures. Data are referred to mean values and to upper and lower P.95 % confidential limits.

Concerning sexual maturity and embryos development (table 1), it seems that B.eburneus finds its best conditions in the mesoaline environments of the lagoon. On the contrary B.amphitrite, fastly reaches its sexual maturity in the laboratory and in the port of Genoa, while in the delta it seems that a higher growth rate is at the expence of sexual maturation rate (Bourget and Crisp 1975).

	T°C	S ‰	species	A	B	C	D	species	A	B	C	D
PO RIVER DELTA	25 - 30	20 - 28	B.amphitrite	94	6			B.eburneus	41	6	26	27
PORT OF GENOA	24 - 25	34 - 37	" "	9	82	8	0,2	" "	43	55	2	
LABORATORY	25	37	" "	30	50	20		" "	100			

Table 1- Sexual maturity and development of embryos percentages in B. amphitrite and B.eburneus. A:seminal vesicules and ovary not visible; B:seminal vesicules well visible; C:ovary with oocytes; D: embryos.

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B-II24

Bilan des connaissances sur la faune profonde d'Amphipodes en Méditerranée : ses implications sur l'histoire et la zonation de cette mer

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Le bilan des connaissances sur les Amphipodes de Méditerrannée est en cours d'élaboration. La faune globale s'élève actuellement à 413 espèces et 3 sous espèces (auxquelles il convient d'ajouter quelques espèces en cours de publication), ce qui représente environ 8% de la faune mondiale d'Amphipodes. On compte un peu plus de 190 endémiques (environ 46%), ce chiffre aura tendance à baisser au fur et à mesure du développement des études dans l'Atlantique-est mais restera malgré tout élevé à cause de la biologie et du mode de dispersion du groupe qui entraîne partout dans le monde un fort endémisme.

On considèrera comme espèce profonde au sens large, toutes les espèces signalées au delà de 150m de profondeur, leur nombre s'élève à 154 (37,2% FT) appartenant à 89 genres et 25 familles. Parmi ces espèces 49 (10,9% FT) ne remontent pas au dessus de 150m, 31 d'entre elles sont endémiques.

Du point de vue biogéographique, parmi ces 154 espèces profondes au sens large, on compte 71 endémiques (46,1% FP) taux comparable à celui existant dans la faune amphipodologique totale; 70 espèces (45,5% FP) Atlanto-Méditerranéennes, ce qui confirme l'importance de l'affinité Atlantique-Méditerranée, mais ne préjuge pas de l'existence des flux ayant pu exister dans les 2 sens et du peuplement simultané de ces deux zones. Par contre la présence sur les 15 espèces ne remontant pas au dessus de 400m, de 3 espèces communes à l'Atlantique et à la Méditerranée, en plus de 12 endémiques, pourrait laisser envisager l'existence d'un peuplement commun avant "fermeture" du détroit de Gibraltar. 4 espèces sont considérées comme cosmopolites, ce qui est un taux très faible mais tout à fait normal dans le groupe

Il semble que l'on puisse soutenir l'hypothèse d'une affinité certaine avec l'Indo Pacifique, basée sur les données suivantes:

-8 espèces sont communes entre l'Atlantique ,la Méditerranée et l'Indo-pacifique

-1 espèce est commune entre la Méditerranée et le Pacifique,

-plusieurs genres présentant des endémiques en Méditerranée ne sont représentés que dans l'Indo-Pacifique: *Ensayara* (5 espèces dont 4 pacifiques), *Arculfia* (1 espèce avec 2 sous espèces dont 1 pacifique), *Pardaliscoides* (4 espèces dont 2 pacifiques, 1 pacifico-méditerranéenne et 1 méditerranéenne),*Prachynella* (2 espèces dont 1 méditerranéenne) , *Pleustoides* (4 espèces dont 1 méditerranéenne). De plus parmi ces genres, *Pardaliscoides* et *Arculfia* sont profonds.

L'ensemble de ces données éliminant la plupart des introductions accidentelles permet de soutenir , en ce qui concerne la Méditerranée, un schéma de peuplement faisant coexister:

-des espèces de la faune de la Téthys.

-des endémiques spécifiées à partir de genres Indo-Pacifiques et pour certains de ces genres, en milieu bathyal donc nécessairement dans des fosses relictes lors de la "crise salée" du Messinien.

-d'un grand nombre d'espèces endémiques issues d'ancêtres communs avec l'Atlantique et le Pacifique.

-d'un fort taux d'espèces communes avec l'Atlantique ne sous-entendant pas nécessairement le repeuplement en sens unique Atlantique -Méditerranée, mais laissant subsister la possibilité de toutes les autres modalités compte tenu qu'en Atlantique,certaines espèces sont strictement limitées à la zone lusitanienne.

Du point de vue bathymétrique on peut considérer que si l'on situe à 150-200m la limite du plateau continental,64,6% de la faune de Méditerranée est limitée au plateau continental, 11,4% a été récoltée au dessous de l'isobathe des 1000m mais seulement 2,2% ne remonte pas au dessus de cette profondeur On a donc un groupe vivant à la fois sur le talus et dans la plaine bathyale qui contient des vasicoles au sens large et des espèces bathyales communes à l'Atlantique et à la Méditerranée.. L'existence d'un stock d'Amphipodes strictement bathyaux comprenant de nombreuses espèces endémiques, ne fait plus aucun doute (Bellan-Santini 1983,1985) compte tenu de l'importance du nombre d'espèces benthiques récoltées au delà de 1000m, mais aussi de la présence parmi elles d'espèces appartenant à des genres voire des familles strictement bathyales ou abyssales: genres *Lepechinella, Onesimoides, Valettietta, Arculfia*,..famille des Pardaliscidae.

En ce qui concerne l'existence d'espèces abyssales et si l'on prend en compte l'argumentation développée par Peres (1985) qui retient ,dans le cas particulier de la Méditerranée,davantage les conditions ambiantes (conditions trophiques) et les variations de faune que la limite bathymétrique de 3000m (Peres 1982), on doit considérer qu'il existe un stock d'Amphipodes abyssaux comprenant au moins les 5 espèces qui ne remontent pas au dessus de 2000m : *Normanion abyssi* (2368m), *Scopelocheirus polymedus* (2400m), *Syrrhoites cornuta* (2520-2626m), *Tryphosella dilatata* (2276-2660m), *Syrrhoites capricornia* (2720m) auxquelles on peut peut-être ajouter *Onesimoides mediterraneus* (1900-2420m). L'existence de ces espèces que l'on peut qualifier d'abyssales au même titre que certains Polychètes (Chardy et al 1973), Cumacés (Reyss 1972,1973), Tanaidacés (Kudinova-Pasternak,1983) ou Isopodes (Pasternak 1983) ne peuvent cependant pas dans l'état actuel de nos connaissances nous permettre de conclure à l'existence d'une biocénose structurée dans un étage abyssal bien délimité ,mais plutôt à des éléments abyssaux en mosaïque, peut-être en enclave dans le bathyal .

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B-II25

Peuplements à Bryozoaires sur Laminaria rodriguezii Bornet (Banco Apollo, Ustica)

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ABSTRACT

The Bryozoans associations of the Laminaria rodriguezii Herbier developping on the Banco Apollo, near Ustica have been analysed. The L. rodriguezii analysis shows that the Bryozoans and other epiphytes are preferentially concentrated on the old parts of fronds and along the borders of the youngest ones. Collectively we have found 57 species of Bryozoans. Two different associations have been distingueshed. The first one, on the fronds, is caracterized by the occurence of Celleporina hassalli, Chorizopora brongniarti and a few number of other species. The holdfast association, in contrast, contains hight percentages of Puellina gattye and Micropora coriacea. It is suggested that the factors controlling the composition and the structure of the envisaged associations are prevalentely : 1) the light reduction from fronds to rhizoides and 2) the strong hydrodynamism which decreases downwards. According to MEINESZ et al. (1983) the studied association of L. rodriguezii belongs to the Biocoenose of Circalittoral hard substrate with large Pheophycees.

Les peuplements à Bryozoaires des prairies de Laminaires sont très peu connus (GAUTIER et PICARD, 1957 ; MOLINIER, 1959 ; GAUTIER, 1962 ; GIACCONE, 1967) excepté le travail de CHIMENZ et SCALETTA (1985) concernant les Bryozoaires épiphytes sur L. rodriguezii des Bancs Talbot et Terrible dans le canal de Sicile.

Nous avons étudié le peuplement à Bryozoaires de la prairie à L. rodriguezii du Banc Apollo, SW de Ustica en mer Tyrrhénienne. Le sommet du banc, d'origine volcanique, se situe à 40 mètres de profondeur et le peuplement à L. rodriguezii qui le recouvre, atteint son maximum de densité à 60 mètres et sur substrat rocheux. Toute la zone est caractérisée par un courant de fond très fort et constant à direction NW-SE.

L'analyse a été faite sur 100 lames dont les frondes mesurent 120 cm de long et 25 cm de large maximum. Les lames les plus longues présentent la partie distale plus ancienne soulignée par un étranglement.

Les épiphytes sont essentiellement représentés par des Bryozoaires et par des Polychètes Serpulidae, des Foraminifères et des Hydrozoaires. Les colonies sont concentrées sur la partie distale des lames ; des concentrations existent aussi sur les rebords ondulés et flexibles des portions jeunes. Les parties centrales des lames supportent, au contraire, des colonies sporadiques. Enfin, la zone méristématique de croissance, de 10-15 cm de long, est toujours sans épiphytes. La couverture moyenne ne dépasse jamais 2 % environ.

En ce qui concerne les rhizomes, le stipe n'est pas colonisé et les épiphytes sont concentrés sur les stolons les plus anciens, où ils présentent des couvertures élevées (jusqu'à 40 % environ).

Nous avons prélevé 57 espèces de Bryozoaires (5 Ctenostomata, 15 Anasca, 2 Cribrimorpha, 24 Ascophora et 11 Cyclostomata). Seules 22 espèces sont communes aux peuplements des lames et des stolons, qui contiennent un nombre plus élevé de Bryozoaires (45 contre 38).

Le peuplement des lames est dominé par deux espèces : Celleporina hassalli (40.69 %) et Chorizopora brongniarti (28.10 %) ; les autres espèces les plus abondantes sont Diaperoecia major (7.16 %), Fenestrulina malusi (4.45 %), Crisia fistulosa (3.87 %), Escharoides coccinea (2.44 %), Mimosella verticillata (2.37), Hapoploma impressum (2.11 %), Diaperoecia tubulosa (2.05 %) et Tubulipora liliacea (1.56). Toutes les autres ont des pourcentages inférieurs à 1 %. On constate, en général, sur la surface totale de la lame, une certaine homogénéité en ce qui concerne la composition du peuplement, mais on peut également relever des variations importantes de fréquence spécifique. Celleporina hassalli et Chorizopora brogniarti sont davantage représentées sur les parties jeunes des lames (42.64 % et 29.51 %) que sur les parties distales (29.51 % et 18.98 %), tandis que Crisia fistulosa et Diaperoecia major augmentent de 2.76 % et 6.50 % à 11.09 % et 12.03 %.

Le peuplement des stolons est dominé par Puellina gattyae (36.40 %) et Micropora coriacea (23.76 %) suivies par Haplopoma impressum (10.08 %), Escharella variolosa (6.92 %), Puellina hincksi (4.19 %), Celleporina globulosa (2.37 %), Crisia fistulosa (1.62 %), Diaperoecia major (1.58 %), Amphiblestrum minax (1.50 %) et Scrupocellaria maderensis (1.27 %) ; toutes les autres sont nettement subordonnées.

Sur les stolons on dénombre deux espèces caractéristiques exclusives : Micropora coriacea et Amphiblestrum minax. Il s'agit de deux taxa toujours associés aux stolons de L. rodriguezii (GAUTIER, 1962 ; ZABALA, 1986) et qui, exceptionnellement, ont été retrouvés, en colonies isolées, dans des fonds meubles circalittoraux.

Les autres espèces, plus abondantes sur les stolons (Puellina gattyae, Haplopoma impressum, Escharella variolosa, Puellina hincksi et Celleporina globulosa), sont des espèces nettement sciaphiles circalittorales qui colonisent des milieux différents mais que l'on pourrait définir comme préférentielles des prairies de Laminaires où leur abondance est probablement liée à l'absence de lumière au niveau des stolons.

Sur les lames manquent des espèces caractéristiques exclusives et l'on y trouve seulement un peuplement sciaphile d'espèces à large répartition écologique ou de substrats rocheux. Il s'agit surtout d'espèces circalittorales qui remontent dans l'infralittoral, seulement en conditions de sciaphilie accentuée, typique des rhizomes de Posidonie, des grottes semi-obscures et du soustrat des fonds précoralligènes.

On y trouve, en outre, des espèces parmi les plus abondantes (Celleporina hassalli et Chorizopora brongniarti) qui sont des espèces rhéophiles épiphytes sur les feuilles des Posidonies, sur des Algues et sur les frondes des Laminaires (GAUTIER, 1962 ; HAYWARD et RYLAND, 1978) ou sur des substrats rocheux liés à des faciès de courant de la Biocoenose DC ou, même, de la Biocoenose SGCF (données inédites).

En conclusion, les facteurs qui contrôlent les peuplements de Bryozoaires étudiés sont :

1. la diminution de luminosité depuis le sommet de la lame jusqu'aux stolons de L. rodriguezii qui rampent sur le substrat ;
2. l'hydrodynamisme très accentué et l'agitation des lames qui diminuent également vers le bas.

L'intéraction entre ces deux facteurs conditionne la composition et la structure du peuplement analysé.

De la comparaison entre le peuplement à Bryozoaires de L. rodriguezii du Banc Apollo et les peuplements d'autres zones de Méditerranée occidentale, se dégage l'uniformité de composition sur la zone totale.

Selon MEINESZ et al. (1983), le peuplement étudié à L. rodriguezii fait partie de la Biocénose des substrats durs circalittoraux à grandes Phéophycées.

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Fishing recruitment and exploitation onto a Donax trunculus stock off Tuscany Coast

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B

RESUME

La population de Filons, en mer Tyrrhénienne Septentrionale, est intensément exploitée. Les analyses des distributions de longueur.et des zones d'abondance montrent que la pêche agit surtout sur les individus de petite taille. Même si, en 1966, a été adoptée une taille égale, un usage optimal de la ressource demanderait une réduction ultérieure de l'effort de pêche.

The truncate donax represents the main natural-growing clam species of the Northern Tyrrhenian Sea; it is professionally exploited by 15 dredges, but a sensitive yield is also due to unlicensed hobby-fishing. Because of supposed over-exploitation and catches reduction, one-year research program started in 1985: this was pointed to investigate the resource status and availability in the Marine Department of Livorno and eventually set either license number or other appropriate fishing limitation.

Four main fishing surveys were carried out in September, December, February and May in the 25 km area along the coast. Every time an average of 35 boat-operated-tows were used to evaluate the clam spatial distribution, abundance, and population characteristics.

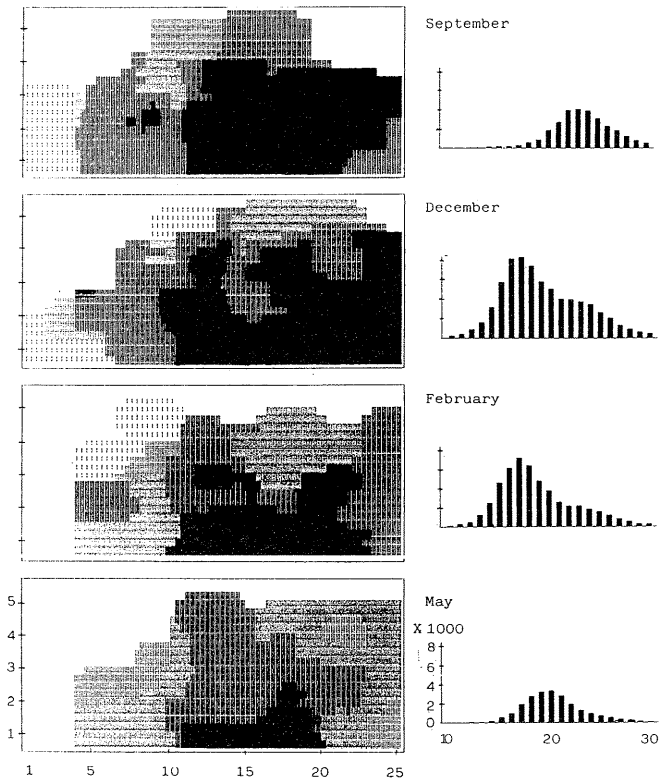

FIG. 1

left: Abundance of donax along the coast-line in km (abscissa) and depth in m (ordinate). Mean catch per tow = ⁞⁞ 4-20 grams, ▒ 20-100 g, ▓ 100-500 g, ▮▮ 500-2000 g, ■ 2000-9000 g.

right: Length frequency of caught population individuals in cm.

Figure 1 shows the density estimate along the coast at various depth between 0.75 and 5.5 m; on the right side, bar charts represent the total length distribution of the donax population in the same period. The main fishing ground, between The Arno and the Serchio rivers (km 12-22), is heavily exploited during the spring months as soon as the clams are recruited. Average length of 24 mm in September falls to 16 mm in December with the newly recruited individuals and slowly rises to 17 mm in February and to 20 mm in May. In the meanwhile the economically fishable area (more than 2 Kg/tow) reduces to one fifth of the original one. These aspects altogether show a strong over-exploitation trend: even if a stock-recruitment relationship is unlikely, the fishing mainly acts upon the lowest age class at unprofitable size (local market prices of large size donax are 30-40% higher than small size ones).

A first management action was to set a minimum legal size equal to 20 mm and a closed fishing season in April and May, only for hydraulic dredges (D.M.M.M. 16/7/86). Hopefully the closed season will be extended to every kind of donax fishing for an efficient effort reduction: the size increase of commercial specimen will elevate both total yield and product quality with a sensitive gain for both the fishermen and the stock.

Commercial catches and stock assessment of Squilla mantis

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Resumé. La squille ocellée dans la mer Tyrrhénienne Septentrionale représente un exemple typique où les CPUE dérivée des campagnes expérimentales de pêche ne réfléchissent pas les captures commerciales pendant le cours de l'année. La raison principale de ce fait réside dans la particulière stratégie de pêche employée par la flotte commerciale.

It is usual to consider abundance estimates from fishing surveys as a good index of population abundance and availability : case occurs when this is not completely true, but others factors will also determine the amount of commercial landings.

Commercial catches of Squilla mantis are reported by the National Statistical Institute (ISTAT) and more accurate landing estimates are available from direct recording in the Livorno whole-sale market. These data have been set in relation to a groundfish survey carried out in 1985-87: in the northern Tyrrhenian Sea, 150 one-hour tows have been performed in spring and summer seasons with a traditional Italian trawl (80 TSL, 400 HP). Significant abundance of S. mantis is limited to 10 miles around the Viareggio harbour (fig. 1), elsewhere the shrimp gives only rare and occasional catches.

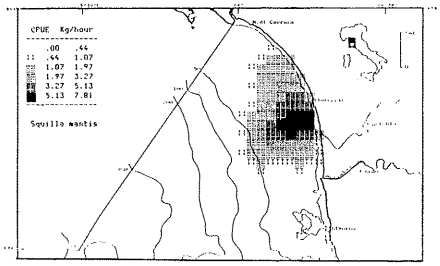

Fig. 1

Yearly mean CPUE of S.mantis.

Fig. 2

Ten years average landings in the Northern Tyrrhenian Sea (q) and in Northern and Central Adriatic Sea (ton).

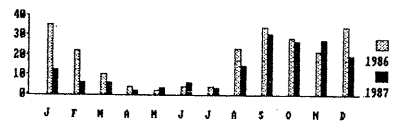

Fig. 3

Monthly landings from Livorno Market records.

Monthly trend of commercial landings in the Northern Tyrrhenian Sea well agree with the Adriatic ones (see fig. 2): catches are decreasing in spring and then increasing in autumn; maximum monthly yield is always in the November-January period.The ISTAT data are confirmed by the direct recordings of whole-sale fish market in Livorno (fig.3), but they are quite different from the CPUE derived from the trawl survey. The survey suggest a sensitive higher presence of S. mantis in summer: August CPUE are more than 10 times than those in April. Table 1 shows the comparison between commercial catches and abundance index and the observed ratios in the two seasons. The difference is mainly due to the fishing strategy of the commercial

	SPRING (April)	SUMMER (August)	ratio
Survey CPUE (gr/hour)	110	1330	1 / 12.1
North Tyrrhenian landings (ton)	91	124	1 / 1.4
Livorno market records (Kg)	295	1896	1 / 6.4

Tab. 1 Abundance and catches: their ratio between spring and summer.

fleet, which exert the fishing in the S. mantis area especially after the rough sea when the species is more available to the fishing gear and therefore fishermen more attracted. While the commercial catches reflect the species availability - obviously higher around winter time - the survey catches rates show the mean species abundance, which is growing soon after the spring recruitment.

Summing up this short note, when trawl survey data are analysed, it is always necessary to keep in mind that these results are average abundance estimates and not maximal fishing availability. Fishermen concentrate the effort in the right moment and place where highest gain is likely: this effort changes and moves along the year, then, sometime, the yield just a little has to do with the real population abundance.

B-II28

Note préliminaire sur les Décapodes bathyaux de la côte Turque de la mer Egée

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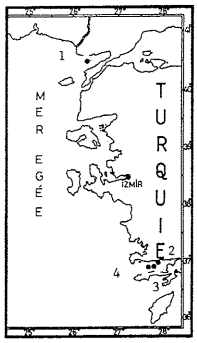
SUMMARY: The presence of 13 Decapoda species are established during benthic investigations carried out in the bathyal zones of the Aegean Sea. 7 of these are reported for the first time from Turkish waters.

A cause de sa position intermédiaire entre la Mer Noire et la Méditerranée, la Mer Egée d'une superficie de 214.000 km^2 contient une faune caractéristique. L'essentiel de ses fonds se situe à une profondeur comprise entre 100 et 500 m, et couvre 88.850 km^2. Au-dessous de 1000 m de profondeur, nous distingons 4 fosses (fosse de Crête, fosse de Chio, fosse d'Anatolie et fosse de Mont Athos) qui forment un "S" du nord au sud.

Les recherches scientifiques menées à partir du bateau de "Piris Reis" en août 1987, nous ont permis de faire quatre prélèvements benthiques profonds en Mer Egée. L'un de ces prélèvements a été fait dans le Golfe de Saros au nord (Stn. 1), les autres (Stn.2,3,4) dans le Golfe de Gökova au sud (Fig.).



Les positions géographiques et les caractéristiques de ces stations sont;

- Station 1: 40° 30'N, 26° 17'E; chalut par 520 m. sur fond vaseux.
- Station 2: 36° 59'N, 27° 50'E; chalut par 290 m. sur fond sableux.
- Station 3: 36° 53'N, 27° 44'E; chalut par 430 m. sur fond vaseux.
- Station 4: 36° 53'N, 27° 39'E; chalut par 600-640 m. sur fond vaseux.

Figure: Stations de prélèvement.

Les Décapodes étudiés proviennent de prélèvements effectués avec un chalut (Beam-Trawl) équipé d'un filet à mailles de 10x10 mm, ce qui nous a permis la capture d'individus de petite taille comme ceux du genre Ebalia.

Cet essai de chalutage nous a permis de répertorier 13 espèces de Décapodes (7 Natantia, 3 Anomura et 3 Brachyura) classées dans le tableau suivant.

Tableau: Distributions des espèces suivant la profondeur.

ESPÈCES	STATIONS			
	1	2	3	4
	520 m	290 m	430 m	600-640 m
Solenocera membranacea (Risso)				+
Parapenaeus longirostiris (Lucas)		+	+	+
Acantephyra purpurea A. Milne Edwards		+		+
Synalpheus cf. gambarelloides (Nardo)				+
Plesionika acantonotus (Smith)				+
Plesionika heterocarpus (Costa)			+	
Plesionika martia (A. Milne Edwards)				+
Calocaris macandreae Bell	+	+		
Munida intermedia A. Milne Edwards et Bouvier	+			
Munida iris rutllanti Zariquiey Alvarez		+		
Dorippe lanata (L.)			+	
Ebalia nux Norman en A. Milne Edwards			+	
Medaeus couchi (Couch)	+			

Comme le montre ce tableau, on a rencontré 4 espèces dans la partie nord et 11 espèces dans la partie sud de la Mer Egée.

Au total, sur ces 13 espèces de Decapodes, sept (A. purpurea, P. acanthonotus, P. martia, C. macandreae, M.intermedia, M. iris rutllanti, M. couchi) sont nouvelles pour les côtes turques de Mer Egée, tandis que les 6 autres avaient déjà été signalées auparavant (KOCATAŞ,1981).

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B-III1

Distribution des peuplements des Polychètes les plus fréquentes du secteur marin devant les embouchures du Danube

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Ces dernières années, au fur et à mesure que le degré d'eutrophisation du milieu marin du nord-ouest de la mer Noire augmentait, le groupe des polychètes devenait dominant dans le macrobenthos,sa densité augmentait à cause du développement en masse de certaines espèces opportunistes (2, 3, 4).

Le travail est fondé sur des recherches effectuées en 1986 et 1987 dans un réseau de stations placées devant les embouchures du Danube à des profondeurs de 5, 10, 20, 30, 40 et 50 m, d'ou l'on a prélevé et analysé 75 échantillons quantitatifs.

Parmi les Polychètes, six espèces ont eu des fréquences plus grandes, au moins à certaines profondeurs ce sont les populations des espèces qui sont analysées dans le présent travail.

Phyllodoce maculata (L.) a été identifiée à toutes les profondeurs, sauf celle de 5 m, la fréquence croit avec la profondeur. La densité de l'espèce a été réduite à toutes les profondeurs, de manière que sa dominance comme densité dans le groupe ne dépasse point 2,6% (tableaux 1 et 2). Le maximum de densité de l'espèce a été d'environ 200 ex/m^2, enregistrée en juillet 1986 er 1987, respectivement à 30 et 40 m de profondeur.

Tableau 1

Fréquence (%) et dominance (%) des espèces du groupe, à diverses profondeurs

Profondeur/	5 m		10 m		20 m		30 m		40 m		50 m	
Espèce	F	D	F	D	F	D	F	D	F	D	F	D
Phyllodoce maculata	0	0,0	16	0,0	21	0,6	32	1,4	45	2,6	70	2,6
Harmothoe reticulata	0	0,1	0	0,0	14	0,2	16	0,4	36	1,4	0	0,0
Neanthes succinea	100	54,1	96	35,1	91	56,5	32	0,7	18	0,7	0	0,0
Nephthys hombergi	0	0,0	0	0,0	21	0,8	72	1,7	72	5,2	70	5,2
Spio filicornis	42	19,0	48	26,3	35	17,2	0	0,0	0	0,0	0	0,0
Polydora ciliata limicola	56	13,2	48	38,4	63	12,5	24	16,1	54	5,0	28	9,3
Melinna palmata	0	0,0	8	0,1	21	6,3	100	79,2	100	84,0	100	72,9

Neanthes succinea Leuck est l'une des espèces dont les peuplements, presque constamment présents sur le substrat sablo-vaseux (fréquence 90%, profondeurs 5, 10 et 20 m), sont aussi dominants, en densité. Ses plus grandes densité ont été observées à 5 m de profondeur, où l'on a également enregistré le maximum 8120 ex/m^2 (septembre 1986). L'espèce apparaît aussi aux profondeurs de 30 et 40 m sur substrat vaseaux, mais la fréquence et l'abondance en sont beaucoup plus faibles (tabl. 1 et 2).

Nephthys hombergi Hucl. et M.-Edw. a été rencontré sur les substrats sableux-vaseaux et vaseux (aux profonfeurs de 20, 30, 40 et 50 m), la fréquence et la densité de celle-ci augmentant avec la profondeur (tableaux 1 et 2). Ses peuplements ont eu de faibles densités qui n'ont pas dépassé 140 ex/m^2 (à 50 m, en juillet 1987).

Spio filicornis O.F.M., espèce psamnophile, a été observée aus profondeurs de 5, 10, 20 m, avec la fréquence et l'abondance maximales à 10 m. La maximum de densité de cette espèce - 8020 ex/m^2 - a été enregistrée en juillet 1987, à 10 m de profondeur.

Polydora ciliata limicola Annenkova a la plus large distribution de toutes les espèces analysées, avec une assez grande fréquence à toutes les profondeurs étudiées. C'est l'une des espèces dont les populations ont intensément proliféré au cours des dernières années, dans les conditions d'augmentation de l'eutrophisation. La densité de l'espèces est maximale à 10 m, où l'on enregistré des valeurs dépassant 18000 ex/m^2 (jouillet 1986).

Tableau 2

Densités moyennes (ex/m^2) des espèces de polychètes à diverses profondeurs

Espèces/ Profondeurs	5 m	10 m	20 m	30 m	40 m	50 m
Phyllodoce maculata	0	2	10	20	29	31
Neanthes succinea	2183	1703	883	10	8	0
Nephthys hombergi	0	0	12	25	58	61
Spio filicornis	769	1275	269	0	0	0
Polydora ciliata	531	1861	195	231	55	109
Melinna palmata	0	2	99	1140	933	854
POLYCHAETA - total	4037	4851	1562	1439	1110	1171

Melinna palmata Grube, bien qu'enregistrée, aussi à 10 m (exemplaires isolés), a été constamment présent aux profondeurs au-dela de 30 m, où d'aillers elle constituant plus de 70% de la densité des polychètes. Espèce de masse dont les peuplements se sont intensément dévevollés ces 10 dernières années, Melinna palmata a eu des densités maximales à 30-40 m de profondeur, où l'on a enregistré des valeurs de près de 5000 ex/m^2 (avril 1987).

Par rapport à la situation existante il y à 25 ans (1),la structure des populations de polychètes apparaît profondément transformée, par la diminution des peuplements de certaines espèces, plus abondantes autrefois (Spio filicornis,Nereis diversicolor, etc.) et la prolifération des populations de quelques espèces opportunistes, favorisées par l'augmentation du taux de substances organiques dans l'eau de mer (Neanthes succinea, Polydora ciliata limicola, Melinna palmata).

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Variations of the trophic structure of the Polychaeta benthic fauna in the Island of Rhodes (Aegean Sea)

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RESUME

Des échantillons benthiques ont été récoltés saisonnièrement en cinq stations situées le long de la côte nord de l'île de Rhodes. Nous démontrons que la structure trophique de la population de Polychètes est surtout conditionnée par l'hydrodynamisme du milieu.

Five stations were selected along the northern coast of Rhodes island (Aegean sea) and were visited on a seasonal basis.On the whole 180 species of Polychaetes were identified. The species were characterized trophically according to Fauchald and Jumars (1979) and were grouped in four feeding types : deposit-feeders(D), carnivores(C), herbivores(H) and filter-feeders(F). In three of the four soft bottom stations the deposit- feeders dominated (Table 1). This was attributed to the intensity of the hydrodynamic conditions of the environment in these stations.

This factor affects the sedimentation rate and indirectly the abundance of the organic particles (detritus), which constitute the main element of the deposit- feeders' diet (Sanz, A. 1986).

In higher energy stations such as R1 (LAT 36-27.5N , LONG 28-17.1E) with hard substrate and R5 (LAT 36-23.2N , LONG 28-1.5E) with coarser sediment, the dominant group was the carnivores whose mobility enables them to be independent from the detritus offer on the bottom.

It is also evident that during the winter-automn period , the density of all feeding types decreases (Fig.1). In fact, during this unstable period the intensity of the hydrodynamic conditions temporarily increases, thus affecting the density of the deposit- feeders as mentioned above.

Moreover, the temperature which in turn controls the planctonic production, reaches during winter period its minimal value which indirectly affects the density of all the benthic polychaetes.

	R1	R2	R3	R4	R5
D	39.56	54.39	44.31	46.83	37.80
C	42.50	28.99	29.59	27.61	39.93
H	6.30	6.77	6.41	23.28	14.37
F	11.64	9.85	19.69	2.29	7.90

Table 1: Average density (indiv./m2) of the various feeding groups in the stations.

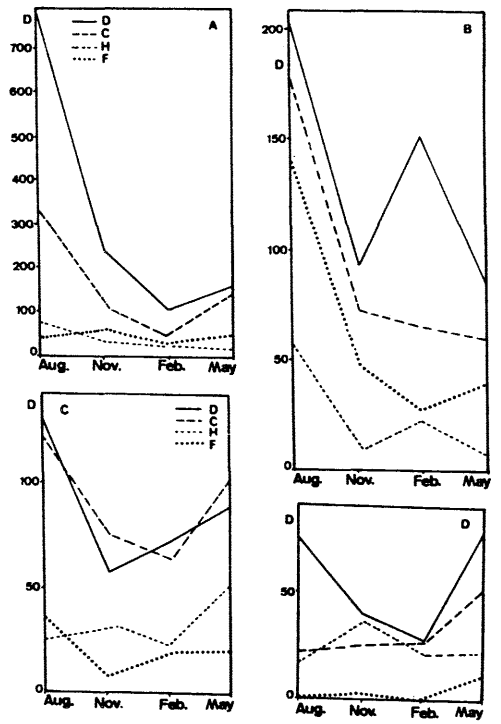

Figure 1: Seasonal variation of the various feeding groups in stations R2 (A), R3 (B), R4(C) and R5(D).

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Les peuplements benthiques du port d'Alger : 3 - Les Polychètes

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MATERIEL ET METHODES : De novembre 1981 à novembre 1982 nous avons étudié la macrofaune d'un fond meuble du port d'Alger. Les résultats concernant les groupes des Mollusques et des Crustacés ont été exposés dans des travaux antérieurs ainsi que la méthodologie (Bakalem et Romano, 1988 a et b). Cette note concernera le groupe des Polychètes.

RESULTATS : 101 espèces de Polychètes ont été recensées ; la densité moyenne est de 1541 ind/m2 avec comme extrêmes : 538 ind/m2 en octobre et 5564 ind/m2. C'est en été et au printemps que le nombre d'espèces est élevé tandis qu'en automne et hiver c'est le contraire. Les Polychètes sont très abondantes dans le milieu au printemps (mai, 3710 ind/m2) et en été (août : 5564 ind/m2) et bien moins abondantes en automne et hiver. Les principales espèces sont : Tharyx marioni, Notomastus latericeus, Nereis caudata, Andouinia tentaculata, Heteromastus filiformis, Lumbrineris latreilli, Polydora antennata, Heterocirrus alatus et Eunice vittata. Les cinq premières et Lumbrineris ont une fréquence de 100 %. La dominance mensuelle de ces espèces est généralement supérieure à 80 %. Tharyx marioni est l'espèce dominante du groupe des Polychètes, ses densités sont les plus élevées, particulièrement en mai et août. Tharyx est peu abondant en octobre. Les fluctuations de Tharyx sont à l'origine de celles du groupe des Polychètes.

Notomastus latericeus : 2ème principale espèce, entre en compétition avec Tharyx marioni pour la colonisation du milieu ; Notomastus est abondant au printemps et en été.

Nereis caudata : son cycle évolutif annuel est identique à celui de Tharyx mais ses densités sont faibles sauf en automne et hiver.

Andouinia tentaculata : les périodes printanière, estivale et automnale lui sont favorables d'où des densités élevées, ses dominances sont fortes en automne et hiver.

Heteromastus filiformis a de faibles effectifs toute l'année excepté en août ; il en est de même pour Lumbrineris latreilli. L'hiver semble être une saison défavorable à Lumbrineris.

Polydora antennata et Eunice vittata sont peu abondantes dans le milieu sauf au printemps où leurs densités et dominances sont relativement élevées. Par contre pour Heterocirrus alatus l'automne et l'hiver sont les saisons favorables.

Ces principales espèces constituent 3 stocks écologiques :

- le stock des indicatrices de pollution (Ip) : Andouinia tentaculata et Nereis caudata
- le stock des indicatrices de matières organiques (I.m.o.) ou de perturbation : Heteromastus filiformis, Lumbrineris latreilli, Polydora antennata, Notomastus latericeus et Heterocirrus alatus - le stock des espèces à large répartition écologique (LRE) : Eunice vittata et Tharyx marioni.

Ces 3 stocks ont une dominance totale généralement supérieure à 70 %. Le stock des LRE est dominant toute l'année sauf aux mois de décembre, avril, juillet et octobre où c'est celui des I.m.o. et en octobre celui des Ip. Si les Ip et les I.m.o. sont groupées en un même stock : celui des indicatrices de milieux perturbés, nous constatons mis à part janvier, mai et aoûtque cestock écologique est le principal avec une dominance supérieure à 50 %.

DISCUSSION - CONCLUSION : Le suivi pendant une année du groupe des Polychètes d'un peuplement macrobenthique d'une station du port d'Alger fait ressortir les points suivants :

- la grande richesse spécifique (101 espèces) de ce milieu portuaire en Polychètes, notamment au printemps et en été ;
- les fortes densités des Polychètes, plus particulièrement aux périodes printanière et estivale (3710 ind/m2 en mai et 5564 ind/m2 en août) ;
- la période hivernale est défavorable tant sur le plan qualitatif que quantitatif aux Polychètes, c'est lors de cette saison que le nombre d'espèces et la densité les plus faibles sont notés ;
- les principales espèces dominantes appartiennent aux familles des Cirratulidés et des Capitellidés : Tharyx marioni, Notomastus latericeus, Andouinia tentaculata, Heteromastus filiformis. A ces espèces viennent s'ajouter Nereis caudata et Lumbrineris latreilli. Tharyx marioni domine largement le groupe des Polychètes ;
- les fluctuations élevées dans le temps des espèces "leaders" : Tharyx marioni, Notomastus latericeus se présentent en dents de scie, ce qui est caractéristique des milieux perturbés ;
- la compétition très importante entre les principales espèces pour la colonisation du milieu ; cela se traduit par des successions très rapprochées dans le temps des espèces ;
- les 3 principaux groupes écologiques sont ceux des indicatrices de pollution, des indicatrices de matières organiques et des espèces à large répartition écologique. Le stock des LRE est le stock dominant la plupart du temps. Prises ensemble, les indicatrices de pollution et les indicatrices de matières organiques constituent un stock plus important que celui des LRE, et dominant presque tout au long de l'année. Cela montre bien que le peuplement des Polychètes de la station étudiée est un peuplement de milieu perturbé, riche en matières organiques.

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B-III4

The distribution of Polychaeta and Crustacea fauna found in Posidonia oceanica Meadows of Aegean Coast of Turkey

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RESUME: Cette étude présente la faune de Polychètes et Crustacés trouvée dans les herbiers de Posidonie de la côte Egéene de Turquie. Les résultats de ces recherches nous ont permis de déterminer 63 espèces de Polychètes et 35 de Crustacés.

SUMMARY: In this study the Polychaeta and Crustacea fauna found in the Posidonia oceanica meadows of the Aegean coast of Turkey have been investigated. As a result of this investigation 63 Polychaetes and 35 Crustacean species have been determined.

INTRODUCTION: P.oceanica shows wide distribution in the infralittoral zone of the Aegean coasts of Turkey. The distribution of this species in this region has been studied by GÜNER (1975). Flowering of P.oceanica in the İzmir Bay and its' cartography around Urla has been shown by PERGENT and PERGENT (1983,1985). The Polychaeta fauna of P.oceanica meadows of İzmir Bay has been studied by ERGEN (1986).

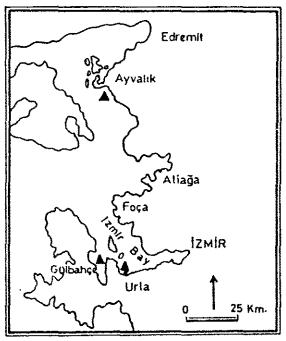

Fig.1: The sampling stations

In this research work the Polychaeta and Crustacea fauna found in P.oceanica meadows of the Aegean coasts have been investigated and a total of 98 species of which 63 are Polychaetes and 35 are Crustaceans have been determined.

METHODS: In order to identify the Polychaeta and Crustacea species found P.oceanica meadows three samplings have been made from three different stations (Fig.1). Sampling area used has been 400 cm^2. The diversity index has been calculated by using Margalef's method and relative dominancy of the species have been determined.

RESULTS AND DISCUSSION: From the three stations chosen which are Urla, Gülbahçe and Ayvalık along the Aegean coasts of Turkey, 1691 individuals belonging to the 63 Polychaeta species and 1186 individuals belonging to the 35 Crustacean species have been collected. When the relative dominancy of 98 species from three stations are compared, 9,5% of Erichthonius brasiliensis, 7,0% of Amphithoe ramondi from Crustacea; 4,2% of Nereis zonata and 3,4% of Platynereis dumerillii values have been obtained from Polychaeta are most abundant.

When the stations are compared the number of species, number of individuals and diversity index (Table I), it can be observerved that the station of Urla is the

Table I: The total number of species and individuals at the stations and diversity indices.

Stations	Number of sampling	Number of species	Number of individuals	Diversity index
Urla	3	82	1713	10.87
Gülbahçe	3	62	502	9.81
Ayvalık	3	60	662	9.08

richest in number of species, individuals and has a higher diversity index. The reason of the high values at the station of Urla is probably because it is situated in the region affected by the polluted waters of the Izmir Bay and the presence of species which show adaptation both to clean and slightly polluted waters.

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B-III5

Comparison between effects of marine diesel fuel and dispersant gold crew on Palaemon elegans and Mugil capito

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RESUME: Les tests de toxicité comparatifs ont amené à observer les effets du MDF (fuel diesel marin) et du dispersant Gold crew sur le Mugil capito et le Palaemon elegans. Les niveaux d'accumulation ont été déterminés à la fois quantitativement et qualitativement par le spectrofluorométré (Model 430 Turner) et la chromatographie en phase gazeuse (Model 428 Packard).

MATERIALS AND METHODS: The organisms P.elegans and M.capito have been chosen as test animals and collected from the Urla shore (İzmir, TURKEY). The laboratory experiments have been conducted in three sets of dispersant, dispersant + MDF using the semi-static system. The fish larvae were 4 cm in length and weighed 0.62 g on the average for 180 animals. The average length for P.elegans was 5.1 cm and had an average weight of 0.82 g for 180 test animals used in 1986 and 1987. The same tests were repeated three times with a total number of 30 fish larvae for each concentration in 1986 and three times with a total of 30 fish larvae for each concentration in 1987 late spring. A total number of 30 grass shrimp were used for each concentration amounting to 270 test animals in 1986 and 1987. The test was carried with three concentrations of MDF, MDF + dispersant and dispersant simultaneously for the definitive test after the effective range was found and repeated three times each year with a total 270 animals for determination of LC_{50} values. The temperature was kept at 18 $\pm$ 1°C, salinity of water 37.2 ‰ and pH 8. The tests were conducted in 4 liter solutions. Later the samples exposed to a concentration of 0.005 % which has been determined as the 72-hour LC_{50} value for MDF and MDF + Gold Crew were preserved. Only those exposed to 0.005% marine diesel fuel were extracted with methanol, benzol (1 : 1) with soxlets. 10 grams of P.elegans and M.capito larvae were preserved. The LC_{50} values for the toxicants were determined using the "Log concentration versus % of survival" method for both species.Later the samples exposed to a concentarion of 0.005 % were presved and accumulation was measured with the spectrofluorometer (TURNER,MODEL430) and peakes observed using the gas chomatography (PACKARD,MODEL428).

RESULTS: The 72-hour LC_{50} values for MDF and MDF+Gold Crew were determined as 0.005 % for M.capito and 0.0064 % and 0.007 % for P.elegans respectively. The confidence limits for M.capito were between (0.0047-0.0054 %) and (0.0066-0.0074 %) for P.elegans for 1987,1988. Thus test animals preserved for 0.005 % MDF which weighed 10 grams were measured for Polyaromatic hydrocarbons (PAH). It was observed that there was 0.38 ug/l in 10 g of P.elegans samples and 0.19 ug/l in 10 grams of M.capito. In P.elegans 3.9 % of C_{16}-C_{22}, 60.9 % of C_{24}-C_{30}, 11 % of C_{32}-C_{34}, and 24.2 % of the others have been determined. For M.capito 9.9 % of C_{16}-C_{22}, 55 % of C_{24}-C_{30}, and 34.8 % of others.

DISCUSSION : In both species it can be seen that accumulation is less when the number of C atoms are less (C_{16}-C_{22}) and most where the range is between C_{24}-C_{30}. P.elegans has a lipophilic cuticula for diffusion and thus a different way of uptake than M.capito which takes in the solution by its gills. In experiments conducted with 8 cm M.capito larvae it was seen that the 4 cm larvae and 8 cm larvae had the same 48 hour LC_{50} (0.0056%) which shows that M.capito are not dependable as monitor animals (1). The 4 cm larvae were not older than a few months whereas the 8 cm (7-14 cm) ones were much older. Salihoğlu (2) has also stated that with Hg no correlation was found between length, age and accumulation. The level of PAH in P.elegans was found to be higher as can be expected from the high amount of lipids it contains and it's being a mobile benthic form. Fish also accumulates polyaromatic hydro carbons most during spring when it is richer in lipids but doesn't take as much PAH through diffusion like the grass shrimp.

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Notes on the Biocenoses of a polluted coastal area in Southern Sicily : the Gulf of Gela

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REMARQUES SUR LES COMMUNAUTES BENTHIQUES DU GOLFE DE GELA (SICILE)

L'ensemble des conditions hydrologiques dominantes le long de la côte méridionale de la Sicile détermine une eutrophisation généralisée des eaux littorales qui contribue à différencier le milieu de ce côté de l'île par rapport aux autres. L'addition des grandes sources de pollution domestique et industrielle, comme c'est le cas dans le golfe de Gela, altère la structure et la composition des communautés benthiques jusqu'à un degré qui reste en grande partie inconnu. L'analyse bionomique accomplie sur les substrats meubles et durs met en évidence une eutrophisation générale du golfe, qui est plus intense à proximité du centre ancien de la ville, du fait de l'hydrodynamisme réduit et de nombreux égouts non traités.

L'analyse des substrats artificiels du port industriel qui distant de 2,5 km de la côte, en mer ouverte, révèle la présence de communautés du fouling portuaire avec une dominance de Mytilus galloprovincialis et de Perna picta. L'augmentation des températures de l'eau par une centrale thermique, en éliminant la plus grande partie des espèces, favorise le peuplement de Mactra stultorum, qui atteint une densité de 4500 individus/400 dm3 de sédiment. Les Polychètes Nereis falsa et Syllis gracillis sont parmi les espèces les plus fréquentes, et en rapport avec le degré de pollution organique.

C-I1

Application of synergistic adsorption for the pulse voltammetric determination of Uranium in natural seawater

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The synergism in the solvent extraction means the manyfold enhancement of the metal ion extraction from aqueous solutions to the organic phase by application of two organic ligands mixture (1).

Mercury drop surface can be a good replacement for the organic phase due to its hydrophobic character. By the combination of the appropriate pair of organic ligands (organic acid as an chelate and a neutral alkil-phosphorous ester as an synergist), metal ions can form mixed complexes which are more hydrophobic than each of them separately. Mixed complex can be formed at the mercury drop electrode surface with very strong adsorption. In this way the concentration of metal ions is many times enhanced at the electrode surface, so it is possible to detect and determine very low metal-ion bulk concentration level corresponding to the concentration in natural aquatic systems, i.e., in seawater and in fresh waters.

As an example of the application of mentioned synergistic adsorption we choose uranyl-ion. In this way uranyl concentration in seawater samples from the Adriatic Sea was determined.

As a system of organic ligands which gave such a synergistc effect we used salicylic acid and tri-n-butilphosphate (TBP). Salicylic acid forms with uranyl-ion complex in the solution (2). TBP, adsorbed strongly at the electrode surface, supstitutes the remaining water molecule in the coordination sphere of the uranyl-complex, forming mixed $UO_2(HSal)_2TBP$ complex which is strongly adsorbed at the electrode surface, too.

The measurements were performed by normal pulse voltammetry, which showed to be sensitive enough for the uranyl concentration level present in natural seawater sample: pH of the solution was adjusted at 3.6 and the concentration of salicylic acid was 1.4×10^{-3} and TBP 2×10^{-4} mol dm^{-3}. By measurements of the reactant adsorption maximum height on the pulse voltammograms detection limit obtained was about 10^{-9} mol dm^{-3} UO_2^{2+}.

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C-I2

Determination of ionic alkyllead compounds in environmental water

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Organolead compounds are introduced into the environment by their usage as antiknock additive in gasoline. Under natural conditions tetraalkyllead species are subject to degradation to inorganic lead (1).Intermediate compounds in this process are ionic alkyllead compounds (tri- and dialkyllead) which are relatively soluble in water and considerably more stable than the initial compounds. It is not surprising then, that organolead compounds are present in natural waters almost exlusively in the form of ionic alkyllead compounds (1).

Anodic stripping voltammetry (ASV) was found to be a convenient method for detection of ionic alkyllead compounds (2). It was successfuly applied to studies of tri- and dialkyllead distribution in an estuary polluted from tetraalkyllead manufacture (3). Although it can be directly applied to very polluted waters (at ug/l organolead levels), it is not sensitive enough to measure the concentration of these compounds in natural waters.

By use of a specific enrichment step we improved the detection limit of the ASV method. A complexometric extraction with sodium diethyldithiocarbamate (NaDDC) was applied, a technique commonly used in combination with GC AAS detection (4). In our method the extracted ionic alkyllead species are back extracted into the acid aqueous solution and tri- and dialkyllead species are simultaneously determined by ASV.Inorganic lead which interferes with organic lead determination by ASV, and which is partly extracted with the procedure applied, is eliminated from the solution in the electrochemical cell by coprecipitation with barium sulphate. It was found that during extraction a small quantity of complexing agent is back extracted into aqueous solution . Under the condition used (pH<2) DDC is very unstable and undergoes rapid decomposition. However, when natural water samples with high organic matter contents are extracted, stabilization of DDC in final acid solution is noticed. It can affect ASV measurements, because DDC is electroactive, with its oxidation peak potential close to the lead reoxidation potential. It was the reason why we introduced an cleanup step including an additional extraction of the final aqueous solution with a mixture of hexane and chloroform. During this extraction DDC is transfered to the organic phase, whereas ionic alkylleads remain in the water solution. Analytical procedure is shown at fig.1.

Repeated experiments with standard solutions proved that recoveries for ionic alkyllead compounds are about 90 %, with the reproducibility of the entire procedure 10-20 %, depending on the concentration level. The detection limit of the method is estimated at 0.2 ng Pb/l for total ionic alkyllead compounds for 2.5 l of sample volume. The practical applicability of the method developed is demonstrated on a number of natural waters and atmospheric precipitate. In lake water (near urban area) 0.3-2 ng Pb/l of trialkyllead was found, whereas in seawater (near harbour) 0.8-10 ng Pb/l could be detected.The inpact of a gasoline station and boat traffic on ionic alkyllead levels in surrounding seawater was studied by the proposed method.

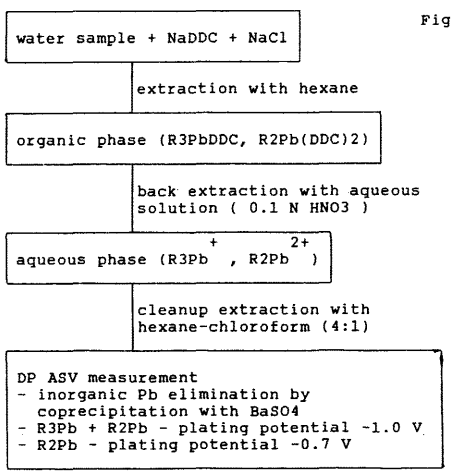

Fig. 1 Analytical procedure

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C

AAS-Determination of Mercury in a marine biological reference material after wet ashing by means of microwaves. Preliminary results

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The application of microwaves to the mineralization of marine biological materials for the purpose of the determination of mercury has been investigated.

The digester "Microdigest - 300" produced by PROLABO was tested. This apparatus consists of a source of microwaves (magnetron), a waveguide, a borosilicate glass round-bottomed flask which contains the sample (capacity 30 ml) and a water circulation system which absorbs the excess of radiations. The long neck of the flask facilitates the reflux of water. The flask is covered with a teflon-lined steel cover. Nitric oxide vapours go out through a small hole in the cover.

The method was tested by using the reference material MA-M-2/TM (lyophilised mussel tissue) issued by the IAEA. The mercury content of this material was certified on the basis of the results of various methods of analysis obtained in a laboratory intercomparison (IAEA, 1985).

65% nitric acid (analytical grade, mercury-free) was used as oxidizing agent. 30% hydrogen peroxide (analytical grade) was occasionally added. Mineralization tests were done under varying operating conditions (amounts of reagents, microwave energy and duration of mineralization). About 800 mg of reference material were mineralized each time. In none of three separate attempts could the material be completely dissolved and the sample solutions were filtered before the determination of their mercury contents by cold-vapour atomic absorption spectroscopy (HATCH & OTT, 1968).

Results given by this method were compared to those of a classical method of mineralization (wet-ashing by HNO3 under normal pressure and reflux) and to the certified value for the mercury concentration in this material (table 1). The confidence interval of the results given by the classical method overlaps the confidence interval of the certified value while results of the microwave mineralization are significantly lower than this value (they are about 20% too low).

The mineralization by microwaves was obviously less complete than the mineralization by the classical method. Incomplete mineralization rather than loss by volatilization is , therefore, the most probable explanation for these low results. An increase of microwave energy was not satisfactory since it produced a strong evaporation of the acid solution. A modification of the cover of the apparatus in order to fit a sufficiently long Vigreux column on the top of the mineralization flask is suggested . Such a system would make possible to increase the microwave energy and to obtain a more complete mineralization.

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Table 1
Mineralization of MA-M-2/TM
by microwaves and by the classical method
(Comparison of results)

Consensus value (a) (µg.g-1)	Attempt N°	Found value (µg.g-1) Mineralization by microwawes (b)	Classical method (c)
0,95 µg.g-1 (0.85 - 1.06)	1	0.78 ± 0,06	0,86 ± 0,07
	2	0.78 ± 0,06	
	3	0,73 ± 0,06	

(a) Recommended by IAEA, 1985
(b) Confidence intervals correspond to a 0.95 probability level and were computed from 4 different measurements of the same solution
(c) Mean value of 5 different mineralizations ± confidence interval corresponding to a 0.95 probability level.

Speciation of Mercury by cold vapor atomic absorption spectrometry : effect of several reduction mediums on inorganic and organic Mercury

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The toxic and accumulative character of methyl, ethyl and phenyl-Hg and its high proportion against inorganic-Hg in many environmental samples makes its determination to be more useful than total-Hg determination. For this purpose it is important to get analytical and enough reliable procedures for the speciation of Hg as inorganic as organic forms. Classical procedure for the determination of organomercurials is carried out by GLC. By other hand, recently have been developed procedures for their speciation by CVAAS on the basis of the diference between the reducing effect of Sn(II) and $NaBH_4$ in several mediums. However, their reducing capabilities depend on as chemical as instrumental variables, therefore their applications to samples have to carry out with restrictive conditions. Furthermore, the reduction of inorganic and organic-Hg by the action of a reducing system depends on the kinetic of the process, therefore the reliability of the results depends also on it.

In this work the reducing power of these agents is show through the reduction percentage of each organic specie respect to the signal given by inorganic-Hg. With this, we want to get an systematic and overall information about the behaviour of these agents in order to optimize the determination of the several forms of Hg.

We have used the following solutions: 0.4 µgHg/ml of $HgCl_2$, CH_3HgCl, C_2H_5HgCl, C_6H_5HgCl, all of them prepared daily from a 100 µgHg/ml stock solutions; $SnCl_2.2H_2O$ 5%+HCl 10%; $SnCl_2.2H_2O$ 5%+ $Cd(NO_3)_2.4H_2O$ 1%+HCl 10%; cysteine 1%; NaOH 45%; $NaBH_4$ 3%+NaOH 1% and HNO_3 20%+$K_2Cr_2O_7$ 1%.

The determinations of Hg were carried out with a Perkin-Elmer 5000 AAS equipped with a recorder 561, Pye Unicam Cold Vapor Kit with an absorbance cell (150 mm pathway) and a peristaltic pump for the reductions with Sn(II) in closed system, and a Perkin-Elmer Mercury Hydride System MHS-10 for the reductions with $NaBH_4$ in open system.

In table 1 are shown the percentages of reduction got when added 10 ml of reducing agent (Sn(II) or Sn(II)+Cd(II)) to 20.5 ml of sample (0.2 µg Hg) + 10 ml HCl (1:10) or 10 ml de NaOH (45%). The three organic forms show a low response in acid medium with and without Cd(II), not easily attributable to impurities of inorganic-Hg; in alkaline medium the reduction is total for phenyl-Hg while for methyl and ethyl-Hg, although high, does not reach to be quantitative, however it is higher than reported by other authors in these mediums (1).

Table 2 indicates the percentages for the former mixtures in presence of 1 ml cysteine. A general decrease of the reducing power is observed, getting a whole reduction only for phenyl-Hg with an alkaline medium in presence of Cd(II). In alkaline medium and without Cd(II), the reduction of organomercurials is remarkable and higher than reported by other authors (2,3), who pointed out that only the inorganic-Hg gives signal.

The presence of cysteine delays the reduction, in such a way that the signal increases against time specially for ethyl-Hg. That means, that when the time of measure increases also increases the percentage of reduction.

From eight mediums tested, only Sn(II) in acid or alkaline medium, without Cd(II)+cysteine, offers the most suitable values to carry out the speciation, although we have not found any medium which could offer a null reduction for the organomercurials. Addition of Cd(II) in alkaline medium improves slightly the recovery of methyl-Hg (4). Furthermore, these mediums without cysteine offer the highest sensibility.

Table 1	Sn(II)		Sn(II)+Cd(II)	
	HCl	NaOH	HCl	NaOH
Methyl-Hg	2.9	92.0	5.9	96.6
Ethyl-Hg	2.7	98.6	4.1	81.8
Phenyl-Hg	2.5	101	3.9	101
Hg(II)sens. (μg^{-1})	0.78	1.08	0.84	1.05

Table 2	Sn(II)		Sn(II)+Cd(II)	
	HCl	NaOH	HCl	NaOH
Methyl-Hg	7.4	12.5	3.4	83.5
Ethyl-Hg	0.7	59.7	3.4	79.5
Phenyl-Hg	2.3	32.0	1.2	100
Hg(II)sens. (μg^{-1})	0.48	1.05	0.43	1.04

Table 3 show the percentages of reduction got when $NaBH_4$ solution was added to 5.5 ml of sample (0.2 µg Hg) + 5 ml of any solution to give suitable medium. The reduction is only quantitative in presence of $K_2Cr_2O_7$ in contrast with the values of 84% (methyl and ethyl-Hg) and 50% (phenyl-Hg) given by Oda and Ingle (5). If we consider methyl-Hg the main compound in samples could be carried out the speciation between this and inorganic-Hg by means of reductions with $NaBH_4$ in HNO_3 medium and later measure of methyl-Hg by addition of $K_2Cr_2O_7$.

Table 3	HCl 1.7%	HNO_3 10%	HNO_3 10%+$K_2Cr_2O_7$ 0.5%
Methyl-Hg	16.3	1.9	99.7
Ethyl-Hg	13.4	8.1	99.5
Phenyl-Hg	34.5	24.7	99.9
Hg(II)sens. (μg^{-1})	1.48	1.48	1.49

The authors acknowledge the support given by the CAICYT (Ministerio de Educación y Ciencia, SPAIN).

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C-I5

Mercury levels in the atmosphere of the Tyrrhenian Area in the Mediterranean Basin

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INTRODUCTION

This paper reports the results obtained during three years of study (85-88) on the distribution of gaseous Hg in the atmosphere of the Tyrrhenian area of the Mediterranean Basin (in the open sea, on islands and in some peninsular zones characterized by the presence of the metal sources of natural and anthropogenic origin). The results were integrated with those available in the literature.

The aim of this research is to assess the influence of the atmospheric Hg flux to the Mediterranean waters. In this preliminary paper we report the results on the present Hg distribution in the atmosphere of the examined area.

EXPERIMENTAL

Separation of gaseous from the aerosol was achieved by pre-treated Sartorius membrane filters. Air was sucked for 2 hours at a constant flow rate of 1 l/min by means of a membrane pump, and gaseous mercury was collected on gold absorbers. The determination was performed by Atomic Fluorescence Spectroscopy (detection limit 0.01 ng) as reported elsewhere (1).

RESULTS

Figure 1 shows the study area, the sampling stations and the measured levels of atmospheric Hg. The lowest concentrations were observed above the open sea (2 ng/m^3). This fact clearly indicates, as also reported by Slemr et al. (2), that the sources of atmospheric Hg are mainly located on the ground.

Slightly higher Hg concentration values (4 ng/m^3) were measured in the atmosphere of rural areas, far from possible anthropogenic and anomalous natural sources (cinnabar deposits, hot steam jets, volcanic activity, etc.).

As far as anomalous natural sources are concerned, the highest levels were found in the atmosphere over the metalliferous region of Mt. Amiata, rich in cinnabar deposits, in proximity to the steam jets used for the production of electric power. The average concentration value of gaseous Hg in this region is 14 ng/m^3; very high values (200 ng/m^3) were also found above deposits of roasted cinnabar deriving from mining activity. These high values, which are encountered in the presence of high soil temperatures, are due to the natural degassing of the deposited material.

A particular investigation was carried out in the Aeolian Islands, where volcanic activity is present. The Hg concentration values were not particularly high (10-15 ng/m^3); only near the solfatara of the island of Vulcano were somewhat higher values found (25 ng/m^3), similar to those observed near to the solfatara of Pozzuoli (Napoli).

The Hg levels measured in the vicinity of Europe's largest active volcano (Mt. Etna, Sicily, at 500 m from the main crater) proved to be very low (3-10 ng/m^3), in agreement with Barghigiani et al. (3).

Higher values were found by Breder and Flucht (4) on Mt. Vesuvio (Napoli) only close to the fumaroles present in the crater (94 ng/m^3).

The measurements taken in the above areas demonstrate that volcanic activity does not always represent an important source of atmospheric Hg.

As regards the contribution of anthropogenic activity to the presence of Hg in the atmosphere, particular attention was dedicated to a chlor-alkali plant and to some large urban areas.

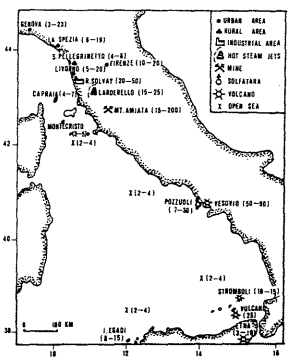

Fig. 1 - Atmospheric mercury levels (ng/m^3) of the Tyrrhenian area in the Mediterranean Basin.

The concentration of Hg around the chlor-alkali complex of Rosignano Solvay (Livorno) was on the order of 20 ng/m^3 in a radius of 500-700 m from the plant itself. High values were measured by Breder and Flucht (4) 150 m above the chimney (80 ng/m^3).

The measurements performed in various urbans areas reveal an increase in the Hg concentration with respect to the values observed in rural areas. In general the concentration value ranges between 5-15 ng/m^3, with lower values for the areas along the coast.

From this first investigation it can be concluded that although considerable geologic anomalies are present in the Tyrrhenian area of the Mediterranean Basin, an appreciable increase of the Hg concentration in the atmosphere is generally not noted.

Natural and anthropogenic sources of Hg seems to have an influence mainly on local scale. The mercury levels over the Mediterranean open sea, and consequently the air-sea exchanges, are probably slightly affected by the presence of industrial and human activity and of a large volcanic area.

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C-I6

Heavy metal concentrations in recent inshore sediments from the Mersin Bay, Turkey, NE-Mediterranean

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A total of 13 surface sediment samples were taken on board the R/V "Lamas" during a cruise in 1985 by using a grab sampler inshore the Mersin Bay (Fig. 1).

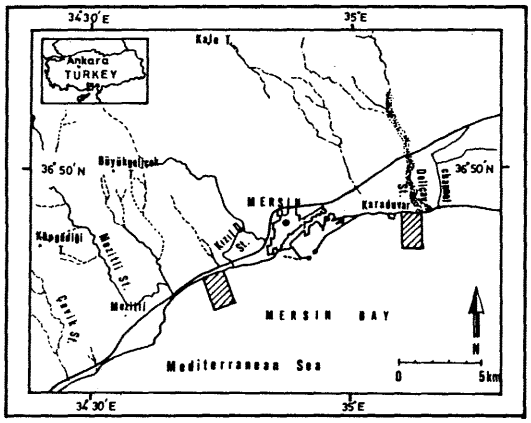

Figure 1: Study area, Mersin Bay, TURKEY.

Samples were than subjected to analysis for grain size, heavy metal, organic carbon and total carbonate contents. Sediments were usually sandy mud and appeared to be rather oxic based on their visible colors, yellow to brown.

Chromic acid-oxidizable organic carbon contents ranged from 0.55 to 0.71 % (Table 1) that were comparable with amounts normally found in marine offshore sediments.

Carbonates (36-52% $CaCO_3$) were made up almost entirely of organism remains, such as of shell fragments. Compared to siliceous and calcareous sedimentary rocks from geologic record (e.g. shales and limestones) that are not influenced by man made activities, the contents of iron, manganese, chromium, copper and lead in tis study can be attributed largely to the natural fluxes from geochemical cycle of these metals (Table 1). Zinc (at only 3 of 13 stations) and cobalt contents were somehow high suggesting their sources widely to be either diagenesis and/or compositionally variations in sedimentary materials rather than a man-made input. Although the latter seems to be not impossible but the data obtained here does not account for such a point. Nickel was presumably derived from a particular rock unit "ophiolite" which is enriched in nickel and occuring commonly in and around the study area.

It has also been shown that Ni, Co and Cu were significantly associated with the Mn and Fe phases rather than with organic matter, carbonates and clays

Table I: Heavy metal, clay, carbonate and organic carbon contents in the studied surface sediments inshore the Mersin Bay. For comparison, metal levels in average shales and limestones are also given.

Sample Number	Clay %	C_{org} %	$CaCO_3$ %	Fe %	Mn ppm	Ni ppm	Zn ppm	Cr ppm	Co ppm	Cu ppm	Pb ppm
M10	16	0.58	36	4.23	550	568	149	57	40	47	14
M29	21	0.71	48	2.61	403	305	42	32	32	21	13
M30	18	†	†	2.21	414	378	39	35	34	20	16
M31	16	†	†	3.98	499	452	87	43	30	26	17
M40	22	0.59	52	2.12	264	249	52	28	19	15	11
M41	21	†	†	2.06	427	257	69	27	21	16	13
M42	25	†	†	1.87	388	367	44	29	30	22	11
M43	21	0.70	49	1.77	380	306	33	26	31	23	11
M44	16	†	†	1.62	301	224	178	22	17	14	10
M45	31	†	†	1.69	236	223	65	26	15	16	10
M54	18	0.55	51	2.55	380	462	134	27	30	22	14
M55	18	†	†	2.80	411	460	25	37	36	†	14
M56	24	†	†	2.74	348	316	48	40	30	25	†
Shales*	†	†	†	4.72	850	68	95	90	19	45	20
Limestones*†		†	†	0.38	1100	20	20	11	0.1	4	9

† indicates not analyzed samples.

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C

Heavy metal distribution in the different sediment fractions in the Estuaries of Axios River in Northern Greece

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Introduction

A five-step sequential extraction technique was used to determine the chemical association of heavy metals,(Pb, Cd, Cu, Fe, Mn, Zn, Cr)with major sedimentary phases (exchangeable cations, easily reducible compounds, organic sulfidic phases, carbonates and residual components) in samples from the estuaries of Axios River in Northern Greece.(1,2). For the determination of the heavy metals which were associated(chelated or adsorbed) with humic and fulvic acids the sediments were treated with 0,1 N NaOH for 10 hours. An easy and fast extraction method using 0,5 N HCl has also been used for the evaluation of the pollution level of the examined area. This extraction removes mainly the "anthropogenic " trace element fraction from the sediment.The concentration of the metals in each phase was determined by AAS.

Results and Discussion

Analytical data concerning the metal distribution in the different fractions for the 3 seasonal samplings during the period of March 1987-October 1987 are given in table 1. The mean values are given by the ratio of the extracted amount to the amount of metals in percentages. In most cases, the sum of the sequential extractions of trace elements was satisfactorily close (10%) to the "total" metal concentrations.
The main conclusions which can be drawn from the chemical fractionation of sediments are the following:
The cation exchangeable fraction which represents the elements adsorbed on the sediments, was comparatively limited except for that of Cd. Hydrous Mn and Fe oxides in sediments are generally strong scavenging agents for heavy metal ions. The H_2O_2 treatment should remove mainly sulfides and organic matter and have only a minor effect on the silicate lattice. The residual solid contain mainly primary and secondary minerals which hold trace metals within their crystal structure.
The various fractions very generally from higher to lower metal concentrations in the following order:
Residual fraction organic fraction easily reducible fraction carbonates fraction cation exchangeable fraction.
The anthropogenic heavy metals in sediments follow the order: Fe Mn Pb Zn Cu Cr Cd.
From the obtained data it can be suggested that the surplus of metal contaminants introduced into the aquatic system from anthropogenic sources usually exists in relatively unstable chemical forms.(3)
The higher proportions of the examined elements are found to remain in the residual fraction. Most of the non-residual portion of them is bound to the ferromanganese oxides and to the organic matter.

Table 1 Heavy metal distribution in the different sediment fractions in St.1 (μg/g)(estuaries)

Fraction	Zn 2	Zn 3	Zn 4	Cr 2	Cr 3	Cr 4	Cu 2	Cu 3	Cu 4	Cd 2	Cd 3	Cd 4
Cation exchangeable	1,50	1,40	2,60	0,07	0,30	0,16	0,22	0,97	0,44	0,14	0,19	0,08
Carbonates	14,4	17,20	17,4	0,70	3,31	0,98	0,27	3,73	1,95	1,5	2,47	2,72
Fe-Mn Hydrous oxides	34,7	16,90	20,6	17,65	4,97	2,20	1,58	0,24	2,0	3,67	0,25	0,11
Organic-sulfides	38,1	44,7	46,1	55,3	42,5	15,1	23,16	24,53	14,74	2,0	0,21	0,10
Residual	45,5	52,86	63,40	61,2	14,8	16,5	21,26	17,07	11,37	2,33	4,04	4,48
Total	147,7	146,8	163,5	150,4	64,3	37,3	50,25	53,6	35,81	8,4	7,1	6,7
Anthropogenic	60,5	49,7	62,75	32,4	7,93	10,3	25,26	17,67	15,0	7,71	4,0	5,0
Humic-fulvic acids	10,26	7,86	16,4	1,03	1,3	6,62	1,79	6,37	7,61	0,34	0,32	0,49

Fraction	Pb 2	Pb 3	Pb 4	Mn 2	Mn 3	Mn 4	Fe(mg/g) 2	Fe(mg/g) 3	Fe(mg/g) 4
Cation exchangeable	0,34	0,61	0,76	9,76	26,35	25,5	4,0	3,3	8,0
Carbonates	19	37	33	68,55	175,3	181,8	38,13	400	389,4
Fe-Mn Hydrous oxides	40	19,05	25	149,4	133,4	123,0	383,7	53,22	915,4
Organic-sulfides	39	49,0	32	95,32	154,6	143,5	758,5	756,2	1,3*
Residual	26	24,76	39	117,1	185,2	177,5	537,4	796,9	1,5*
Total	165,0	145,1	160,1	500,25	708,3	610,5	1,92*	2,8*	5,1*
Anthropogenic	95,0	71,43	71,43	206,7	295,0	356,0	575,7	851,9	1,5*
Humic-fulvic acids	4,69	3,35	5,82	0,22	5,21	5,04	42,8	119,9	47,5

2 Spring 1987, 3 Summer 1987, 4 Automn 1987

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Trace metals in the sediments of the Acheloos Estuary I. General Trends

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Acheloos is one of the major rivers of Greece with mean average flow estimated to 167 m^3d^{-1} (Scoullos 1982). Major changes in it affect the overall "structure" of its estuary and consequently the distributions of salinity, nutrients and trace metals in the entire NW section of the Patraikos Gulf and part of the Ionian Sea. It might also affect the productivity of the wellknown traditional fishfarms of the nearby Messolongi lagoon.

The ongoing works and the announced new gigantic projects for deviation of the major part of the Acheloos waters to Thessaly, in order to irrigate farming lands, construct hydroelectric power plants and finaly discharge to the Aegean Sea, raise a series of serious environmental questions and urgently calls for in depth study,and understanding of the present function and distribution of the Acheloos estuary system, since its structure might be altered drastically in the course of the coming years.

Acheloos acts as a major source of inorganic nitrogen for the Patraikos Gulf (Scoullos et al 1985) due partly to the washout of fertilizers and runoff. However, in general it is not among the polluted rivers since it does not pass through heavily industrialised areas.

In the present work which is part of a project carried out since 1982 we present the overall distribution patterns of various metals and we attempt to establish simplified trends and identify correlations between trace metals and major constituents of the sediments.

A series of minicores (1m in length) have been collected from 14 stations from the estuary of the Acheloos river using a Mackereth (1969) pneumatic corer and Perspex tubes. The sediments were analysed for carbonates, organic carbon and a series of trace metals extracted (a) by 0.5N HCl and (b) by conc. HNO_3 from fractions with grain sizes smaller and greater than 61μm.

Acheloos is silled with a mouth bar. Its relatively narrow mixing zone having significant salinity gradients (S‰.38 - 1‰.) has a total width of a few kilometers upstream as well as outside the mouth. An accumulation of carbonates in the bottom sediments was observed throughout this zone. However, this was not the case for a distinct small strip of the river bed located at the shallowest part of the bar where carbonate concentration in the fine sediment is extremely low and the aluminum one is particularly high.
The carbonate concentration in the sediments decreases in the upstream "riverine" stations as well as in the offshore "marine" ones. Aluminum shows, in general, the reverse trend.

From the results became clear that most of the metals show their peak concentrations (see Table I) in two sites. The most prominent one is located outside the river mouth, in fact in the area where salinity usualy exceeds 25 ‰. and the dynamic energy of the particles decreases abruptly following a steap increase of the depth of the sea bottom.

TABLE I: MINIMUM AND MAXIMUM CONCENTRATIONS OF TRACE METALS IN THE ACHELOOS RIVER ESTUARY.

Metal	extracted with HCl(ppm) min	extracted with HCl(ppm) max	extracted with HNO_3 (ppm) min	extracted with HNO_3 (ppm) max
Al	400	3000	4500	39600
Cd	0.10	0.25	0.10	0.25
Cr	2.30	10.0	23.6	130
Cu	3.70	29.5	7.00	38.4
Fe	800	6600	2400	22700
Mn	300	740	400	890
Ni	17.1	50.2	26.4	180
Pb	2.5	14.4	3.7	15.1
Zn	7.2	34.9	24.8	82.9

The other zone of relatively high metal concentration is located upstream, right before the river mouth bar. There, the metals seem to be deposited mainly as a result of the abrupt increase of the pH. In fact the pattern of each metal is differentiated according to its major species present and its responce to desorption, coagulation and precipitation processes.

Trying to establish simplified correlations for the interpretation of a large series of data we have identified, in a first approximation, two groups of trace metals:The first, and most numerous one (Cu, Pb, Cr, Zn, Fe, Ni) shows a negative correlation with carbonates and a positive one with Al, at least in the surface sediments.Scoullos and Oldfield (1986) have identified the ability of fine "clay" particles to act as major metal carriers in the system. The correlation is extended to the entire sediment column for few metals such as copper. It is noteworthy that throughout a long series of samplings of suspended particles from the Acheloos estuary we have established excellent correlations between aluminum and various metals (e.g. iron) in the suspended matter which is reflected also in the sediments.

The second group has metal concentrations following the trend of carbonates. Mainly manganese follows this pattern and in a lesser extent cadmium. These two elements are also the ones more effectively extracted by HCl (having the highest M_{HCl}/M_{HNO_3} ratios).Several metals slightly deviate from the above described trends and their distribution seems to be largely influenced by the organic carbon content of the sediments.
Using "surface enrichment factors":
$K_{sf} = (C_s/Al_s - C_d/Al_d)/(C_d/Al_d)$
where C_s the measured surface concentration
C_d the reference concentration at a given depth of the sediment column
Al_s and Al_d the relevant Al concentrations,
it appears that lead, zinc and nickel are the elements which have been affected more obviously by anthropogenic inputs.

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C-I9

Heavy metal concentrations in superficial sediments from the Gulf of Olbia, Sardinia

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The city of Olbia and its hinterland discharge their untreated and partially treated sewage into the Gulf of Olbia in the North East of Sardinia. The most higly polluted area is a channel (Fig.1), where the Olbia harbour is located, flanked by several sites for the production of shellfish. In 1985 a significant algal bloom occurred in the channel. The aim of the present paper is to measure the level of heavy metals (Cd, Cu, Cr, Zn, Pb) in the superficial sediments of the channel, both to evaluate the potential hazard to the shellfish themselves and to obtain significant information in view of the forthcoming dredging operations to improve navigation in the channel. This information will help to select an adequate disposal site for the dredged sediments.

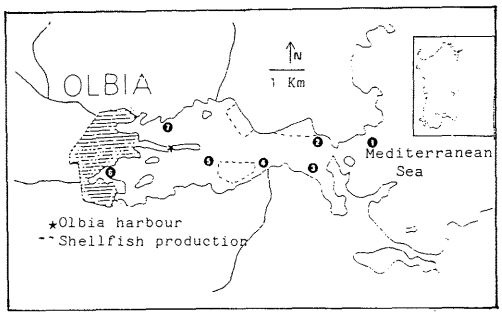

Fig.1. Location of the sampling sites .

Seven sampling stations were selected along the channel. Core samples of the sediments were collected in October'86 by divers. The samples were immediately frozen after collection. The upper part of the core (1-5 cm) was removed, air dried, grounded in an agate mortar, and sieved at 100 mesh. Aliquots were digested in an nitric-perchloric acid mixture, according to the method suggested by IRSA-CNR (1985) Analysis were carried out on a Perkin Elmer atomic absorption spectrophotometer. An NBS River Sediment Standard (1645) was used to check the analytical procedure.

Sampling site	Pb	Cu	Cr	Cd	Zn
1	1.1	5.2	1.6	0.2	40.2
2	6.1	5.0	11.0	1.6	70.5
3	7.2	5.0	3.5	2.1	55.2
4	8.0	22.0	12.0	2.0	105.3
5	10.2	9.0	9.0	1.6	86.1
6	17.1	15.1	6.0	3.1	104.0
7	16.0	5.0	2.0	0.7	70.0

Tab.I. Mean concentrations (µg/g dry wt) of heavy metals in surface sediments.

The metal concentrations do not vary significantly along the channel. Sampling station 1, at the point where the channel communicates with the open sea,showed the lowest values for all metals considered. The highest Pb concentrations were found at stations 6 and 7, which are the nearest the harbour and the city. The values were lower than those found in other harbour areas in the Mediterranean and are in the range of those found by other authors in coastal areas (Tab.II).

	Pb	Cu	Cr	Cd	Zn	References
Olbia Gulf	6.1-17.1	5.0-22.0	2.0-12.0	0.2-2.1	40.2-10	This study
Cagliari Gulf,Sardinia:						
-Harbour zone	21-860	4.9-180	22-100	__	60-65	Contu et al ,
-Outer harbour	8.8-44	3.1-8.8	1.3-7.2	__	10-25	1983
Coastal areas of Israel	3.9-19.7	0.3-2.9	1.7-12.4	0.3-2.2	2.1-18.2	Roth and Hornung,1977
Bay of NIce	4-112	2.1-35.4	__	0.7-2.4	__	Flatau et ., al, 1982
Sicily Channel Coast	5-20	4-15	2.5-16.2	0.2	7-26	Castagna et al, 1987
Venice Lagoon	3.1-278	21-463	14.7-46.4	1.1-25.4	61-5930	Pavoni et al.,1987

Tab.II. Heavy metal concentrations (µg/g dry wt) in sediment collected in different areas of Mediterranean.

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C-I10

Chromium fluxes through Mex Bay inshore waters*

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Introduction: The first survey of chromium in inshore waters of Alexandria was conducted by Aboul Dahab and Halim (1986) in Mex Bay West of Alexandria. The Bay has a mean depth of 9.8 m. It's surface area is of 19.4 Km^2 and its volume 190.3 X 10^6 m^3. The Bay receives several effluents: agricultural drain water (6 X 10^6 m^3 day^{-1}), waste water from a chlor-alkali plant (35 X 10^3 m^3 day^{-1}) and also from the Western Harbour of Alexandria (3.1 X 10^6 m^3 day^{-1}, El Gindy, 1986). The Western Harbour receives 90 X 10^3 m^3 day^{-1} of brackish water from a navigation canal (Noubaria Canal) and 1.2 X 10^3 m^3 day^{-1} of waste water from 16 tanning factories.

The daily average total chromium input from the respective effluents to Mex Bay was quantified by Aboul Dahab and Halim (1986).

Table (1): Average daily discharge of chromium from the Main effluents to Mex Bay

Effluent Cr species	Umum drain	Chlor-alkali effluent	Western Harbour outlet
Particulate Cr	324	4	25
Dissolved Cr	132	3	16
Total Cr	456	7	41

El Gindy et al., (1986) estimated the residence time of the fresh water input to Mex Bay as 2.08 days. Aboul Dahab and Halim recently determined the sedimentation rate in Mex Bay (0.85 Cm yr^{-1}) by studying sediment cores from the area (unpublished data).

The scope of the present work is to estimate the amount of chromium deposited to Mex Bay sediments, the amount of chromium leaving the Bay by water exchange with the open sea and to investigate chromium accumulation in marine organisms belonging to different trophic levels from the Bay.

Material and Methods: Sediment: Sediment samples were taken by a core device from the stations shown in Fig. 1. The superficial layer of sediment (0-2 cm) was analysed. Samples were air dried, ground in a agate mortar and sieved to pass 63 µm mesh to normalize all samples. Samples were dissolved totally with HNO_3, HF and $HClO_4$ acids and the dried residue taken up in 0.1 M HCl acid. GFAAS technique was used for the measurement of Cr concentrations.

Biota: Donax trunculus, Penaeus kerathurus, Neptunus pelagicus, Boops boops, Mullus barbatus, Sardina pilchardus and Rhinobatus halavi were collected on two occasions from Mex Bay by commercial trawlers (Winter and Summer 1986). Samples were identified and prepared in view of the method recommended by UNEP, 1984. Digestion was done by concentrated HNO_3.

To check the analytical method, NBS River sediment (1645) & Bovine liver (1577) were analysed for Cr. The efficiency ranged from 97 % to 102 %. All manipulations were carried out in a laminar flow hood in a dust-free room.

Results: Density, organic carbon, chromium concentrations and the index of relative pollution potential are given in Table 2. Chromium concentrations in the sediments from Western Alexandria fluctuated between 42 $\mu g g^{-1}DW$ and 751 $\mu g g^{-1}DW$ (station 1 and 14, respectively) with an average of 243±213 $\mu g g^{-1}DW$. Significantly high chromium concentrations were determined at station 14, within the outlet of the Western Harbour (978 $\mu g g^{-1}DW$) and at station 13 immediately downstream from Umum Drain outlet (543 $\mu g g^{-1}DW$). Stations 10 and 11 also showed relatively high chromium concentrations (311 $\mu g g^{-1}DW$ and 382 $\mu g g^{-1}DW$, respectively). The minimal value of 42 $\mu g g^{-1}DW$ at station 1 is assumed to be the background level for the area. The percentage of organic carbon in the sediments of Mex Bay ranged between 0.1 % and 3.3 % with an average of 1.4 ± 1.1 %. In the inner part of the Western Harbour outlet it was 4.2% and 3.3 % in outer part (station 14* & 14, respectively).

No significant correlation was found between chromium concentration and organic carbon ($r = +0.25$) in Mex Bay sediments. For this reason we assume that the incorporation of chromium in the Bay sediments was done largely by inorganic processes.

Biota: The mean chromium concentrations in the marine organisms from Mex Bay are very scattered (Table 3 and Fig. 2). The relatively high concentrations of chromium in the soft parts of the bivalve Donax trunculus (255 µg $Kg^{-1}FW$) compared to fish levels (70 to 153 µg $Kg^{-1}FW$), suggests a higher rate of accumulation. There was a considerable difference between chromium concentrations in the flesh of the crab Neptunus pelagicus (465 µg $Kg^{-1}FW$) and the shrimp Penaeus kerathurus (222 µg $Kg^{-1}FW$). There were wide differences between chromium concentrations in the flesh of the four fish species studied. The level increased in the following order: Boops boops (70 µg $Kg^{-1}FW$) < Mullus barbatus (94 µg $Kg^{-1}FW$) < Sardina pilchardus (127 µg $Kg^{-1}FW$) < Rhinobatus halavi (153 µg $Kg^{-1}FW$).

Discussion: The sedimentation rate (0.85 cm yr^{-1}) in Mex Bay can be converted to a weight basis using the formula:

Bulk sedimentation rate = $F = R(1-P)d$ (Hamilton-Taylor, 1979)

where R = sedimentation rate, 0.85 cm yr^{-1}, P = porosity, 0.844 and d = density, 2.596 g cm^{-3}. $\therefore F = 0.85\ (1-0.844)2.596 = 0.3442$ g $cm^{-2}yr^{-1} = 9.43$ g $m^{-2}day^{-1}$. Using the chromium concentration in the sediments of the inner Mex Bay (452 $\mu g g^{-1}DW$, average of the stations in the inner Bay, and given the surface area of the Bay (19.4 X $10^6 m^2$), the chromium sedimentary flux for the whole Bay would be 9.43 X 19.4 X 452 X 10^{-3} = 83 Kg day^{-1}. The average annual rate of rainfall over the investigated area (19.4 Km^2) is 192.1 mm, and the total amount of rainfall therefore is 192.1 X 10.4 X 10^3 m^3 yr^{-1} = 10.2 X 10^3 $m^3 day^{-1}$. This is a negligible value compared to the fluxes from the land-based sources.

Aboul Dahab and Halim (1986) found a rapid decrease in suspended chromium concentration in a seaward direction in Mex Bay. Approximately 95 % of the suspended chromium is deposited and remains within the Bay. They also found that the dissolved chromium concentration at the Mex Bay outer boundary is 1.054 $\mu g l^{-1}$ and at the discharge points is 4.345 $\mu g l^{-1}$. The net export by water exchange (E) of a dissolved component from A to B can be approximately expressed as: $E = W(X_A - X_B)$ where W is the water exchange rate due to the mixing and X_A and X_B are concentrations of the component at A and B respectively.

$$W = \frac{\text{Basin volume}}{\text{Fresh water residence time}}$$

$$\therefore W = \frac{190.3 \times 10^6}{2.08} = 91.49 \times 10^6 m^3\ day^{-1}.$$

Since no considerable vertical gradient for chromium is observed (Aboul Dahab and Halim, 1986), the average concentration for the water column is taken:

$$E_{\text{dissolved chromium}} = 91.49 \times 10^6 (4.345 - 1.054) = 301.1\ Kg\ day^{-1}.$$

From the total amount of chromium flux to the Bay, 474 Kg day^{-1} (Table 1), flushing of the Bay to the open sea removes 301 kg day^{-1} and sedimentation within the Bay 83 Kg day^{-1}.It is apparent that the main process of chromium removal, is by water exchange.Sedimentation accounts for 22 %. Although this budget is crude, it provides approximations of the inputs, outputs, and of the standing stock of chomium in the water and biota of the Bay, which is about 90 Kg.

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*Compte tenu des normes appliquées, les tableaux et figures annoncés dans ce travail n'ont pu être reproduits.

C

Le Plomb dans les eaux côtières du Bassin Méditerranéen nord-occidental

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Le plomb a été déterminé par voltampérométrie (1) sur des échantillons d'eau de mer non filtrés, prélevés en surface, le long du littoral méditerranéen, au cours de la mission INTERSITE (13-27 septembre 1984).
Des variations régionales des niveaux de concentration ont été observées :

- La zone hauturière du Bassin Nord Occidental
Les deux concentrations mesurées (70-76 ng.l^{-1}) sont conformes à ce qui a été antérieurement publié (2)

- Le Golfe du Lion et le littoral Corse (11 échantillons)
Ces zones ont une valeur moyenne de 63 ± 11 ng.l^{-1}, légèrement inférieure à celles du large. Bordées de régions peu urbanisées, elles semblent moins influencées par les apports atmosphériques de Plomb que le reste du bassin.

- Le littoral du Languedoc Roussillon (5 échantillons)
Des remontées d'eaux profondes plus froides T<15°C fréquentes dans ces régions à cette époque (3) se traduisent par de très faibles concentrations (28±11 ng.l^{-1}). Une valeur très basse : 13 ng.l^{-1} a même été observée. Cette valeur est inférieure à la moyenne des eaux profondes méditerranéennes (2).

- Le cordon littoral du Rhône (6 échantillons)
Ces eaux sont identifiables par leur faible salinité (S<37). Elles présentent des teneurs relativement basses (47 ± 13 ng.l^{-1}) alors que des valeurs fortes ont été observées à l'embouchure même du fleuve : 860 ± 340 ng.l^{-1}. Le Plomb apporté par les eaux du Rhône semble piégé par la sédimentation dans l'estuaire (4). Les eaux du Rhône ne contribuerait pas à l'enrichissement de la Méditerranée en Plomb.

- Le Golfe de Fos-Marseille (6 échantillons)
L'activité urbaine de cette région se reflète dans les fortes concentrations trouvées (107 ± 52 ng.l^{-1}), avec une très forte valeur (920 ng.l^{-1}) à la sortie de l'émissaire de Cortiou dont l'impact est localisé (85 ng.l^{-1} à 400 m et 56 ng.l^{-1} à 1 km au Sud de l'émissaire).

- La côte varoise (5 échantillons)
Les remontées d'eaux froides, bien que d'origine plus profonde dans cette région (5) ont eu moins d'influence sur les valeurs superficielles (59 ± 12 ng.l^{-1}) que dans le golfe du Lion.

- Le côte d'Azur (4 échantillons)
Siège d'un courant de surface côtier permanent : le courant Ligure qui draine dans ses eaux les apports telluriques de la région, cette zone présente des fortes concentrations (Pb = 129 ± 36 ng.l^{-1}) représentatives de la mer Ligure côtière (Pb = 144 ng.l^{-1}) (6). Des mesures réalisées sur du plancton ont montré que les espèces prélevées dans cette région, près des côtes, étaient significativement plus riches en Plomb (7,9 ± 2,8 ug.g^{-1}) que les espèces prises au large (1,9 ± 1,2 ug.g^{-1}) (7)

CONCLUSION

Les concentrations du plomb dans les eaux côtières du Bassin Nord Occidental sont influencées par les conditions hydrologiques locales et par la nature des Apports continentaux (Fig.1). Les plus fortes valeurs ont été relevées près de Marseille et dans le courant Ligure. Une attention particulière devra être portée à cette dernière région puisqu'il semble que les concentrations de plomb associés aux organismes de la chaîne alimentaire reflètent les valeurs des eaux côtières de surface.

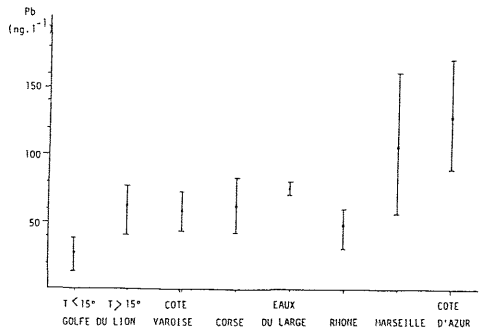

Figure 1 : Valeurs moyennes et domaine de variation du plomb dans le nord du Bassin Occidental Méditerranéen.

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Caractérisation des eaux interstitielles de sédiments marins : capacités complexantes et masses moléculaires

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Pour aborder le thème général des intéractions métaux - matières organiques, l'un des paramètres les plus fréquemment étudié est la capacité complexante du milieu . Le caractère global de telles mesures, effectuées directement sur des eaux naturelles, explique tout l'intérêt suscité par ce paramètre (1) .

Dans le cas d'eaux interstitielles (E.I.) de sédiments marins prélevés en zone littorale, les échantillons sont chargés en matière organique : Les capacités complexantes par rapport au cuivre mesurées par " D.P.A.S.V. " (2) sont alors fortes et généralement supérieures à 1 µmole/l. .

Le travail qui a été entrepris ici vise à déterminer plus précisement quelles fractions moléculaires sont responsables de ces phénomènes de complexation par rapport au cuivre dans des E.I. issues de sédiments prélevés aux alentours de Nice (FRANCE) .

Dans ce but, parmi les techniques d'études de la spéciation chimique dans les eaux marines (3), nous avons soumis nos échantillons d'E.I. à l'ultrafiltration (4) (seuil de coupure = 1OOO Daltons) et à la chromatographie par perméation de gel (5) en utilisant l'eau de mer comme éluant .

Sur les différentes fractions obtenues par ces techniques on mesure les capacités complexantes par " D.P.A.S.V. " .

Il a été montré (6) (7) que l'aspect des pics de redissolution dépend de nombreux paramètres d'ordre expérimentaux et de la matière organique. C'est pourquoi nous avons accordé une attention toute particulière à l'allure des courbes polarographiques obtenues en étudiant les comportements singuliers présentés par certaines fractions . Les substances humiques ont été mises en évidence par spectrofluorimétrie ultra-violette (8) et le carbone organique dissous a été évalué par oxydation au persulfate (analyseur "DOHRMANN DC 80") .

Les résultats obtenus permettent une détermination quantitative et qualitative des masses moléculaires des substances responsables des phénomènes de complexation dans les E.I. étudiées . Ils mettent en relief les paramétres propres aux conditions expérimentales et à la qualité de la matiére organique présente dans nos échantillons .

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C-I13

Importance du macroplancton gélatineux dans le stockage et le transfert de métaux traces en Méditerranée nord-occidentale

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Des organismes du macroplancton gélatineux appartenant aux Thaliacés : Thalia democratica et Salpa fusiformis et aux Siphonophores : Agalma elegans, Hippopodius hippopus, Chelophyes appendiculata et Abylopsis tetragona ont été prélevés à la sortie de la rade de Villefranche-sur-mer en Méditerranée Nord-Occidentale au printemps 1987 à une période où ces organismes étaient particulièrement abondants. Parallèlement des échantillons de matière en suspension ont été collectés dans des pièges à sédiments placés à 200 m de profondeur en zone côtière (Programme Dyfamed en coopération avec l'A.I.E.A. de Monaco). Des analyses de Cd, Cu, Pb et Zn ont été effectuées par absorption atomique (four et flamme) et par polarographie de redissolution anodique sur ces différents échantillons.

Le Tableau 1 donne les concentrations en métaux trouvées dans les Siphonophores :

Tableau 1 : Concentrations exprimées en µg métal /g (poids sec)

Espèce :	Cd	Cu	Pb	Zn
Chelophyes n=13	1.3±0.4	7.7±4.6	1.5±0.7	75±27
Agalma n=7	0.5±0.1	4.4±1.9	2.6±0.5	36±6
Abylopsis n=5	0.6±0.1	3.2±1.7	0.6±0.3	82±23
Hippopodiusn=4	1.0±0.7	4.9±2.5	2.4±0.7	180±49

Le Tableau 2 donne les concentrations dans les Thaliacés (Salpa et Thalia) ainsi que dans les échantillons recueillis dans les pièges à sédiments. Ces concentrations sont exprimées en ng métal/µg phosphore.

Tableau 2 : Concentrations exprimées en ng métal / µg phosphore

Echantillon	Cd	Cu	Pb	Zn
Salpes	0.1	1.8	0.9	8.7
Matériel pièges	0.66	50	292	163

Les concentrations en Cu et en Zn trouvées dans les pièges sont comparées à celles données par Krishnaswami et al.(1985) pour les fèces de mêmes Salpes (9ng Cu/µg P et 54 ng Zn/µg P) et montrent que, dans le matériel particulaire, 18% du Cu et 33% du Zn proviendraient des fèces . En estimant une contribution moyenne de 25% de métal apporté par les fèces de Salpes au matériel particulaire, on peut en déduire les concentrations en Cd et en Pb dans les fèces de Salpes qui seraient de l'ordre de 0,16 ng Cd/ µg P et de 50 ngPb /µg P. On note des facteurs d'enrichissement (Métal dans fèces/Métal dans Salpes) de 1,6 pour Cd, 5 pour Cu, 55 pour Pb et 6 pour Zn.

En conclusion, les organismes gélatineux n'ont pas de concentrations très elevées en métaux sauf en zinc qui est accumulé particulièrement par les Siphonophores ; ce phénomène avait été déjà observé pour des échantillons prélevés en 1984 (Roméo et al., 1986, 1987). D'autre part, les Salpes contribuent d'une façon notable, par leurs fèces, aux flux des métaux , et en particulier du plomb en Méditerranée.

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C-II1

On interaction of Copper with surface active material in natural waters

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Copper ions are very important for natural aquatic system as copper is in lower concentrations an essential element necessary to biota (few nanogramms) and very toxic at higher concentrations. Because of its wide application in agriculture and industry copper is potentially very hazardous trace element. The distribution and fate of copper ions in natural waters is mainly influenced by the presence of organic matter as well as by the adsorption processes on different surfaces (1,2,3).

Copper ions form very stable organic complexes and because of that organic compounds, especially those which at the same time have surface active properties, influence greatly the behaviour of copper ions in the solution and at the interfaces. The representatives of such substances are proteins, fatty acids and lipids as well as humic substances.

Very useful information about the behaviour and interactions of copper ions with organic matter in the solution and on the different interfaces can be obtain from the electrochemical investigation at the model interface mercury electrode/aqueous solution.

Anodic stripping voltammetry is widely used for trace metal speciation in natural waters because of its sensitivity. During the preelectrolysis time the adsorption of surface active substance can influence the available free electrode surface and the rate constant for reduction of heavy metal ions.

The great majority of surface active substances has the maximum adsorption on the mercury electrode at -0.6 V vs Ag/AgCl, i.e. the potential of the electrocapillary maximum where the surface charge of mercury is zero. Because of that heavy metal ions like Cd^{2+}, Pb^{2+} and Zn^{2+} which have the reduction half-wave potential in the region of the surface active material maximum adsorption, are influenced by surface active substances (4,5). Because copper ions have the half-wave potential of reduction at -0.1 V vs Ag/AgCl reference electrode, which is in the potential region of desorption of majority of surface active substances one could expect a weaker influence upon copper oxido-reduction processes. But copper's great tendency to form organic complexes as well as its environmental significance make copper one of very interesting and important heavy metal ion for such studies. The method is based on the previous formation of the adsorbed layer of the surface active substance on the electrode surface at the potential -0.6 V vs Ag/AgCl together with the simultaneous reduction of copper ions at the same potential, and then the study of the anodic dissolution of copper at the modified surface.

Oxido-reduction processes of copper ions have been studied by differential pulse voltammetry using the hanging mercury drop electrode (HMDE) method in the presence of organic film which was formed in the solutions of different concentrations of selected biogenic surface active substances. The adsorption studies of surface active substances were carried out by capacity-current measurements using a.c. polarography, as described previously (6,7). The determination of the complexing properties of the surface active material were carried out by the complexing capacity measurements with Cu^{2+} ions by DPASV (1,8). It has been estimated that geopolymers and biopolymers like humic substances and proteins, respectively have a very pronounced effect on the anodic wave of copper ions. At lower concentrations of copper ions complexing properties of surface active material are most important and the main interaction will be the complexation. At higher concentrations of copper ions and the surface active substances the predominant reaction will be the inhibition of the oxido/reduction process of copper ions because of the adsorption of the organic matter on the electrode.

It has been also investigated the interaction of copper ions with surface active material in the samples of natural aquatic systems: seawater, fresh water, as well as in phytoplankton culture media, and comparison is made with the behaviour of different model compounds.

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C-II2

Adsorption of Cd(II), Pb(II), Cu(II) and Zn(II) ions on mineral and model surfaces under seawater conditions

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The adsorption of the trace metals Cd, Pb, Cu and Zn was studied on natural Fe-bentonite and kaolinite. Results are presented in the form of Schindler's adsorption isotherms: $[Me]_{ads}/[Me]_{tot}$ vs. log X (kg dm^{-3}) where X is the weighted amount of adsorbent.

Adsorption characteristics for the four metal ions on Fe-bentonite and kaolinite showed similar behaviour for Pb, Cu and Zn while Cd was very slightly adsorbed on both solid phases. In comparison with earlier adsorption results on model particulate matter such as γ- Al_2O_3 (surface area 117 m^2g^{-1}, number of sites 8 nm^{-2}) and SiO_2 (surface area 220 m^2g^{-1}, number of sites 4.5 nm^{-2}) (Bilinski et al., 1976; Plavšić et al., 1980) and on synthesized northupite mineral $Na_3Mg(CO_3)_2Cl$ (surface area 6 m^2g^{-1})(Vančina et al., 1986), the following adsorbability order was observed for seawater conditions with respect to the weight of the adsorbent:

for Pb γ-Al_2O_3 > SiO_2 > bentonite > kaolinite
for Cu γ-Al_2O_3 > bentonite ≈ northupite > SiO_2 > kaolinite
for Zn γ-Al_2O_3 ≈ SiO_2 > bentonite > kaolinite
for Cd very low adsorption was observed except for northupite.

The effect of major and minor cations (Mg^{2+}, Ca^{2+}, Sr^{2+}) on cadmium adsorption was studied with decreasing inhibition of Cd adsorption in the following sequence: $Mg^{2+} > Ca^{2+} > Sr^{2+}$.

For anionic seawater constituents the following effectiveness order was: $Cl^- > Br^- > J^- \approx SO_4^{2-} \approx SiO_3^{2-}$.

Cadmium was observed to adsorb less in natural seawater as compared to artificial or UV-irradiated seawater. Because of the weak interaction of cadmium with organic matter in seawater, it appears that the natural organic matter in seawater adsorbs on the bentonite surface, thus interfering with cadmium adsorption at the bentonite surface.

Selected model organic ligands, which were recently found in natural sediments by Hadžija et al., (1985) and by Steinberg et al., (1987) have been studied. Alanine, glutamic acid, galactose and galactosamine have been established as inhibitors, while oxalic acid was found to be a catalyst of cadmium adsorption.

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C-II3

The mobility of some Carboxy and Hydroxy Benzene derivatives on thin layers of Silica gel plain and Fe(III)-impregnated

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The mobility of metals through soil and sediments is predominantly attributed to their complexation with humic substances, mainly via their functional groups such as carboxy and hydroxy. These investigations were performed with naturally occuring humic material[1,2] and in this way no informations could be obtained about the activity of the functional groups with respect to their position in the benzene ring.

In our previous work we had examined by the use of thin layer chromatography in water systems as developers, on plain and Fe(III)-impregnated silica gel, the behaviour of some phenolic acids usually found as degradation products of humic material[3].

In this work we have tested the benzene derivatives containing more than one hydroxy and carboxy group in different positions and carboxy groups which are not bonded directly to the benzene ring. All tested compounds are derived from some of the presumed structures of humic acids or their precursors.

The following was found:

- on plain plates the compounds tested behaved more or less consequently to their solubility in water. Phenolic acids which are slightly soluble in water exhibit small mobility. Compounds having greater solubility, as are for example, dihydroxy benzenes and benzene carboxylic acids moved faster.
- on impregnated plates the compounds behaved accordingly to physico-chemical properties of the Fe(III)-complexes formed.

From the behaviour of the compounds on impregnated plates, some conclusions about the activities of the corresponding functional groups may be drawn. The fact that on impregnated plates phenolic acids with free hydroxy group and dihydroxy benzenes moved considerably may indicate that Fe(III) as well as other metals, by complexation with the related functional groups in soil and sediments, become movable. On the other hand benzene carboxilic and dicarboxilic acids as well as phenolic acids with protected hydroxy groups moved slowly or stayed practically on the start position on impregnated plates. This behaviour may imply the retardation of the metals depending on the positions of these groups.

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C-II4

Méthodologie de mesures chimiques en continu et en temps réel

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La combinaison de l'analyse à flux continu et du prélèvement continu permet le dosage en temps quasi réel (avec décalage constant dû au temps d'arrivée de l'eau de mer à la chaîne à flux continu augmenté du temps nécessaire à la réaction colorimétrique) des sels nutritifs ou d'autres substances, permettant la surveillance, l'investigation supplémentaire et la vérification.

Un système simple fonctionne à bord du bateau-laboratoire RAMOGE (vedette de 14 mètres). Un tube préleveur, dont l'ouverture dirigée vers l'avant et protégée par une crépine en nylon, est installé sur un dispositif reposant sur des skis nautiques tractés latéralement.

Ce tube aspire l'eau de mer trente centimètres sous la surface. Un conduit souple en TYGON relie le préleveur à une chaîne d'analyse à flux continu TECHNICON installée à bord du bateau-laboratoire. Cette chaîne détermine actuellement la concentration en nitrates et en nitrites (décalage constant en temps égal à 8 minutes).

L'aspiration de l'eau de mer est assurée par une pompe péristaltique MASTERFLEX assurant un débit de 1500 ml/min dans une cuve à trop-plein dans laquelle est immergée l'aiguille de prélèvement de la chaîne à flux continu.

Le matériel a été testé le long du littoral monégasque. La figure reproduite présente, de haut en bas, trois tracés :

- le littoral,

- la route réelle du bateau-laboratoire, à une distance moyenne de la côte égale à 150 mètres,

- un graphique d'enregistrement sur lequel les pics A, B, C et D correspondent probablement, le jour de la surveillance considérée, à l'activité de déversoirs d'orage côtiers.

Le tracé du contour exact de la nappe de "pollution" nécessiterait des explorations secondaires (elles ne sont pas toujours utiles dans le cadre d'une surveillance de routine).

L'analyse en continu à bord :

- évite la présence de "trous" dans la cartographie d'une surveillance,

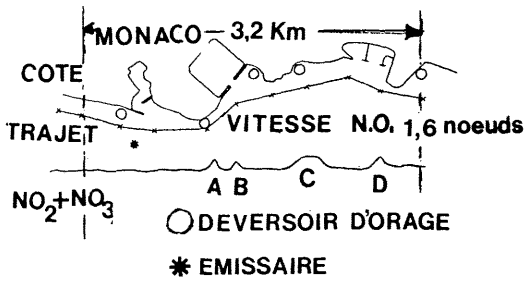
- constitue un "indicateur de tendance", à la hausse ou la la baisse, des concentrations,

- ne permet pas le dosage quantitatif précis des substances étudiées.

Il est donc souhaitable de conserver des chaînes d'analyse à terre pour les déterminations précises.

Si le système utilisé permet de contribuer à localiser des contaminations, il permet de manière plus générale de localiser les distributions hétérogènes de plusieurs paramètres chimiques.

Son utilisation à bord de très petites unités de navigation (une vedette de 8 m à faible tirant d'eau suffit) nous paraît devoir être recommandée.



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C-II5

Vertical distribution of Calcium, Magnesium, Mercury and pH measurements in stratified Krka Estuary

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It was recently suggested that haloclines are important sites for contaminant accumulation (Žutić and Legović, 1987; Mantoura, 1987). The experimental method for mercury determination and sampling by scuba diving were described by Kniewald et al., (1987), together with some preliminary data in Krka estuary. It was observed mercury accumulation at FW/SW interface on a limited number of samples in the profile. Mercury has been also studied in various stations at Adriatic sea (Mikac et al., 1988).

The objective of the present study was to perform more detailed profile study of Ca, Mg and Hg ions and also precize pH measurements at three characteristic points of Krka estuary (G, K-S, E-3). Sampling point G is at the entrance of Guduča river to Prokljan lake. This river carries predominantly clays and quarz as particulate matter. Sampling point K-S is chosen at the entrance of Krka river to the same lake. It brings predominantly calcite as particulate matter. Station E-3 is situated at the exit of Prokljan lake, in which the main mixing of components takes place.

Experimental : About 10 samples have been collected for each profile during April 1987. Part of each sample was acidified for Ca, Mg and Hg determination and non acidified part was used for turbidity and pH measurements. Visible colloids could not be determined by tyndallometric method, indicating particless smaller than 100 Å.

Experimental data are presented in the form of depth profiles, together with salinity and pH_{NBS} measurements. In order to compare experimental results in all three stations, salinity dependance is presented. Significant difference has been observed. Ca and Mg concentrations showed linear dependence on salinity. It indicates that there is no inhibition of diffusion transport of these ions through the organic film studied at FW/SW interface by Žutić and Legović(1987), Žutić et al.(1988) and by Ćosović and Vojvodić(1988). Behaviour of mercury was completely different. The surface concentration was low in all three stations: G(2.3 nM dm^{-3}), K-S(2.5 nM dm^{-3}) and E-3(1.5 nM dm^{-3}). It increased with salinity. The pronounced Hg maximum was found at E-3 station(6.9 nM dm^{-3}) at S=21 total parts per million; at G station (7.8 nM dm^{-3}) at S=22; and a crach point at the same salinity at K-S station (5.5 nM dm^{-3}) without the pronounced maximum.

Thus, accumulation of Hg at FW/SW interface was observed only at stations E-3 and G, followed by decreased removal to bottom sediments. The interface at K-S station had the least influence on Hg removal to sediments.

The measurements of pH_{NBS} also have shown that different behaviour exists in all three stations. The measurements will be continued with time when different biological activity, respiration and remineralization occurs, to get better understanding of metals transport (Ca, Mg, Hg and other trace metals) in various stations of stratified estuary of Krka river.

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C-II6

Wind stress and distribution of chemical parameters in the Krka River Estuary

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Krka river estuary is a carstic, mainly stable stratified estuary, characterised by close interactions of hydrometeorological phenomena, underground carstic waters and nearshore saline water of the Adriatic sea.

Some enquieries were made during windy weather (autumn 1987), and some (autumn 1984, partially 1986) during stable hydrometeorological conditions. Selected surveys showed no great diferences in river flow and similar stratification. So, we supposed windy weather was the main factor influenced on dynamic and distribution of chemical parameters.

Thermocline and halocline sinked during windy weather. In the same situation current field was formed under influence of drift currents (Fig.1). Even in these conditions, prevailing efects on current direction were by periodic tide currents.

Tide oscilations were taken from tide gauge registration in Zlarin, near the mouth of the estuary. Validity of this data were checked by visual hours registrations on a few places along the estuary. It was established Zlarin's tide gauge registrations has been representative for the whole estuary under the waterfall.

General picture of the current field indicated that in the upper part of the estuary and Prokljan lake dominated influence of the river flow, while near mouth of the estuary and Šibenik, harbour, dominate periodical tide currents.

Distribution of the chemical parameters offered important efects of wind stress upon surface fresh layer and the upper part of deep saline layer. For example, oxygen content shows undersaturation, even during wind blowing. Aeration played important role only in the upper part of the water column, while near bottom undersaturation remained.

During windy days sinking of thermocline and halocline enables oxygen supersaturation. This was a short time disaster and after few hours former state returned. Distribution of nutrients were also examined. While, for phosphate, there was no way to get a straight line of mixing, because of small concentration and antropogenic influences, nitrate and silicate gave straight line near theoretic for situations without wind, for the whole estuary. During a windy conditions, we registered dropping concentration of nutrients in surface fresh water layer, and growing in saline layer. It's possible that processes of remineralization also play a role in last phenomena. Higher values of total alkalinity indicate that convection also intensifie mixing of layers.

Conclusions

Results confirmed influence of wind stress on dynamic of the estuary and distribution of some chemical parameters. More conservative parameters were representative for a windy situation. Some parametars like phosphorus and amonia made a problem because of a small concentration and urban influences. In next investigations it had been proposed better quantification of the registered phenomena.

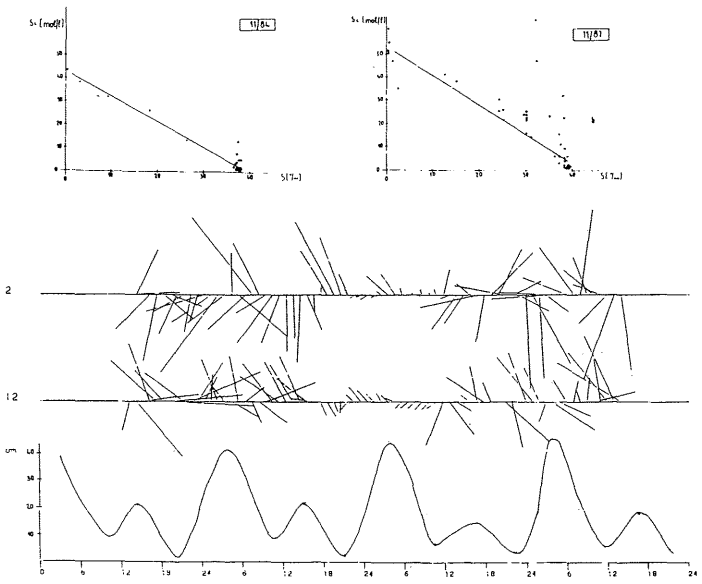

Fig. 1. Wind stress efect on current hours vectors (18.-21.11.1987) and distribution of silicate

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C-II7

Etudes des paramètres physico-chimiques des sels nutritifs dans le lac de Bafa Aydin (Turquie)

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RESUME

Dans ce travail nous avons étudié quelques paramétres hydrographiques; S %o, DO, T°C, NO_2^--N, NO_3^--N, NH_4^+-N, PO_4^{-3}-P et SiO_4^{-2}-Si. Des prélévement ont été effectués chaques mois de Septembre 1986 à Août 1987, sur quatre stations caractéristiques du lac de Bafa.

Les resultats obtenus ont montré que les concentrations des NO_2^- -N, NO_3^- -N, NH_4^+- N, PO_4^{-3}-P, SiO_4^{-2}-Si varient aussi de 0.00 à 49.61 ; 0.24 à 41.00 ; 13.65 à 504.46 ; 0.00 à 93.93 µg/l , 2.28 à 27.36 µg.at/l pour Si en fonction des stations et des pleuvent.

C-II8

Biogeochemical cycling in organic rich sediment of two lakes in Tunisia

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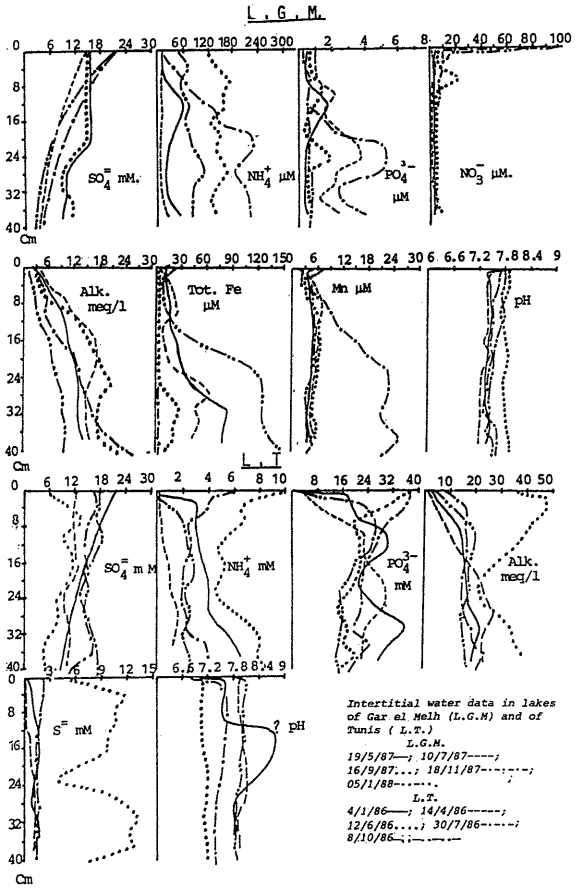
The lake of Tunis and the lake of Garel Melh are situated in the north of Tunisia. They communicate with the opensea and have salinity which can exceed 40‰ in summer. Tunis lake's sediment consist of silty mud rich in organic matter(4% of organic carbon) and sulfide(0,7‰dry sediment; HCl soluble sulfide). The porosity of the sediment is high. Sediment from Gar el Melh is composed mainly of mud where the rate of organic carbon and sulfide are about 0,2% and 1‰respectively.The porosity here is less important than in Tunis lake. Carbonate content varies between 20-40% in Gar el Melh and between 25-60% in Tunis. In both lakes, the rate of organic matter varies seasonally and the water depth never exceeds two meters. The two types of sediment are anoxic, where oxydation of organic matter is mainly conducted by sulfato-reduction bacteria. Bacterial activity is influenced by temperature which varies between 18-28c.

Analysis of sulfate, ammonium, nitrate,phosphate, alkalinity, Ph, sulfide, and metals, in the interstitial waters during1986 in the lake of Tunis and 1987 in the lake of Gar el Melh, allow us to understand the behaviour of these elements and to evaluate their influences on free waters. The concentrations of elements (see curves) varie with time because of variations of bacterial activity and because of influences of waves and currents on sediment. Waves and currents are very significant in the lake of Tunis because of the great porosity of the sediment. They are cleaning agents of the sediment. In the absence of waves and currents and during summer, bacterial activity increases consequently the concentrations of sulfide, ammonium and phosphate increase in the interstitial waters.So fluxes by molecular diffusion are established and make anoxic the free waters. This is the case especially in the lake of Tunis. Besides bacterial activity and waves and currents, precipitation/dissolution seem to control the concentrations of the elements. For example, in the lake of Gar el Melh, monosulfides like mackinawite and greigite, siderite, and vivianite control iron and phosphate in interstitial waters. Mathematic modelisations based on the equation of diffusion and treated in no stationarry system are done for ammonium in the lake of Tunis*. In this model, the coefficient of diffusion was supposed not to change with time. This assumption is unreasonnable and induces errors in the calculations of the rate of production of this element. Modelisations tacking into account physical processes are in course.



* A. ADDED; R. BARATIE; F. FERNEX : modelisation non stationnaire des echanges a l'interface eau-sediment dans le lac de Tunis.8 th IAS Regional Meeting of Sedimentology. Tunis 1987.

C-II9

On the chemical composition of the Black Sea water along the Romanian coast in October 1987

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Résumé. L'eau de mer échantillonnée sur la plateforme continentale roumaine de la mer Noire, a été analysée pour les macro et microéléments en appliquant des méthodes chimiques et d'analyse par activation neutronique instrumentale. Les zones correspondent à celles où ont été effectués des prélèvements de Moules Mytilus G., pour l'étude de la pollution, en octobre 1987.

Introduction. The aim of this paper was to carry out a general investigation on the macro and microelements dissolved in the offshore Black Sea water that is not under directly influence of the terrestrial human activities and to explain the behaviour of selected man made and natural radionuclides, found in *Mythilus G.* sampled on the same sites [1]. *Material and Methods.* Seawater sampled at Sulina (37 km. East, 7 km. South, Serpents Island), Portitza (7.3 km. East) and Mangalia (7 km. East) in the beginning of October 1987, after a storm of 5 degree, has been analysed making use of analytical spectrophotometric and instrumental neutron activation methods. The results are included in Table 1 for macro ions,in Table 2 are other characteristics and in Table 3 are the elements found by instrumental neutron activation analysis.

TABLE 1 - Macro-ions mg/ℓ in Black Sea water in October 1987

Location	Na^+	K^+	Mg^{++}	Ca^{++}	Cl^-	SO_4^{--}	HCO_3^-
Sulina 8-X-1987	5687.7	151.1	875.5	285.5	9210.6	3456.0	256.2
Portitza 6-X-1987	5224.5	142.1	719.8	248.4	9219.6	1824.0	268.4
Mangalia 13.X-1987	5402.0	141.1	688.2	226.4	8865.0	2496.0	268.4

TABLE 2

Location	org.subst. mg/ℓ	H_2SiO_3 mg/ℓ	Tot.hardn. mg/ℓ	Fixed resid. at 105°C mg/ℓ	Total miner. mg/ℓ
Portitza	12.5	5.1	200.5	17515.1	17649.7
Sulina	14	Traces	237.6	19781.3	19909.0
Mangalia	12.5	Traces	190.1	17955.2	18089.5

NH_4^+, NO_2^-, NO_3^-, HBO_2 were lack in all the samples.

TABLE 3 - Macro and microelements concentration of Black Sea surface water (October 1987)

Concentration		Sulina	Portitza	Mangalia
Cl	%	46.80±1.64	60.04±1.76	46.48±1.63
	g/ℓ	9.2 ±0.3	10.2 ±0.3	7.9 ±0.3
Na	%	23.52±0.59	29.92±0.75	24.16±0.60
	g/ℓ	4.6 ±0.1	5.1 ±0.1	4.1 ±0.1
Mg	%	3.82±0.76	3.60±0.78	2.62±0.63
	g/ℓ	0.75±0.15	0.61±0.13	0.45±0.11
Ca	%	0.87±0.13	0.24±0.07	0.71±0.11
	g/ℓ	0.17±0.03	0.04±0.01	0.12±0.02
Br	ppm	2020±120	2213±130	1500±90
	mg/ℓ	39.5±2.3	37.7±2.2	25.6±1.5
Sr	ppm	289 ± 25	74 ± 14	247±25
	mg/ℓ	5.6 ±0.5	1.3±0.2	4.2±0.4
Fe	ppm	< 36	76±19	42±15
	mg/ℓ	< 0.70	1.3±0.3	0.7±0.3
Zn	ppm	11 ± 1	4.4±0.6	3.2±0.5
	µg/ℓ	215 ± 20	75±10	55±8
Cr	ppm	< 0.9	< 1.2	< 1.1
	µg/ℓ	<18	<20	<19
Sb	ppm	0.5 ±0.1	5.5±0.5	17 ±0.2
	µg/ℓ	10 ±2	94±9	29 ± 3
Sm	ppm	0.21±0.04	0.19±0.07	0.15±0.06
	µg/ℓ	4.1 ±0.8	3.2±1.2	2.6 ±1.0

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C

L'oxygène dissous, indice hydrochimique des eaux eutrophisées de la zone centrale du littoral roumain de la mer Noire

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Dans des bassins clos comme les mers d'Azov ou Noire et la Méditerranée, qui ont un échange limité d'eaux avec l'océan, les influences anthropogènes, dues à l'apport des fleuves ou aux déversements directs d'eaux usées domestiques ou industrielles qui introduisent en mer des quantités importantes de matière organique, sels nutritifs, métaux lourds, substances artificiellement actives, représentent les premiers maillons de certaines chaînes de processus et phénomènes ayant transformé la structure et le fonctionnement des écosystèmes marins.

En mer Noire, cette situation concerne les eaux côtières du littoral roumain, directement soumises à l'influence du stock fluvial, au nord-ouest du bassin. La croissance extrêmement importante des quantités de sels nutritifs et de matière organique (2) en est la cause primordiale, en provoquant, par le développement en masse de certaines espèces de plancton végétal, l'augmentation de la productivité primaire planctonique (1), de manière explosive, par la chaîne colatérale des floraisons. Cette eutrophisation biogénique est accompagnée de phénomènes qui influencent négativement les systèmes naturels du milieu marin, se reflètant également dans la structure chimique des eaux marines et particulièrement dans le taux d'oxygène dissous, considéré comme principal indicateur chimique des eaux eutrophisées. Ses valeurs caractéristiques, durant la saison chaude, présentent quelques écarts par rapport aux lois de sa dynamique et de sa distribution dans les eaux littorales, modifications également signalées en d'autres secteurs (3).

Le présent travail concerne la zone centrale du littoral roumain Constantza (44°10'N)-Portitza (44°40'N) ; il est basé sur l'analyse de 1200 échantillons prélevés de mai à septembre de 1984 à 1987, sur un réseau de 14 stations réparties sur deux profils parallèles à la côte, à une distance respective de 3 et 15 Mm dans la couche de 0 à 40 m.

Les données recueillies ont permis de souligner les particularités suivantes :

. concentrations extrêmement élevées d'oxygène à la surface, pendant toute la période analysée, au-delà du contrôle du régime thermique, fréquemment au-dessus de 9 cm^3/l, ce qui dépasse les conditions normales (5-6 cm^3/l) ; cette situation est due à une activité de phosynthèse extrêmement intense. Le maximum enregistré représentait 18.43 cm^3/l, au nord de la zone étudiée, où l'influence fluviale est plus forte. La nature biotique de l'excès d'oxygène est confirmée par l'état permanent de supra-saturation de la couche superficielle, avec des valeurs supérieures à 150 %, et un maximum de 303,6 % ;

. importante absence d'oxygène dans la couche proche du fond, avec des valeurs dans la plupart inférieures à 3 cm^3/l, minimum 0,43 cm^3/l, toujours au nord du secteur marin étudié. Cet état d'hypoxie, progressant à mesure que la saison chaude avance, est dû aux grandes quantités de substance organique issue de la photosynthèse, qui n'arrivent plus à se minéraliser dans la masse d'eau et tombent dans les sédiments superficiels, ou s'ajoutent aux quantités de matière organique du stock continental et s'y décomposent, en consommant une grande quantité d'oxygène ;

. importante différence entre le degré d'oxygénation des eaux superficielles et celles de profondeur déterminant, pour la distribution verticale, un caractère évident de diminution des valeurs avec des déclins sur la colonne, ayant de grands gradients verticaux (maximum 3 $cm^3/l/m$).

Afin de clarifier toutes ces anomalies, nous avons choisi 300 échantillons pour effectuer simultanément les analyses phytoplanctoniques. Nous avons créé quatre lots de données, en calculant les coefficients de corrélation de l'oxygène avec la température, la salinité et la biomasse phytoplanctonique ; la signification des valeurs des coefficients de corrélation a été révélée à l'aide du test Student.

Valeurs des coefficients de corrélation de l'oxygène avec T°C, S‰ et Fpk mg/cm^3

	1984	1985	1986	1987
O_2 - T	+ 0,062	+ 0,446	+ 0,579	+ 0,180
O_2 - S	- 0,574	- 0,720	- 0,853	- 0,659
O_2 - Fpk	+ 0,777	+ 0,493	+ 0,624	+ 0,590
r	0,329	r 0,174	r 0,230	r 0,149

La principale conclusion que l'on peut tirer du tableau ci-dessus est que dans la zone étudiée (soumise à l'influence permanente du stock fluvial), fortement adoucie et riche en sels nutritifs et en matières organiques, l'oxygène n'est plus corrélé (ou il a une corrélation positive) avec la température, contrairement à la loi de solubilisation des gaz liquides, conformément à laquelle la corrélation est négative. Ce fait s'explique par l'action favorisante de la croissance de la température sur le déclenchement des phénomènes de développement massif du plancton végétal, donc sur le renforcement de l'activité de photosynthèse.

La corrélation avec la salinité est normale, négative, et de même indirecte, sa diminution sensible agissant dans le sens de l'augmentation de la biomasse phytoplanctonique et implicitement de la croissance du taux d'oxygène.

Les observations ci-dessus de reflètent dans la bonne corrélation de l'oxygène avec le phytoplancton, le plus grand coefficient de corrélation étant celui de l'année 1984, où la biomasse phytoplanctonique a atteint un taux maximal.

En conclusion, on peut affirmer qu'au cours de la saison chaude de l'année, dans les conditions mentionnées, le taux d'oxygène est fortement influencé par les facteurs biotiques qui deviennent parfois déterminants. Les coefficients de corrélation calculés peuvent être considérés comme valables, compte tenu du degré important de variabilité de la zone, dont les paramètres ont une évolution considérable dans le temps.

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Oxygen deficient conditions and nutrient status in the Elefsis Bay

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Summary

This paper concern the nutrient status and the oxygen deficient conditions in the Elefsis Bay (Fig. 1), an anoxic basin in the Saronikos Gulf. The concentration of nutrients and dissolved oxygen have been determined during seasonal surveys of water characteristics. The Elefsis Bay threatened by organic overload is in a more serious state of degradation than the rest of the Saronikos Gulf and the destratification phenomenon has substancial effect on the distribution and circulation of oxygen and nutrients in the Bay. The oxygen utilization rates ranged between 1.3 and 1.8 $ml.l^{-1}$ $month^{-1}$ from March to June and were considerably higher than those reported for oceanic waters. The nutrient enrichment appears to be considerably influenced by eutrophication and human activity. Comparison of nutrient levels in Elefsis Bay and in other coastal waters of the Aegean Sea (Fig. 2) is shown in Table 1.

Elefsis Bay, the most industrialized area in Greece, showed a tendency to concentrate all nutrients, but especially ammonium (up to 16 times background). Thessaloniki Bay showed the highest values of phosphate, as well as increased values of ammonium, similar to those in the Inner Saronikos Gulf. The northwestern part of the Thermaikos Gulf, Thessaloniki Bay and Alexandroupolis Gulf contained three times as much silicate as background, owing to the contribution of rivers. The eastern Thermaikos Gulf, the Pagassitikos Gulf and the south Euboikos Gulf presented only slightly greater concentrations of nutrients than those of the Aegean Sea. The north Euboikos Gulf displayed a marked accumulation of nitrate and silicate, due mostly to the great depths and underwater springs. All nutrients were present in all areas at levels well above background. The quality of the receiving waters, with respect to nutrients, depended on the different sources of nutrients, the morphology of the area and the currents.

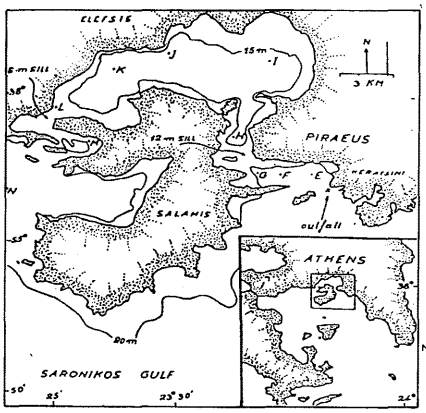

Figure 1 : Locations of the stations across the east-west transect in the Elefsis Bay.

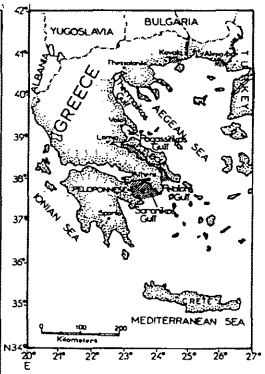

Figure 2 : Map of Greece showing the compared areas.

Table 1

Ratio of total nutrient per Gulf to background nutrients.

Area	PO_4^{-3}-P	SiO_4^{-4}-Si	NH_4^+-N	NO_2^--N	NO_3^--N	DN	Reference
Elefsis Bay	5.31	4.10	12.66	2.64	6.17	8.04	-
Western Saronikos Gulf	2.25	2.95	2.50	1.11	6.39	4.00	Friligos(1983)
Inner Saronikos Gulf	2.50	1.39	4.10	1.55	2.60	3.97	Friligos(1982)
North Eyboikos Gulf	2.87	13.20	1.66	0.49	10.20	5.27	Friligos(1985a)
Kavala Gulf	1.80	1.49	1.00	0.51	1.41	1.10	Friligos(1985b)
Alexandroupolis Gulf	1.32	3.28	1.00	0.65	6.21	3.27	Friligos(1985b)
South Euboikos Gulf	1.46	1.41	0.65	0.48	1.17	0.86	Friligos(1985a)
Pagassitikos Gulf	1.02	2.80	2.60	1.25	2.36	2.28	Friligos(1987)
Thessaloniki Bay	5.33	3.35	4.58	3.83	3.88	4.14	Friligos(1986)
Western Thermaikos Gulf	2.09	3.81	2.91	2.40	3.80	3.22	Friligos(1986)
Eastern Thermaikos Gulf	1.18	2.21	1.97	1.53	2.20	2.00	Friligos(1986)

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Eutrophication assessment based on frequency distribution patterns of some environmental variables

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Fitting physical and chemical variables to frequency distributions may prove to be a powerful tool in the management of coastal waters. If the probability distributions of variables related to eutrophication is established, an assessment of the occurence of nutrient/phytoplankton values above cetain levels will be a procedure carried out on a routine basis from existing bodies of data. In the present paper the fitting of some environmental variables characterising the quality of coastal waters to a number of probability distributions is attempted and the possibility of these to be of use in water quality assessment is discussed.

Sampling was performed monthly from 10 Stations, spaced along the coastal area of the city of Rhodes (Period of sampling: May 1983 - April 1984). The water samples were collected from surface waters and dissolved oxyzen, chlorophylls, phosphate, silicate, nitrate, nitrite and ammonia determinations were carried out (Strickland and Parsons, 1968). Fitting of the data was performed on lognormal and gamma distribution functions (Heyman at al 1984). The goodnes of fit was tested using the Kolmogorov -Smirnov test on the pooled data.

The lognormal frequency distributions of oxyzen, chlg, phosphate, nitrate, ammonia and total inorganic nitrogen are given in Fig. 1. The distribution of oxyzen values is rather symmetrical

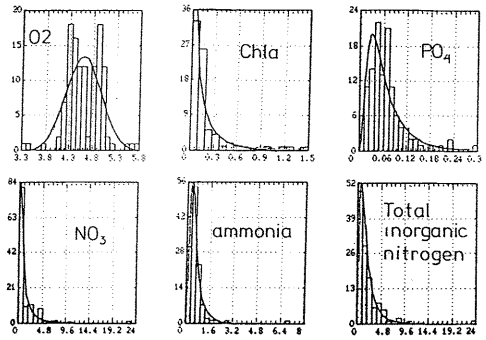

Fig. 1. Frequency distributions of dissolved oxygen, chla and nutrient variables fitted to lognormal distribution.

and good fit was also shown to the normal distribution pattern. The remaining variables follow more skewed distributions. Nitrate, ammonia and total inorganic nitrogen show very short right-hand tails. Phosphate show a distribution pattern more "normalised". The distribution parameters and the goodness of fit are shown in Tab. 1. All parameters showed very good fit to the lognormal distribution. Gamma distribution is only applicable to oxyzen, phosphate and silicate whereas, nitrite showed a better fit to gamma rather than to the lognormal distribution.

Tab. 1. Probability distributions of dissolved oxyzen, chla and nutrient concentrations. Parameters a and b as well as the goodness of fit (K-S test) are given.

Probab. distr.	Para-meter	O2	Chla	PO4	SiO2	NO3	NO2	NH3	TOT N
Log-normal	a	4.60	0.23	0.07	12.87	1.55	0.08	0.61	2.13
	b	0.36	0.45	0.06	6.12	3.35	0.16	0.48	2.38
	K-S*	0.08 **	0.17 *	0.01 **	0.06 **	0.10 **	0.15 *	0.08 **	0.08 **
Gamma	a	155.33	0.52	2.02	3.12	0.32	1.55	0.80	0.60
	b	33.75	2.61	30.24	0.24	0.21	23.72	1.27	0.28
	K-S*	0.08 **	0.25 *	0.11 **	0.13 *	0.28 *	0.09 **	0.26 °	0.23 °

K-S: Estimated Kolmogorov Statistic, ** Not rejected at 95% level
* Not rejected at 99% level, * Rejected at the 99% level.

The results presented above indicate the following:

1. The oxygen distribution pattern is symmetrical and therefore this variable can be considered as being conservative (Heyman et al, 1984).

2. Nutrient and chla distributions are highly skewed with pronounced rihgt-hand tails

3. Lognormal distribution seems to be more satisfactory for assessing the concentration levels of environmental variables.

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C-II13

A comparative study on the nutrients, anionic detergents and environmental parameters in Izmir Bay (Aegean Sea)

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ABSTRACT

In all 10 stations were selected for this study. Primary ecological factors nutrients levels and anionic detergent concentrations were recorded from the polluted towards the non-polluted areas of the bay. The results show that, there is a decrease steadly in the pH, temperature, nutrient levels and detergent concentrations, starting from the inner stations towards the outer ones. The transparency (Secchi disc),oxygen levels and salinity values have increased from in the same direction. However, a fluctuation in the parameters studied was observed due to the seasonal variations in the coastal discharge.

INTRODUCTION

Due to a gradual increase in the volume of effluents from industry, urbanisation and agricultural practices, pollution is effecting the İzmir Bay to a large extent like other bay in the coast of Turkey. The effluents come form different sources 98 discharge points and 7 streams. As such, an important rate of contamination by toxic substances and this is of seen especially during summer months in the bay vital importance for public health.

As indicated in our previous studies (GELDİAY and UYSAL,1978;YARAMAZ and TUNCER, 1985) toxicity of the pollutants effects the biological activity. Both the larval development as well as the oxygen transport are inhibited by 0.1 gr/m³ detergent concentrations in the marine environmet. On the other hand nitrate and phosphate ratios too have been raported to produce toxic effects on the algaes and plancton after certain levels (TOPHING,1976) In view of this, the studies in this direction are being continued.

MATERIALS AND METHODS

Fig. 1 : The locations of the sampling stations in the Izmir Bay.

The locations of the 10 selected sample stations, staring from the inner bay towards the outer, are shown in Fig.1.Samples of water were collected from the different depths using Hydro-Bios water samplers. The sampling was done seasonally during 1986. The analysis of the samples were made by methods described by STRICLAND and PARSONS (1972), WOOD (1975).

RESULTS AND DISCUSSION

The results obtained are given in the tables 1 and 2. In order to give a clear picture of our finding the results have been covered in the figures 1 and 2 too. A persual of these tables and figures shows that, there is a gradual decrease in the levels of nutrients (NO_2^- - N, 1.34-0.03 ; NO_3^- - N, 2.14 - 0.63 ; NH_4^+ - N, 21.24-3.89; PO_4^{-3} - P , 3.32-0.17 ; SiO_4^{-2} - Si, 9.72-3.32 ; ug.at/l; anionic detergent concentrations (4.34-0.42 mg/l); Temp. (18.50-18.13 °C) pH (7.74-7.68) and an increase in the trancparency (Secki-disc 1.93 m - 13.65 m) , DO (5.03-7.25 mg/l), Salinity (‰ 35.60-38.32) as we move from the inner towards the outer bay. On the other hand, a increase in the parameters studied was observed due to the effects of Gediz river discharges.

These results are expected to effect the fauna and flora of the bay to a large extent (KOCATAŞ,1981) the prohibitive steps taken during the last 5 years by the İzmir Municipality seems to have played a great pole in this direction. The Çakalburnu and Ragıp Paşa fishing areas are still inactive due to the pollution effects. If steps are not strenghtened more than the present situations Homa area will too suffer the same fate. It is possible that these strong steps against pollution revive the above mentioned areas too in near future. It appears to us that untill the time the grand Canal Project around tha bay of İzmir is completed there will be an increas in the posphate and nitrate levels, because of the use of phosphate rich detergents in our area. However, this problem could be overcome to some extent by prohibiting the use of said detergents and suggesting the use of NTA detergents.

We believe that, prohibitive steps taken towards the cleaning of some of the polluting sources should be spread over all other sources. A completion of all these steps will revive the marine life in the bay of İzmir.

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Distribution of chlorophyll and nutrients in Izmir Bay (Aegean Sea)

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SUMMARY : In two subregions of İzmir Bay, TIN, phosphate, silicate and chlorophyll-a concentrations were measured between the years 1984-1985. In the Inner Bay which has been polluted Si:N:P ratios were 4.68:7.02:1 while they waere 51.45:20.55:1 in an unpolluted region, Gülbahçe Bay. From these ratios and nutrient-chlorophyll correlations, it was suggested that TIN and Phosphate may be the limiting nutrients in the Inner Bay and Gülbahçe Bay respectively.

INTRODUCTION : The knowledge of the nutrient levels and nutrient ratios in the Aegean sea were reported by Mc GILL (1963),FRILIGOS (1981), BÜYÜKIŞIK (1983), BÜYÜKIŞIK and ERBİL (1987) but chlorophyll observations in the eastern part of Aegean Sea have not been reported. This paper will give the unique observations of chlorophyll concentrations and nutrient levels in the eastern part of Aegean Sea.

MATERIAL AND METHODS : Sampling were made vertically at the stations given in figure 1 between 1984-1985. Chlorophyll-a were measured using three chromatic method. Nutrients were determined according to STRICKLAND and PARSONS (1972). Totally 30 samples were taken in Gülbahçe Bay at the date of 30th May, 13th August, 14th November 1984. 44 samples were also taken in Inner Bay at the date of 25th May, 14th August, 15th November 1984 and 27th February 1985.

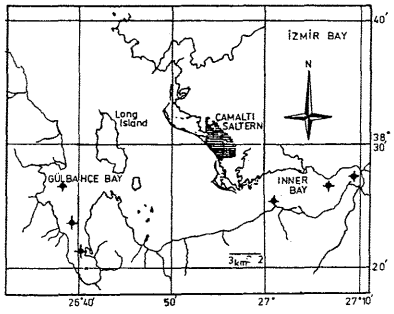

Figure 1: İzmir Bay and location of stations.

RESULTS AND DISCUSSION :

In the Gülbahçe Bay, the chlorophyll-a concentrations were low in May (mean:0.85 µg/l.,range: 0.45-1.37) and increased in August (1.87,1.09-3.18). In November, mean value decreased again (0.20,0.02-0.34). The mean nutrient concentrations and ranges were the following: Total inorganic nitrogen (2.26 µg-at/l., 0.5-5.3), reactive phosphate (0.11 µg-at/l .,0.00-0.37), reactive silicate (5.66 µg-at/l., 0.99-17.37).

In the Inner Bay, while the mean chlorophyll-a's value was 5.33 µg/l (1.61-9.36) in May, it increased to 13.32 µg/l. (2.29-24.22) because of the diatome growth (BÜYÜKIŞIK and ERBİL, 1987) in August and decreased to 4.07 µg/l. (0.5-7.69) in November. By the end of February, another diatome bloom raised the value to 28.04 µg/l. (1.68-61.87). The mean nutrient concentrations were the following: TIN (10.11 µg-at/l.,0.4-35.9), reactive phosphate (1.44,0.0-4.6), reactive silicate (6.74 µg-at/l.,0.3-35.7).

There was a good correlation between TIN, P and Si in the Inner Bay. The relationships were expressed as [TIN] = 9.76 [P] -3.07 (cor.:0.927) and [Si] =3.728[P] + 1.379 (cor.:0.731). These two equations express that Phoğsphate and silicate will still be present while TIN were consumed completely. From these results, it follows that TIN is likely to be a limiting nutrient in the Inner Bay. Si:N:P ratios were low (4.68:7.02:1) in the Inner Bay. The low Si:P ratio arise from the silicate depletion of diatomes and from slower turnover rate than that of phosphate. The Si:N:P ratios in Gülbahçe Bay were 51.45:20.55:1. These high ratios are due to the phosphate deficient waters of Gülbahçe Bay. Phosphate is more limiting to phytoplankton than total inorganic nitrogen and silicate. The following relationship proves that result too: [Chl-a(µg/l)] =2.559[P(µg-at/l)] +0.780 (cor.:0.366). TIN and silicate were inversely related with chlorophyll because of the fact that phosphate deficient waters, containing low chlorophyll-a, have high nitrogen and silicate. Hiperbolic relationships were found in the Inner Bay due to the high biological productivity.

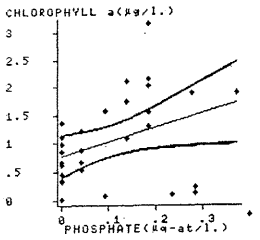

Figure 2: The phosphate/chlorophyll-a relationship in Gülbahçe Bay.

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Dissolved nutrients in the Levantine Basin of the Eastern Mediterranean Sea

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The Mediterranean Sea has been described as the most impoverished large body of water in terms of dissolved nutrients (Redfield et al., 1963). There are a number of studies which have determined the nutrient concentrations in the western and central Mediterranean Sea. In this study, dissolved nutrient data are presented from a cruise of the R/V Shikmona in the Levantine basin of the Eastern Mediterranean Sea south of Cyprus in August-September 1987. Mesoscale eddies have been recognized and studied as potentially important oceanographic features. Recently, similar eddy features have been discovered in the Levantine basin of the eastern Mediterranean Sea (Robinson et al., 1987). Fox and Kester (1986) noted that dissolved nutrients can be used to identify and delineate such mesoscale eddy features. We have used analysis of dissolved nutrient as well as temperature profiles to search for the presence of such eddy features within this region of the Levantine basin.

The temperature and salinity measurements were measured in situ by a Neil Brown CTD. The nutrient determinations were carried out in the lab on samples which had been preserved by freezing on a rapid flow analysis Alpkem system. For a complete description of the methodology used see Krom et al (in prep).

The temperature and salinity profiles were typical of previous data from this region of the Eastern Mediterranean in summer. There was a 30-50 m deep mixed layer. At a depth of 70 m there was a salinity minimum of N. Atlantic water. From 100 to 500 m the Levantine intermediate water was found which was underlain by deep water which continues down to as far as was sampled (2000 m). This pattern was also observed using nitrate and A.O.U. data to calculate "preformed" nitrate. The upper layers, to a depth of 150 m, had low nutrient content. The deep waters below 500 m reached levels of 5.5.-6.3 uM nitrate and 10-12 uM silica. These values of dissolved nutrients at depth were much lower than those found typically at similar depths in other oceans: 40 uM nitrate in the Pacific and Indian Oceans and 20 uM nitrate in the Atlantic Ocean, 130 uM silica in the Pacific and Indian Oceans and 40-100 uM silica in the Atlantic Ocean (Spencer, 1975).

Fig. 1a and b represents the vertical distribution of temperature, salinity and dissolved nutrients across two of the three major E-W tracks of this cruise. On the southerly track (32.5°N) there was very little variation between stations (Fig. 1a). Based on the temperature and salinity profiles which were measured every 50 kms on this leg, there was no evidence of any mesoscale eddy features in this region.

On the more northerly track (33.5°N), two eddy features were encountered and can be clearly defined (Fig. 1b). The major structure was centered on station 338. It is a warm core eddy in which the thermocline and nutrient iso-concentration lines are depressed by 350 m relative to the adjacent areas. It is not possible on the basis of temperature and salinity contouring alone to determine how deep the feature extends, because the temperature and salinity are essentially constant below 500 m. However, the contours derived from the silica profiles show clearly that the eddy extends down to at least 2000 m depth. A second mesoscale feature centered on station 335 was also observed.

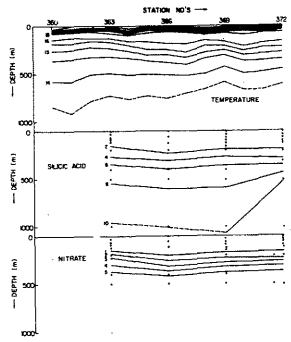
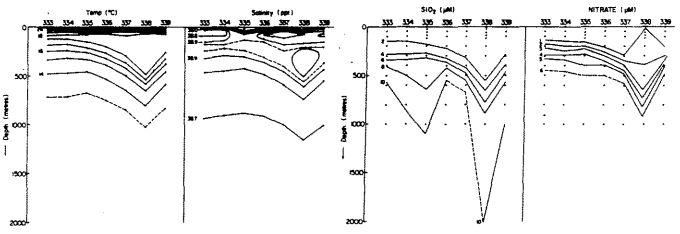


Fig. 1. Section in the Eastern Mediterranean (Aug. 1987). Isopleths indicate temperature, salinity, silicic acid and nitrate. See Krom et al. (in prep.) for precise station locations.
(a) at 32.5°N,
(b) at 33.5°N, showing a warm core eddy.



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C-III2

The emission of humic acid fluorescence by phytoplankton

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ABSTRACT

The chlorophyll-α and humic acid fluorescence of phytoplankton cultures and of samples of coastal sea water from the Northeastern Mediterranean have been measured. Cultures of phytoplankton were maintained under sterile conditions at 25 °C. The number of cells present was determined periodically by optical microscopy. Humic acid concentations were determined spectrofluorometrically using 360 nm exitation and monitoring 455 nm emission according to the procedure given by Balkaş *et al.*, (1983) and commercial soil humic acid was used as a standard. Chloropohyll-α concentrations were also determined spectrofluorometrically using exitation at 425 nm and monitoring emmision at 660 nm according to the procedure of Strickland and Parsons (1968) and using coproporhyrin as a standard.

The phytoplankton culture generated humic acid fluorescence as soon as cells started to die. Figure 1 shows typical generation of humic acid fluorescence by *Nitzia Longissima* diatoms and the number of living intact cells in the culture. Probably all species of phytoplankton generate "humic acid" fluorescence as is suggested in Figure 1 by the rise in emmission when a culture of mixed phytoplankton was added to the sterile nutrient-humic acid solution. In a healthy colony of phytoplankton birth and death will be occuring simultaneously, growth being the excess of births over deaths. These results suggest that the intensity of "humic acid" fluorescence may be usable as a measure of death rate.

Statistical measurements of the intensity of humic acid fluorescence from samples of surface water collected from the NE Mediterranean resulted that in the coastal region humic acids occur non randomly in clumps.

Further insight into the distribution of humic acid in coastal waters of the NE Mediterranean was obtained from its depth profiles with the chlorophyll-α profiles (Figure 2). At some locations and at the same time the humic acid and chlorophyll-α concentrations were in phase, maximum and minimum concentrations of both compounds occured at the same depths and the concentration of humic acid was approximately proportional to the concentration of chlorophyll-α. The laboratory studies of phytpoplankton suggest that such results should be interpreted as observations of healthy colonies of phytoplankton, the concentrations of humic acid being consequence of the more or less stable rate of mortality within the colony. Sometimes humic acid and chlorophyll-α concentrations were out of phase, humic acid maxima occuring at the same depths as minima in the chlorophyll-α concentrations. In these instances it is natural to regard the humic acid as arising from decayed or decaying vegetation. Thus it would seem that in these unproductive coastal waters much of the humic acid fluorescence of the sea generated from colonies of living phytoplankton and from decaying vegetation and that in consequence it is distributed non randomly in clumps

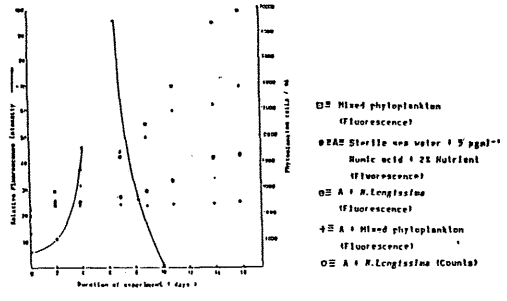

Figure 1. Development of fluorescence from phytoplankton culture

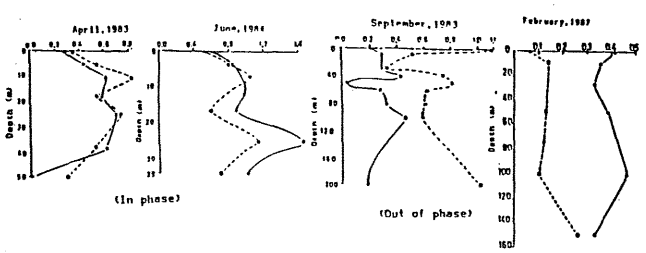

Figure 2. Humic material and chlorophyll-α profiles in the Northeastern Mediterranean

Humic material (------) chlorophyll-α (———)

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C-III3

Distributions of nutrient elements in the Northeastern Mediterranean : physical factors affecting the distribution

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The Mediterranean Sea, particularly the eastern Mediterranean, has long been known as an impoverished body of water (McGill, 1961, 1965 and 1969; Schink, 1967; Miller et al., 1970 and Morcos, 1972) due to the low levels of nutrient elements. Incoming Atlantic surface waters are already low in nutrients, and therefore unable to replenish losses due to outflow of the relatively nutrient-rich intermediate water through the Strait of Gibraltar. While the oceanographic data related to the levels of nutrient elements within the southern and southeastern sections of the eastern Mediterranean are considerable (Israel Report, 1985; Morcos, 1972; McGill, 1961, 1965; and Emara, 1973), there is only one set of data within the northeastern basin of the Mediterranean which was obtained during the October-November, 1961 cruise of R/V Chain.

In order to fill the gaps in the data related to the levels and horizontal distributions of nutrient elements within the eastern Mediterranean, levels of nutrient elements, namely ortho-phosphate ($o\text{-}PO_4$), molybdate reactive silicate ($Si(OH)_4$) and total oxidized nitrogen compounds (NO_3+NO_2) (ONC) were measured seasonally within the coastal and off-shore regions of the northeastern Mediterranean during the 1986-1987 cruises of R/V BILIM. Data were taken in April, June and November, 1986 and in February-March, June and September, 1987. Concentrations of nutrients were found to be very low within the upper 100m depth layer and rapidly increased below 100m down to 800m. The concentration ranges for the ortho-phosphate, reactive silicate and oxidized nitrogen compounds (ONC) for the upper layer waters were found to be in the range of 0.04-0.50 μg-at P/l, 0.50-3.0 μg-at Si/l, and 0.50-3.0 μg-at N/l, whereas those of deeper layers were 0.10-0.50, 4.0-5.0, and 4.0-10.0 μg-at/l, in respective orders. The striking feature in both horizontal and vertical distributions of nutrient elements is the good correlation with the circulatory features of the region. The presence of meso- to large-scale cyclonic and anticyclonic gyres in the region affects the distribution of nutrient elements within the area. The Rhodes gyre is a well known and relatively large scale cyclonic gyre located in the western section of the northeastern Mediterranean. Nutrient-rich deep waters in this region are transported upward into the upper euphotic zone by vertical movements at the center of the gyre. The consequence of this upwelling is the enhancement of primary productivity and standing stock of the area. The anticyclonic gyres found in the offshore regions of the Antalya Bay and Iskenderun Bay are the areas where reverse processes in the nutrient distribution are observed.

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C

Deep chlorophyl- a maximum in the Northeastern Mediterranean

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Chlorophyll-α used as an estimation there of the standing phytoplankton crop, investigated in the Northeastern Mediterranean. The analysis of chlorophyll-α was performed on the 90% acetone extracts and both spectrophotometrically and spectrofluorometrically. Strickland and Parsons' (1968) formula was employed for the calculation of spectrophotometric results from the absorbances measured at 750, 600-665, 645 and 630 nm. Calibration used coproporphyrin I-tetra methyl ester as a standard and this chlorophyll-like substance was absolutely measured spectrophotometrically for the determination of low chlorophyll-α concentration by spectrofluorometry. An emission wavelength of 660 nm and exitation wavelength of 425 nm were used with a 60 nm bandwith. The vertical attenuation of light was measured by a submarine photo-detector. The detector measured the percentage of light at selected depths with respect to the intensity of the surface light. Inorganic phosphate, (nitrate+nitrite) and reactive silicate were measured by Technicon II Autoanalyzer following the methods given by Strickland and Parsons, (1968).

Sea water samples were collected by R/V BİLİM, a research vessel of Middle East Technical University, covering the period from April,1983 to February,1987. Deep chlorophyll-α maxima were observed in the NE Mediterranean regardless of the time of the year execpt winter and the location. Deep chlorophyll-α layer usually located at a depth of 1-10 % of the incident suface solar radiation and the layer coincided with the depth range of slight nutrient gradient layer and this corresponded to the 80-130 m range in the water column in the NE Mediterranean. The typical exemples of deep chlorophll-α maxima together with the vertical distribution of temperature, solar radiation and nutrients are illustrated in Figure 1. Deep chlorophyll-α has regularly been noted in oligotrophic waters (Cullen, 1982) and in the Eastern Mediterranean, off the Israeli Coast (Berman *et al*;, 1984 a).

The reasons for the deep chlorophyll-α maxima can be discussed as follows: Phytoplankton cells may aggregate within the nutricline due to increased buoyancy or other behavioral characteristics. As is clearly seen from Figure 1 the euphotic zone is poor in nutrient supply and a slight increase of nutrients with depth encourages the primary producers to inhabit deep waters. A very significant portion of phytoplankton biomass and phytosynthetic activity in oligotrophic regions is associated with organisms smaller than 3 μm even 1 μm (Johnson and Sieburth,1979; Li *et al.*, 1983). Often these pico-planktons are relatively more numerous towards the bottom of the euphotic zone or in deep chlorophyll maxima and they are adapted to low intensity of light in the green region of the spectrum (Platt *et al.*, 1983). At all seasons both for nearshore and pelagic waters, the majority of the chlorophyll in the Eastern Mediterranean is associated with organisms smaller than 3 μm (Berman *et al.*, 1984 b). The euphotic zonein the NE Mediterranean is relatively deep since the 1% of the incident solar radiation was detected in the range of 100-120 m and photosynthetic active phytoplankton prefer to inhabit the deeper levels of the euphotic zone.

The horizontal and vertical distribution of chlorophyll-α were also influenced by the physical aspescts in the NE Mediterranean, especially the regional (cyclonic and anticyclonic) circulation systems.

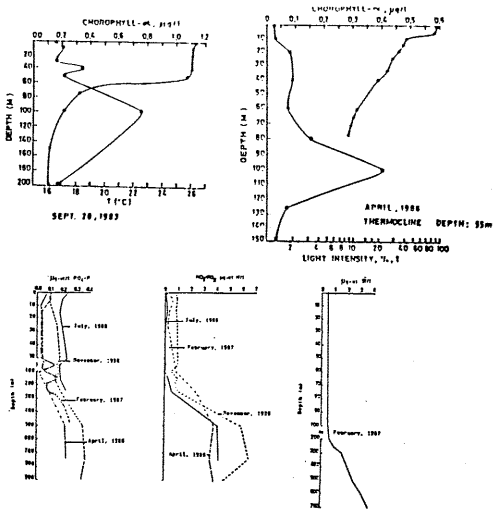

Figure 1. Vertical distribution of chlorophyll-α, water temperature, light and nutrients in the NE Mediterranean

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The composition of sediments from the Northeastern Mediterranean

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ABSTRACT

Mediterranean waters are quite oligotrophic and water becomes increasingly poor as it moves eastwards. Thus the sediment underlying these waters is not as rich in organic material as have been expected, but 1-10cm thick Halocene and Pleistocene sapropels -organic rich clays- are widely distributed in the Eastern Mediterranean (Kullenberg, 1952; Calvert,1983; Shaw and Evans, 1984). The nature, distribution and origin of sapropels in the sediments of especially the Northeastern Mediterranean is lacking, thus the present study is just a start for the future investigation of the chemical compostion of the sediments and the sapropel and sapropelic layer of the sediments in the region. For this purpose core samples were collected during the April,1983 cruise of R/V BİLİM to the NE Mediterranean.

The core samples were collected using a piston corer lined with plastic tube. Opal and quartz were determined on smear slide sediment samples by X-Ray Fluorescence Spectrometer with CuKα radiation following the methods of Eisma and Van der Gaast, (1971) and Calvert, (1966) respectively. The total organic carbon and carbonate were determined using a gravimetric Carbon Analyzer and measuring the carbondioxide evolved by dry combustion at 1100 °C and by hot 10% HCl respectively. Humic acid was extracted from the dry sediment with 0.5M NaOH at reflux temperature. The extracted humic acid is precipitated by the acidification of the extract with 0.1M HCl to pH=2.

The organic carbon content of the sediment samples from the coastal shelf of the NE Mediterranean was very low and measured less than 1% of dry weight. The low percentage of opal, >5%, is also consistent with the low organic carbon content. The concentrations of quartz and clay minerals were also low in the analyzed sediment samples their quantities can be given as >7% and >28% respectively. Thus the major component of the Northeastern Mediterranean coastal sediments is calcium carbonate since for all the analyzed sediment samples the concentration of $CaCO^3$ was in the range of 61-63% . The concentration of total organic carbon in the sediment was found relatively high, 3.8%, at one of the sampling station since the area seems to be under the effect of terrestrial input. On the other hand there is weak possibility of the presence of sapropelic layer in this core sample. The assumption is weak because the total depth of the water column was around 70 m depth where the core sample was collected and it was previously shown that the sapropelic layer was observed in the sediments of 400 m depths or more in the NE Mediterranean (Shaw and Evans, 1984).

The amount of humic acid extracted from the NE Mediterranean coastal sediment samples is quite low, being approximately 1% of dry weight. Humic acid accounts for about 2.0-5.5% of the organic matter in these sediments. In the Eastern Mediterranean sapropels, humic acids were found to amount 22-60% of the total organic material (Deroo, 1978).

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C-III6

Echange de sels nutritifs et d'oxygène à travers le détroit d'Otrante et l'arc de Crète

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Abstract. This paper presents a preliminary study of the exchange process of the Ionian sea with the Adriatic and Aegean sea, based on the data from LIA-5 cruise of R/V AEGAIO (March - April 1987).

We identified the mixing of the Adriatic water with the Levantine one, in the vicinity of Otranto Strait. The water inflowing from the Adriatic is of recent formation, rich in oxygen and poor in nutrients. Exchanges between the Aegean and Ionian seas through the straits of the Cretan Arc show a supply of nutrients in the Aegean by the inflow of LIW from the Levantine intermediate water.

La mer Ionienne joue un rôle important dans la circulation de la Méditerranée Orientale. En effet, elle communique à la fois avec le bassin occidental à travers le détroit de Sicile, avec la mer Adriatique à travers le détroit d'Otrante et avec la mer Egée à travers les trois détroits occidentaux de l'Arc de Crète.

Dans cet article nous examinons les échanges de la mer Ionienne avec l'Adriatique et la Mer Egée. Les données utilisées proviennent de la campagne LIA-5 réalisée en Mars - Avril 1987 à bord de N/O AEGAIO (Figure 1).

Les eaux profondes des stations 1,2 et 3, proches du détroit d'Otrante, ont des importantes concentrations en oxygène (>5,5 ml/l, Figure 2) ce qui indique qu'elles sont formées récemment. En effet cet masse d'eau dense (σt>=29,20) est de l'eau d'Adriatique "Ad" formée en hiver au sud de cette mer (Wust 1961, Zore - Armanda 1972, Georgopoulos et al. 1986).

La distribution verticale de l'oxygène, des nitrates et des phosphates présente d'importantes fluctuations dans les couches profondes de ces stations qui sont due au mélange des eaux de l'Adriatique qui sortent au-dessus du seuil avec les eaux de la mer Ionienne qui se dirigent vers le détroit.

Les eaux profondes (au-dessous de 600 m) de la mer Ionienne deviennent homogènes à partir du sud de 39°N latitude. L'oxygène se stabilise autour d'une valeur de 4,2 ml/l (Figure 2) les phosphates 0,2 µM et les nitrates 5 µM. Cette eau homogène est

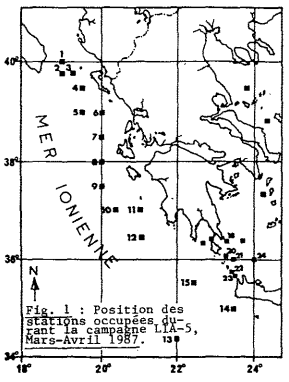

Fig. 1 : Position des stations occupées durant la campagne LIA-5, Mars-Avril 1987.

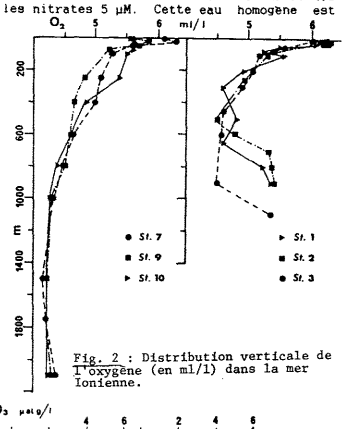

Fig. 2 : Distribution verticale de l'oxygène (en ml/l) dans la mer Ionienne.

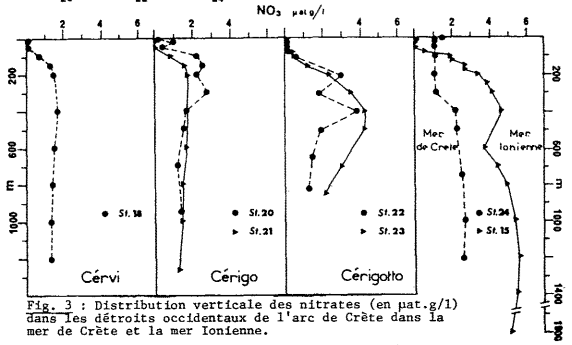

Fig. 3 : Distribution verticale des nitrates (en µat.g/l) dans les détroits occidentaux de l'arc de Crète dans la mer de Crète et la mer Ionienne.

de l'eau profonde de la Méditerranée Orientale formée selon Lacombe et Tchernia (1972) par le mélange de l'eau Adriatique "Ad" avec l'eau Levantine "Le" dans une propotion de 7:1.

Il faut remarquer que les stations proches du détroit d'Otrante ont un rapport N/P ~ 26,4, différent des autres stations de la Mer Ionienne (N/P ~ 20,9). Cette différence provient probablement des diverses proportions du "Ad" et du "Le" dans ces deux groupes des stations.

En ce qui concerne les échanges avec la Mer Egée à travers les trois détroits occidentaux (Cervi, Cerigo, Cerigotto) de l'Arc de Crète, on peut constater, à partir des distributions verticales des nitrates dans les stations proches des détroits, que l'apport en sels nutritifs dans la Mer de Crète en cette époque se fait principalement par le détroit de Cerigotto (Figure 3). Il faut noter que le seuil de ce détroit est plus profond que les deux autres et sa largeur est de 32 km.

En comparant la station 24 dans la mer de Crète avec la station 15 dans la Mer Ionienne, à l'ouest des détroits (Figure 3) on peut constater un important appauvrissement des eaux profondes en sels nutritifs dans la Mer de Crète.

En Mer de Crète on observe une couche superficielle mélangée, caractéristique de cette saison, qui arrive à 300 mètres de profondeur, avec une concentration constante en nitrates (1 µM). A partir de cette profondeur la concentration des nitrates augmente légèrement pour se stabiliser autour de 2,5 µM (Figure 3). Par contre, la couche de surface en Mer Ionienne est complètement privée de nitrates. Un fort gradient apparaît entre 100 et 400 mètres. Au-dessous de 600 mètres la concentration des nitrates se stabilise (Figure 3).

En conclusion, cette étude préliminaire permet d'identifier les processus de mélange de l'eau Adriatique avec l'eau Levantine à proximité du détroit d'Otrante pendant la période de Mars - Avril. L' eau entrant de l'Adriatique est une eau de formation récente riche en oxygène et pauvre en nutritifs. L'échange aver la Mer Egée à travers l'Arc de Crète fait apparaître un apport de sels nutritifs vers le sud de la Mer Egee, par l'entrée d'eau intermédiaire Levantine.

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C-III7

Recherches des paramètres physico-chimiques, des sels nutritifs et des détergents anioniques dans la pêcherie d'Homa, Izmir (Turquie)

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RESUME

Nous avons étudié les concentrations des sels nutritifs et des surfactants, les données hydrographiques T°C, DO, S‰, pH, NO_2-N, NO_3-N, NH_4^+-N, PO_4^{-3}-P, SiO_4^{-2}-Si, Sestone, les détergents anioniques, en 1986, chaque mois au niveau de trois stations situées dans la pêcherie d'Homa, entre la rivière Gediz et la saline Çalmati, dans la baie extérieure d'Izmir.

Les résultats obtenus laissent apparaître que T°C, DO, S‰, pH varient de 4°C à 30,5°C ; de 6,0 à 11,2 mg/l ; de 27,49 à 38,61 ‰ ; de 7,45 à 8,10. NO_2-N, NO_3-N, NH_4^+-N, PO_4^{-3}-P, SiO_4^{-2}-Si, Sestone et les détergents anioniques varient également de 0,12 à 1,76 ; de 0,52 à 5,12 ; de 2,53 à 62,59 ; de 0,19 à 8,08 ; de 1,63 à 19,22 µg.at/l ; la Sestone oscille de 30,90 à 274,00 mg/l ; de 0,11 à 4,22 mg/l en fonction des stations.

INTRODUCTION

La pêcherie d'Homa située à 38°33'10"N et 26°49'50"E a une superficie de 1800 ha et la profondeur moyenne est d'un mètre ; elle se trouve dans la baie extérieure d'Izmir (Fig. 1).

Cette pêcherie est l'une des plus importantes de la région Egéenne. La production annuelle de poisson de cette pêcherie varie entre 30 et 60 tonnes. En 1986-1987, 35 tonnes de S. auratus L., 15 tonnes d'A. anguilla L., 10 tonnes de Mugil spp. et 5 tonnes d'autres espèces, dont la valeur économique est très élevée, ont été recueillis.

MATERIEL ET METHODES

Les prélèvements ont été effectués en surface ; les trois paramètres, les déterminations de T°C, de DO (mg/l) et de pH, ont été réalisés in situ. Jusqu'au laboratoire, les échantillons d'eau de mer ont été conservés dans le mélange glace-sel.

La salinité a été dosée à l'aide d'un Beckman Modèle RS-7B, la Sestone au moyen de millipore filtres systèmes et les autres paramètres par spectrophotométrie Perkin-Elmer Modèle 35 (1, 2, 3).

RESULTATS ET DISCUSSIONS

Concentrations moyennes des paramètres étudiés :

	Station 1	Station 2	Station 3
T°C	19,42±0,55	19,35±0,53	19,10±0,40
DO (mg/l)	8,19±0,19	8,06±0,16	8,33±0,08
S ‰	34,55±0,11	34,50±0,08	36,27±0,07
pH	7,78±0,02	7,74±0,02	7,69±0,01
NO_2^--N (µg.at/l)	0,77±0,18	0,69±0,25	0,45±0,15
NO_3^--N (µg.at/l)	2,31±0,26	2,20±0,25	2,03±0,36
NH_4^+-N (µg.at/l)	14,57±1,43	14,26±1,15	6,98±0,73
PO_4^{-3}-P (µg.at/l)	1,71±0,51	1,56±0,46	0,88±0,27
SiO_4^{-2}-Si (µg.at/l)	9,55±1,09	10,42±1,30	8,58±1,74
Sestone (mg/l)	77,76±1,08	79,03±1,10	120,00±1,97
Dét.an. (mg/l)	1,71±0,33	1,41±0,34	1,04±0,22

Comme on peut le constater sur le tableau, les concentrations de la Station 1 sont plus importantes que les autres, en fonction de la rivière Gediz.

La pêcherie d'Homa est influencée par la pollution de la baie d'Izmir et par les apports de la rivière Gediz (4).

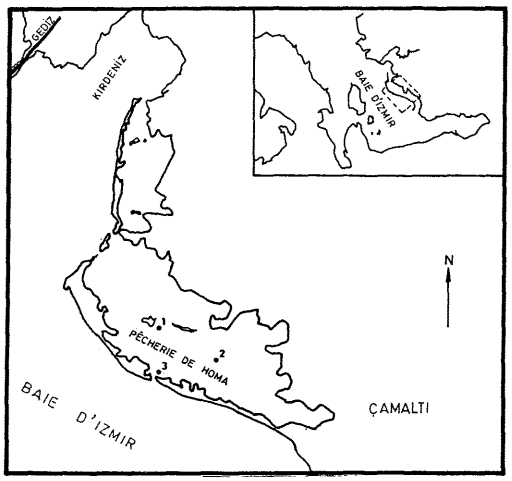

Figure 1

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C

Seasonal variation of nutrients, dissolved Oxygen, pH, temperature, transparency and salinity in Thermaikos Bay (1984-1987)

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The Bay of Thessaloniki and the greater Thermaikos coastal area are considered very important assets of this part of the Mediterranean Sea. Located in the North-West corner of the Aegean Sea, the Bay of Thessaloniki is actually used for various activities of economic and social interest such as shipping, fishing and recreation. The population of the metropolitan area of Thessaloniki is estimated to be about 1.000.000. The harbour of Thessaloniki is steadily growing many projects for extention are under study Various tourist resorts have been developed along the coast of the Bay.

The Bay is the final receiver of the total amount of wastes from various sources of domestic and industrial origin, so it is ivenitable that it is polluted. Various chemical and microniological analyses conducted during the last years in a number of locations in the Bay have indicated that in a distance of 4-5 km from the city the water was heavily polluted.

The seasonal variations of the distribution of temperature, pH, transparency, dissolved oxygen, phosphates, nitrates, nitrites, ammonia, silicates and salinity have been studied in the Thermaikos bay at nine stations and at various depths in the water column during the period September 1984 - July 1987. Studies of the above-mentioned parameters have been made in the Thermaikos bay by Friligos ten years ago.

Seawater samples were collected from surface, mid-depth and bottom with a Nansen sampler of 1,5 l capacity.

Temperature were obtained with a thermometer attached to the Nansen sampler. The fixation of the dissolved oxygen was made on board as rapidly as possible after the sampler had been recovered. The determination was made later in the laboratory using the Winkler method as modified by Grasshoff (1983). A Secchi disc was used for tramsparency measurements. The Salinity and Conductivity measurements were made on board using a WTW Mod. LF 191 salinity meter equipped with a measuring cell LT 1/T (cable length 50 m). The water samples for nutrient analyses were collected in 100 ml glass bottles (Si - samples in PVC bottles) and kept under deep freeze. After thawing they were analysed as described by Gasshoff (1983). A Perkin Elmer Mod. lamda 3 spectrophotometer was used for the measurements.

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Hydrographic and chemical properties of Middle and South Adriatic Sea water

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During 1986-1987 investigations of physical and chemical properties of waters of the middle and south Adriatic sea were carried out, on 19 stations divided into four characteristic areas.

On the basis results obtained during these studies and previous longterm investigations, which this Institute has been doing in the middle Adriatic sea, we can conclude that in the entire area we have intensive processes of mixing water masses.

Table 1. Mean values, range and coefficient of variation (c.v%) of nutrients (mmol/m^3) and some trace metals in water (W), sediments (S) and marine organisms. (MO) at four characteristic stations in the studied area.

Stations		201	204	210	218
Parameters					
PO_4-P	$\bar{x}$	0.061 ± 0.02	0.063 ± 0.02	0.065 ± 0.04	0.051 ± 0.03
	c.v.	3.23	3.23	6.15	5.88
	P	0.047	0.104	0.146	0.103
NH_4-N	$\bar{x}$	0.66 ± 0.29	0.66 ± 0.30	0.83 ± 0.44	0.74 ± 0.55
	c.v.	43.9	44.8	48.3	74.3
	N	0.55	1.30	2.36	1.36
NO_2-N	$\bar{x}$	0.173 ± 0.08	0.111 ± 0.04	0.115 ± 0.5	0.156 ± 0.09
	c.v	46.2	36.0	43.5	57.7
	N	0.288	0.188	0.355	0.410
NO_3-N	$\bar{x}$	0.76 ± 0.18	1.17 ± 0.36	0.83 ± 0.31	0.72 ± 0.39
	c.v	23.7	39.1	37.4	54.2
	N	0.58	3.71	2.77	2.14
Hg	W*	2.2 ± 1.1	2.4 ± 2.3	2.5 ± 2.0	1.9 ± 1.1
	S**	43.3	80.0	70.0	80.0
	MO***	260	350	370	1090
Zn	W	640	770	510	1070
	S	11.6	44.6	79.5	37.0
	MO	3910	2600	2150	-
Cd	W	117	30	23	30
	S	0.10	0.10	0.06	0.04
	MO	10	10	10	-
Pb	W	230	90	170	170
	S	18	29	38	29
	MO	1000	1000	1000	-
Cu	W	340	130	220	320
	S	3.04	24.1	27.4	21.1
	MO	380	470	17670	-

* Values in ng/dm^3 of water (W)
** Values in µg/kg DW of sediments (S)
*** Values in µg/kg FW of marine organisms (MO, Mullus barbatus)

Hydrography and chemical parameters shou us, that the whole studied area belongs to the warm sea with rather high salinity, well aerated sea, with high content of oxygen (O_2) and saturation of oxygen and poor in nutrients. (Buljan, M. 1976). (Tab. 1).

Despite the above mentioned facts we still have high organic production (Pucher-Petković, T. et al. 1985) which possibly enables rapid turn-over and contributes to a high production rate (about 90 gC/m^2 year).

As far as concentrations and distribution are concerned, we can conclude that assimilation-regeneration processes have a main role in the nutrient cycle in the Adriatic sea.

We have also investigated content of some heavy metals (Hg, Zn, Cd, Pb and Cu) in water sediments and marine organisms. Obteined data (tab. 1) are at the level of natural content of those elements in ecosystem, (Branica, M. et al. 1985), that is, the study area is not influenced by antropogenic factors, although in some organisms we have recorded higher concentration of some elements, especially mercury. Therefore, it should be pointed out that special attention should be paid to a continuous "monitoring" of these metals in the sea, especially in sediments and marine organisms.

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C-III10

Some results of the transadriatic oceanographic cruises with R/V "Andrija Mohorovicic" in April 1987

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As usually, the Adriatic, as an inland sea, essentialy depends on hydrometeorologic and dynamic properties of the basin.

These properties, during the spring cruise of 1987 were once more specific and are reflected on its oceanographical (physical, chemical and biological) parameters.

Especially, untill now unusual phenomena were first time registred in the euphotic zone of the Southern Adriatic.

Explanations and results of these more recent oceanographic researches will be given and analysed.

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C-III11

Changes of UV-hydrolizable Phosphorus and Nitrogen in the Northern Adriatic Sea

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INTRODUCTION

The Adriatic Sea is, as the whole Mediterranean Sea poor in nutrients. However, the northern Adriatic is one of the most productive areas of the Mediterranean. This area receives highly polluted discharges from the Po River (mean flow rate 1500 m^3/s), which supports blooms in the open waters in spite of the generally low concentrations of orthophosphate and inorganic nitrogen in the region. However, it was observed that not only orthophosphate, but also organic phosphorus shows significant seasonal changes due to basic biological cycle. It can be supposed that the same occur also for organic nitrogen. So, for better characterization of trophic level of this area distribution of total phosphorus and total nitrogen were studied, since they can be important sources of these elements for primary producers.

MATERIALS AND METHODS

Measurements were carried out at six stations in the central part of the northern Adriatic Sea during 23 cruises performed in the period from 1980 to 1984. Samples for total phosphorus and nitrogen were collected from at least four depths and stored in polyethylene bottles at -30 °C until analysis. Determinations were carried out a few days after collection in unfiltered water after oxidation of organic matter by UV-irradiation (250 nm). Basic physical, chemical and biological parameters were determined immediately after collection.

RESULTS AND DISCUSSION

The measured parameters in the northern Adriatic Sea have significant spatial and temporal variation. At the western part of this area salinity values in the surface layer falls up to $30 \cdot 10^3$, and concentrations of total phosphorus and total nitrogen up to 1.3 µmol/l and 30 µmol/l, respectively, could be reached (Table 1). These waters with higher nutrient content can support higher primary production, resulting in oxygen oversaturation in this layer. In the bottom layer oxygen concentration far bellow saturation were found, as results of intensive decomposition of organic mater and accumulation of nutrients. Generally, the concentration of total phosphorus and total nitrogen in this area were significantly higher of those measured at the eastern part of the northern Adriatic Sea (Table 1). In the surface and bottom layer most of the measured values for total phosphorus and total nitrogen (more than 80%) were grouped in interval from 0.05 to 0.25 µmol/l and 1 to 10 µmol/l, respectively, which was nearly two times larger of those obtained for the eastern part. However, their concentrations in intermediate layer were significantly lower, and did not differ from those measured in eastern part (Table 1).

Table 1. Mean values ($\bar{x}$) and ranges (R) of total phosphorus (TP) and nitrogen (TN) and contribution of organic phosphorus ($cont_{oP}$) and organic nitrogen ($cont_{oN}$) in surface (S), intermediate (I) and bottom (B) layer of the northern Adriatic Sea.

PARAMETERS	layer	EASTERN PART n	$\bar{x}$	R	WESTERN PART n	x	R
	S	63	0.16	0.03-0.48	63	0.32	0.03-1.33
TP	I	81	0.12	0.04-0.25	80	0.18	0.04-0.43
µmol/l	B	62	0.18	0.03-0.45	61	0.36	0.07-1.13
	S	63	76	33-100	63	64	0- 94
$cont_{oP}$	I	80	73	25-100	81	63	0-100
%	B	60	64	16- 91	60	42	6- 81
	S	68	4.5	1.7-10.4	63	6.7	1.9-29.6
TN	I	85	4.2	1.1-14.8	81	4.4	1.2- 8.6
µmol/l	B	67	4.5	1.6- 9.4	58	5.6	1.7-14.5
	S	63	66	14-95	63	67	4-93
$cont_{oN}$	I	81	70	26-98	79	64	0-95
%	B	61	61	28-88	53	49	0-82

In the upper layer prevailed organic fractions of phosphorus and nitrogen (over 60% in average), due to intensive primary production. In bottom layer regenerative processes led to predominance of their inorganic fractions (Table 1). At the eastern part the changes of parameter values were lower. In this area with elevated salinity values, nutrient concentrations were lower and dissolved oxygen near saturation level in whole water column. The concentration of total phosphorus and total nitrogen were almost uniform in whole water column (Table 1), and usually did not exceed (less than 20% of measured values) 0.25 and 6 µmol/l, respectively. Organic fraction of phosphorus and nitrogen prevailed in whole water column accounting for more than 60% (in average) in their total content.

The distribution of total phosphorus and nitrogen in the northern Adriatic Sea shows that a significant concentration gradients were established in the region. The higher concentration found at the western part are due to nutrient apport from the land, mainly from polluted Po River whose water can spread far away from the coast. The concentration measured at the eastern part are similar as those found for central and southern Adriatic (CNR; unpublished data), suggesting that this area is influenced by oligotrophic waters from the central Adriatic areas.

Composition and sedimentation of particulate organic matter in shallow coastal waters (Gulf of Trieste, Northern Adriatic)

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Particulate matter in the sea consists of organic and inorganic fractions, arbitrarily defined as matter larger than 1 µm. The quantity and composition of particulate matter varies temporally and spatially in response to physical and biological factors. Among them, the most important in coastal areas are riverine discharge, runoff from rainfall, wind-wave and tidal resuspension, biological production and shore erosion. Studies on the composition of particulate matter in the central and SE part of the Gulf of Trieste (in the period 1979-86) revealed that the majority (approx. 60-70 %) of it is composed of a minerogenic fraction, having identical mineralogical composition as surficial marine sediment: calcite (26 %) > illite (24 %) > quartz > (16 %) > chlorite/kaolinite (15 %) > microcline (8 %) > dolomite (7 %) > plagioclase (6 %) > montmorillonite (5 %) > pyrite, gypsum (4 %). This inorganic particulate material originates principally from sediment resuspension and riverine inflow of fine particles, since larger ones are deposited at the river mouths.

The particulate organic matter fraction is mainly composed of carbohydrates (on the average about 19 %) and proteinaceous matter, of which proteins with molecular weight > 10 000 represent on the average about 6 %, with an additional small lipid fraction (about 1 %). All these components on the average amount to only about 26 % of the total particulate organic matter in the Gulf. The remaining, major, fraction is prorably composed of humic material and lignin of terrigenous origin. The amino acid composition of the proteinaceous fraction in decreasing order is: Gly > Glu > Asp > Ala > Val > Leu > Ser > Thr > Lys > Ile > Pro > Arg > Phe > His. The mean POC, PN and PP concentrations amount to about 410, 85 and 35 µg l^{-1}, respectively. The mean C:N and C:P ratios (atomic) are low, averaging to about 4 and 27, respectively, due to the fact that nitrogen and phosphorus are also bonded in inorganic particles and adsorbed onto particulate material. Amino acid-N and amino acid-C amount to only 16 and 12 % of PN and POC, respectively. POC samples from the Gulf of Trieste showed $\delta^{13}C$ values in the range between -21.1 and -25.3 °/oo, with a mean value of -23.1°/oo. $\delta^{13}C$ seasonal variation in POC shows the inverse relation with phytoplankton biomass and primary particulate production. Mixing models constructed with C:N ratios and $\delta^{13}C$ values of source material forming POC, i.e. allochtonous (riverine and sewage) and autochtonous (phytoplankton) POC, showed that marine POC in the Gulf of Trieste is a mixture of about 1/3 of riverine POM and 2/3 of phytoplanktonic organic matter in the absence of the input of sewage POM which is the most variable. Pelagic food web analysis using $\delta^{13}C$ values of various classes of pelagic organic matterial (phytoplanktonic, POC, net-zooplankton) indicated that the labile fraction of POC is primarily a food for net-zooplankton, while the ^{13}C depleted detritus of riverine and sewage origin is probably deposited on surficial sediment or exported out of the Gulf by horizontal currents.

The sedimenting POC and PN are little affected by the input of allochtonous particulate matter and the contribution of benthic macrophytes. The resuspension of bottom sediments has a great influence on the gross sedimentation rates of particulate organic carbon and nitrogen, averaging about 80 - 90 %. 50 - 70 % of particulate organic carbon and nitrogen produced in the sea water column is decomposed there or transported away by horizontal currents. About 88 % of particulate amino acids are decomposed or transferred to the dissolved amino acid pool during sedimentation. From amino acid analyses in different classes of suspended and sedimentary organic matter the generalized order of amino acid stability during sedimentation was found to be: AA-S > AA-OH > aromatic, neutral-AA with branched C-chain > basic > acidic, neutral-AA with straight C-chain, proline.

Variations des rapports N:P dans le Bassin Occidental de la Méditerranée

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Compared to the Atlantic adjacent waters, the Mediterranean waters are characterized by a lower level in nutrients (PO_4 and NO_3) and by higher N:P ratios. This discrepancy can not be easily explained even if its origin is probably due to the assimilation-regeneration processes inside the Mediterranean basin. In fact, previous works have shown that the difference in the N:P ratios disappears if we take into account the organic forms of nitrogen and phosphorus.

A more accurate study, based on recent data obtained in the Western Mediterranean Sea and in the Atlantic waters near the strait of Gibraltar (Mediprod IV and Mediprod V cruises) give some more insights : 1/ The Atlantic waters keep N:P ratios around 16:1 during their eastward transport in the Mediterranean Sea, while nitrate and phosphate are consumed and become depleted in the north of the basin. 2/ The vertical N:P ratio distribution is characterized by low values (~ 16) in superficial waters (salinity < 38.0), by maximum values (often higher than 30) in subsuperficial waters where salinity reaches 38.20, and by uniform values (20-22) in intermediate and deep waters. These vertical distribution and the subsuperficial maximum can probably be attributed to the biological activity that was found intense along the Algerian coasts. These high values can originate the N:P ratio in the deep water which is formed in winter by the mixing of superficial and intermediate waters.

Les eaux méditerranéennes se distinguent de celles de l'Océan Atlantique par leur pauvreté en éléments nutritifs et, également, par des valeurs différentes des rapports atomiques de ces éléments. Alors que les eaux atlantiques présentent un rapport N:P (NO_3/PO_4) très proche du rapport de Redfield (16:1), les valeurs pour les eaux méditerranéennes sont supérieures à 20:1. Cette différence n'a pu être expliquée d'une manière convainquante même si on peut penser qu'elle tient aux processus de consommation et de minéralisation au sein même du bassin. En effet, on a pu montrer que cette différence ne se retrouve pas si, au lieu de prendre en compte les seules formes minérales, on inclut les formes organiques de l'azote et du phosphore.

Une étude plus détaillée, basée sur les données récentes obtenues dans le bassin occidental de la Méditerranée et le proche atlantique (Campagnes Médiprod IV et V), apporte certaines précisions : 1/ tout au long de leur parcours, les eaux superficielles d'origine atlantique conservent un rapport N:P proche de 16:1 et sont en même temps soumises à une consommation qui a pour effet de les rendre totalement appauvries en nitrate et phosphate dans la partie nord du bassin. 2/ La distribution verticale des rapports N:P est caractérisée par des valeurs proches de 16 dans les eaux superficielles de salinité inférieure à 38, par des valeurs maximales (souvent supérieures à 30) dans les eaux sous-jacentes à salinité d'environ 38,20 et ensuite homogènes jusqu'au fond (20-22). Cette distribution n'apparait que dans le bassin occidental lui-même ; elle est absente dans la mer d'Alboran.

Cette distribution, et plus particulièrement l'existence du maximum subsuperficiel du rapport N:P, a pour origine probable les processus d'assimilation-reminéralisation liés à l'activité biologique intense dans la partie sud du bassin. Au moment de la formation des eaux profondes (composées d'eaux superficielles et d'eaux intermédiaires), ces très fortes valeurs peuvent être à l'origine des valeurs de N:P supérieures à 20 rencontrées dans ces eaux.

C-III14

Nutrient distributions and cycling in the Rhone Estuary

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The River Rhone is one of the largest flowing into the Mediterranean Sea and certainly the largest of the Western Mediterranean. The fertilizing effect carried out by this river over the Gulf du Lion and the western Mediterranean is extremely important since the amount of dissolved and particulate nutrients is very large.

During a series of cruises, the nutrient concentrations in a number of stations located within and just outside the Gulf du Lion, have been analysed. Concentrations of Nitrate, Nitrite, Ammonia, Phosphate and Silicate have been routinely measured in the dissolved inorganic form.

The preliminary results obtained show a large area influenced by the water flowing from the Rhone as a large plume a few meter thick. The extent and thickness of the plume vary strongly with the changes in meteorological conditions however, it always shows large vertical as well as horizontal gradients at the boundaries between the river water and the sea water.

The present paper discusses the mixing processes in the near field of the river plume, comparing the mixing processes that takes place at small scales across the boundary frontal zones with those taking place at large scale between the mouth of the river and the outer reaches of the plume.

Another important phenomenon may be the effect of the proximity of the bottom sediments on the fertilization of the water column. Although this does not seem to be a strong effect, a subtle increase in some of the concentrations has been noticed at great depths probably due to the resuspension at the shelf edge and in the canyons of sediments with a release of interstitial water.

C-III15

Nutrient dynamics in oligotrophic Mediterranean areas

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Large areas of the Mediterranean Sea are, particularly in summer, highly oligotrophic. Surface concentrations of chlorophyll a are very often =< 0.1 ug/l. This is due to the restricted flow of nutrients from the richer deep waters in absence of strong vertical velocities. Banse (1987) has discussed some of the processes that take place in the highly oligotrophic areas of the oceans which give rise to the Deep Chlorophyll Maximum (DCM) a feature often found in such places as the North Pacific Gyre or the Sargassos Sea.

The same processes take place in the Mediterranean areas which have a vertical flux of nitrate due to eddy diffusion only about twice as large as the values computed for the oceanic areas mentioned.

The present paper is an attempt at comparing the validity of the principles hypothesized for the oceans in the Mediterranean environment.

Other important processes with regard to the production of phytoplankton biomass may be the inflow of nutrients from the atmosphere. Much data are now available on the contents of nutrients in aerosol and rain water which should allow a reliable estimate of the nutrient inputs by this mechanism.

Remineralization of nutrients from living and decaying particles through the action of bacteria but also of microheterotrophs (ciliates, tintinnids, etc.) seems to play an important role in the upper 800 m of the column and especially in the 200-300 m. Particles do not seem to settle at the velocities mentioned previously (Karl et al., 1988), therefore making eddy diffusion one of the most important mechanisms for exporting organic matter from the euphotic layer into the lower parts of the column.

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Interaction of Cadmium and Copper with surface active material released by marine phytoplankton

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C

Dissolved organic matter plays an important role in the physico-chemical forms and speciation of other micro- and macro-components in the aqueous phase. The presence of organic ligands regulates the bioavailability, bioaccumulation, toxicity and transport of trace metals through biological membranes (Anderson and Morel, 1982). Since phytoplankton exudates represent the main source of organic matter naturally occuring in seawater (Fogg, 1977) with a large fraction being surface active (Žutić et al., 1981), it is necessary to study its interaction with other ions and molecules of seawater constituents.

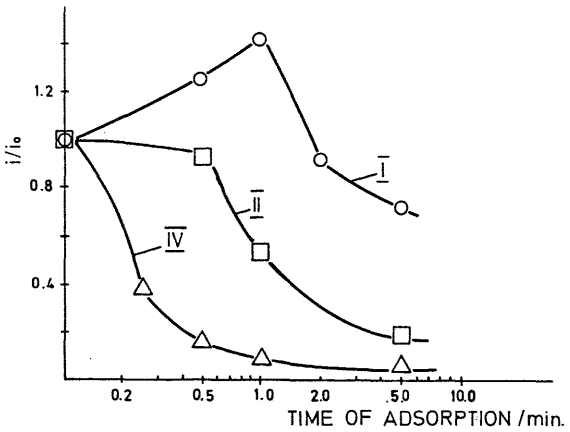
We report here on the investigation of the surfactant production by marine phytoplankton Dunaliella tertiolecta, as well as the study of physico-chemical interactions of cadmium and copper with released material, both at the model interface and in the bulk solution by using electrochemical methods (Ćosović and Vojvodić, 1982; Kozarac et al., 1982; Plavšić et al., 1982). Axenic cultures have been prepared by membrane filtration using previously cleaned Millipore filter, 0.22 /um (Kozarac et al., 1988).

Cultures were grown on modified f/2 media without and with trace metals and chelators. The results for surfactant activity, Cu complexing capacity and interaction with Cd at model interface are presented in Table 1 and Fig. 1.

Table 1: Surfactant activity and the apparent complexing capacity of different Dunaliella tertiolecta exudates. Cells were separated by gentle centrifugation (3000 rpm) prior to measurement. Cultures were grown on (I) modified f/2 medium without trace metals and chelators, (II and III) with trace metals and without chelators, and (IV) f/2 medium.

Dunaliella tertiolecta cultures	I	II	III	IV
Number of cells per ml	5.15×10^5	5.9×10^5	1.2×10^6	1×10^6
Surfactant activity equiv. T-X-100 (mg/l)	0.18	1.2	1.3	2.6
Surfactant activity equiv. T-X.100 per cell	3.01×10^{-10}	1.57×10^{-9}	1.3×10^{-9}	1.5×10^{-9}
Apparent complexing capacity mol Cu^{2+}/l	9.5×10^{-7}	5.8×10^{-7}	5.3×10^{-7}	-

Fig. 1. Relative decrease of reduction current of 10^{-5} M Cd^{2+} due to the presence of surface active material in different cultures of Dunaliella tertiolecta adsorbed at the mercury electrode/water interface.



It was shown that the content and type of released surface active material and complexing ligands depend on the initial composition of growth media. In all cases strong interactions of present organic substances with Cu in the bulk phase and Cd at the interface were observed. These will be discussed in terms of the comparison with results obtained with model substances as well as through investigation of real marine and estuarine samples.

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E-I1

The tidal lagoon environment as an expression of confinement ?

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The aim of this work is to analyse the macrobenthic assemblage of an intertidal environment on loose sediment, in the light of the confinement theory proposed by Guelorget and Perthuisot (1983). The intertidal lagoon environment pertaining to loose sediment has been studied very little in the Mediterranean, given the relative unimportance of tidal excursion in this basin; nevertheless in the North Adriatic spring-tide excursions of about 1 m are recorded. In the environment we studied - the Canarin lagoon, a brackish lagoon in the Po river delta - there are certain areas where the banks are formed of loose sediment and inclination is very slight, in these areas low spring-tides uncover tidal flat having a width of approximately 100 m.

The Canarin lagoon has a surface of 7 km ^{2} and an average depth of 1 m, salinity varies considerably (8-35 %) depending on the tide and the contribution from the Po River; the lagoon communicates well - by means of a mouth - with the sea in front of it, which slopes very gradually away from the shore. In the period of July 14-17, 1987, samplings were made with a Van Veen grab in 9 stations in the area of the sea facing the lagoon, to a depth of 8 m, in 6 sandy-silt subtidal stations in the lagoon and in 4 stations on an intertidal silty-sand flat in the lagoon (for each station three samplings were made). Of the 9 stations located in the lagoon, 3 were chosen at increasing distance from the mouth, 2 in fringe areas less affected by hydric changes caused by the tide and one in an even more marginal area which, unlike the other stations, has a depth of 3.5 m; in the intertidal area the stations were situated at MLWS, MLWN, MTL and MHWS. A previous publication (Parisi et al., 1985) indicated that in the lagoon, the distance from the mouth opening on the sea had a positive correlation with a decreasing hydrodynamic gradient.

The macrobenthic communities in the marine area before the lagoon can be classified as biocoenosis of fine sands in very shallow water (SFHN) at 2.5 m depth and biocoenosis of fine well-sorted sand at 5 and 8 m; in the lagoon the macrobenthic assemblage of the subtidal stations is quantitatively dominated by the polychaetes Neanthes succinea , Nephthys hombergii, Streblospio shrubsolii e Polydora ciliata, by the gastropod Hydrobia ventrosa, by the bivalve Cerastoderma glaucum an by the crustaceans Corophium orientale and C. insidiosum. Thus the lagoon presents an original macrobenthic assemblage, having no elements in common with the sea in front of it except for two species: N. hombergii and P. ciliata.

The hypothesis to be tested is the following: should the intertidal lagoon macrobenthos be considered as an expression of further confinement with respect to that of the subtidal lagoon population, as suggested by Guelorget and Perthuisot? This is the same as replying to the following questions:

1) with respect to the macrobenthic assemblage of the submerged area, does the intertidal population present special bionomics characteristics?
2) does it have increased density?
3) is there a decrease in number of species?
4) does it show structural simplification?

Because of a lack of data, we cannot yet discuss production. Bionomics examination of the macrobenthic assemblage was carried out by Correspondence Analysis; other structural parameters used were: density, number of species, diversity (Shannon's diversity index) and evenness (H/log2).

Regarding the results, we must first say that the most confined station, at 3.5 m depth, presented an almost complete lack of fauna. In our opinion, this situation is due to the thermic and haline stratification which results in a low oxygen concentration (1.34 ml/l O_2), and for this reason this station was not utilized in the bionomic and structural analysis of the macrobenthos. We feel that it is important to point out that in lagoon environments affected by contributions of fresh water, depth probabily acts as a confinement factor. On the axes determinad by the Correspondence Analysis, the first axis arranges the subtidal stations in relation to their distance from the mouth opening on the sea and the intertidal stations are placed together with the more confined stations. The intertidal macrobenthic assemblage is therefore similar to that found in the stations that are less affected by hydrodynamism and does not show original characteristics with respect to the subtidal one; beginning with the species present in the area closest to the mouth, one simply notes a gradual impoverishment passing from the more confined to the intertidal stations. There is a reduction in number of species passing from the subtidal stations closest to the mouth (34 species) to the intertidal stations (20 species); the two most confined subtidal stations show an even greater decrease (12 species). In the intertidal stations, density (25,000 ind./m^2) has values five times greater than those of the subtidal stations. Regarding diversity, the subtidal stations have values of Shannon's index between 2.01 and 2.89; intertidal values are between 0.70 and 1.10 while the most confined subtidal stations have intermediate values. Evenness follows a course similar to that of diversity, with values that diminish as distance from the sea mouth increases. Increased confinement therefore determines a reduction in the number of species, simplification of macrobenthos structure, an increase in the relative dominance of a very few species and increased density. Both the order resulting from the Correspondence Analysis and the trend of the structural parameters indicate a resemblance from the bionomics and structural points of view between the two stations less affected by hydrodynamism and the intertidal stations. At this point there are two possible answer: (1) either the same group of environmental factors (confinement) cause the same type of response in the two different areas as suggested by Guelorget and Perthuisot, or (2) the limiting environmental factors are differentiated in the two areas - on one hand, a decrease in the beneficial influence of the tide and on the other, more or less prolonged periods of exposition to the air. At the end, however, both groups of environmental factors result in the same macrobenthic structure. In our opinion, it appears that the more plausible reply is the second, and that in both areas, although the environmental limiting factors are different, the same group of species manages to survive, this for in the lagoon, subject to noticeable fluctuation of environmental parameters, the species have already been chosen for their high ecological adaptability.

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E-I2

Inventory of the Amphipod Crustaceans of the Italian Peninsula Coastal Lagoons

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RESUME - INVENTAIRE DES CRUSTACES AMPHIPODES DES LAGUNES COTIERES DE LA PENINSULE ITALIENNE. Plus de 40 espèces ont été récoltées dans 17 lagunes côtières italiennes de la Mer Tyrrhénienne et de la Mer Adriatique. Les lagunes de la Mer Tyrrhénienne sont caractérisées par une diversification plus marquée, et par la dominance des espèces à large répartition, accompagnée par la pauvreté d'éléments endémiques, contrairement à celles de la Mer Adriatique.

The Amphipod Crustaceans of the Italian peninsula coastal lagoons have been studied in various works (for the bibliography, see in DIVIACCO, 1981; 1982; 1983, DIVIACCO & PINKSTER, 1982; RELINI et al., 1985; TARAMELLI & PEZZALI, 1986) and, although detailed information on ecology and their distribution in some zones are still lacking, it is possible to make up a preliminar inventory (TAB. I).

TABLE I

	North ← Tyrrhenian Sea											South ↔ Adriatic				North Sea
	O	B	F	M	C	S	F	L	P	F	M	L	A	V	L	S	C.
	R	U	O	O	A	A	O	U	A	U	I	U	L	A	E	C	A
	B	R	G	N	P	B	N	N	T	S	S	C	I	R	S	A	N
	E	A	L	A	R	A	D	G	R	A	E	R	M	A	I	R	A
	T	N	I	C	O	U	I	O	I	R	N	I	I	N	N	D	R
	E	O	A	I	L	D		A	O	O	N	N	O	A	O	I	
	L		N		A	I					O	I			V	N	
	L		O		C	A									A		
	O				E										R		
															I		
Amphithoe ramondi	o				o												
Lembos sp.					o												
Leptocheirus pilosus		o	o			o	o									o	o
Microdeutopus gryllotalpa	o		o	o	o	o				o		o	o	o	o		
Colomastix pusilla	o																
Corophium acherusicum	o		o			o						o			o	o	o
Corophium acutum	o																
Corophium insidiosum	o	o	o	o	o	o	o	o	o	o	o	o	o		o	o	o
Corophium orientale		o				o	o	o	o							o	o
Erichthonius brasiliensis	o				o					o		o					
Erichthonius punctatus	o				o							o					
Dexamine spinosa	o			o	o												
Echinogammarus olivii																	o
Echinogammarus pungens														o			o
Echinogammarus pungentoides																	o
Echinogammarus sp.						o											
Elasmopus affinis										o							
Elasmopus pocillimanus					o												
Elasmopus rapax			o														
Gammarella fucicola					o												
Gammarus aequicauda	o	o	o	o	o	o	o	o	o	o				o	o		o
Gammarus crinicornis																o	o
Gammarus insensibilis	o		o	o	o	o	o	o		o							
Melita hergensis					o		o										
Melita palmata	o	o		o		o	o	o	o			o		o		o	o
Microprotopus maculatus			o														
Ischyrocerus inexpectatus	o																
Jassa marmorata	o																
Jassa sp.																	o
Leucothoe incisa					o												
Leucothoe spinicarpa					o												
Perioculodes aequimanus	o																
Perioculodes longimanus					o												
Perelonotus testudo	o																
Hyale crassipes	o									o							
Orchestia gammarellus														o			
Orchestia mediterranea	o			o		o				o				o			
Orchestia platensis									o					o			
Caprella acanthifera	o																
Caprella dilatata				o													
Caprella equilibra	o		o		o												
Caprella sp.					o						o						
Phtisica marina					o												
Pseudoprotella phasma	o											o					

Seventeen lagoonal environments have been considered, distributed along the Tyrrhenian sea and Adriatic sea, northwards up to the Po river delta. The Venice lagoon, constituted by a whole of environments, from marine, to harbour, and proper brackish waters, is not considered here.

The Amphipod list, obtained from the literature (see bibliography) and from personal observations, includes over 40 species. Thirty-nine species, 29 of which exclusive, are present in the Tyrrhenian lagoons, while 15 species, 6 of which exclusive, are present in the Adriatic ones. Nine species are present in both zones.

The greater variety of the Tyrrhenian lagoons certainly contributes to their species richness, in opposition to the poverty in Adriatic sea, even if this fact may be partially due to the greater number of studies in the lagoons of the former sea.

Orbetello and Caprolace are the most diversified environments, with a greater number of species, some of which even marine, particularly in the areas near the sea. Typically lagoonal species are less than half of the total number, and only 2 (*Corophium insidiosum* and *Gammarus aequicauda*) are distributed almost everywhere, tolerating extreme ecological conditions.

Widely distributed species (cosmopolite and circumtropical) and eastern and northern Atlantic species dominate in Tyrrhenian basins, while amphiatlantic and Mediterranean endemic elements are scarce. Widely distributed species are also scarce in south Adriatic basins and their number still decreases northwards, in favour of Mediterranean endemic elements.

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E-I3

The Halmyric Environment : a proposal

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E

Along the Mediterranean shores, more than in any other sea, there is a variety of environments with changing salinities, both brackish and hypersaline. Furthermore, the Mediterranean lands present a wide diversity of landlocked saline aquatic environments. Much thought has been given by Mediterranean oceanographers and limnologists to the classification of these aquatic environments, often from different approaches. Marginal to the marine and to the freshwater environments, the environments with changing salinity present an unity of their own, which at least for methodological reasons deserves a separate definition.

It is proposed to reunite these environments under the name **"Halmyric environments"**, using the greek name of a lagoon area of the Black Sea, Halmyris(=Razelm). These environments present a salinity restriction of their biota. The halmyric biota are a stock of very adaptative and genetically variable species ,some of which are represented in both brackish and hypersaline waters. Halmyric waters are characterized by fluctuating salinities, often modified ionic composition, vertical stratification , frequently with oxygen deficiency. The ecosystems are to a large extent based on detritic pathways, either resulting from import or from rich local aquatic plant growth .The planktonic grazing pathway has a limited importance. Soft bottoms are prevalent. Cosmopolitism of the biota, primary or secundary by its origin is frequent.

The halmyric environments are furthermore subject to large scale human impact, both economic and detrimental. The need for an "interdisciplinary" approach to define the main traits of the halmyric environments is therefore an urgent one. The fragmentation according to the oligohaline-hypersaline scale, or according to geomorphological shapes (lagoons, estuaries, limans, lakes, ponds, sebkha's , swamps, salty springs, etc.) is in fact counterproductive.

The Mediterranean area is unique in presenting a long history of halmyric waterbodies of marine dimensions, in the form of both the Messinian and the Sarmatic environments. From the geological perspective their common environmental and biological traits are even more evident.

Halmyrology should be a discipline of its own on equal footing with Oceanography and Limnology.

E-I4

Experimental enrichment of estuarine zones with sewage sludge. Changes in community structure of estuarine tidal creeks

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Human growing population in coastal regions has increased the contamination of coastal wetlands with sewage wastes. Increased concern about pollution of deltas and estuarine zones shown interest in community structure and succession of estuarine fauna.

The taxa found in this study were very similar to those found elsewhere in similar shallow coastal marine environments exposal to nutrient enrichment. For example in shallow creeks draining into coastal lagoon of the Ebro Delta, similar densities of *Streblospio benedicti, Capitella capitata, Polydora sp.* and several oligochaetes were found. This list of species is quite similar to the obtained from our place of study and suggest that there is a widely distributed cosmopolitan fauna of those environments.

Benthic macrofaunal populations were censused in control plots and in experimental plots in Great Sippewisett Salt Marsh (Massachusetts, USA) in which food resources were enriched by adding 2 dosages of sewage fertilizer during the growing season (highest fertilization, XF= 75 g/m*m wk; high fertilization, HF= 25.2 g/m*m wk), (Valiela et al, 1973). Fertilization began in 1974. Animals in the sediments of tidal creeks bisecting these plots were sampled during 1974, 75, 79, 86, 87 and 88.

No differences in total biomass values in 1974 and 1987 were found, but an important change in species composition was observed between those years, therefore, different species contributed to similar biomass values. Diversity of fauna in all creeks diminished since the beginning of the experiment in 1974.

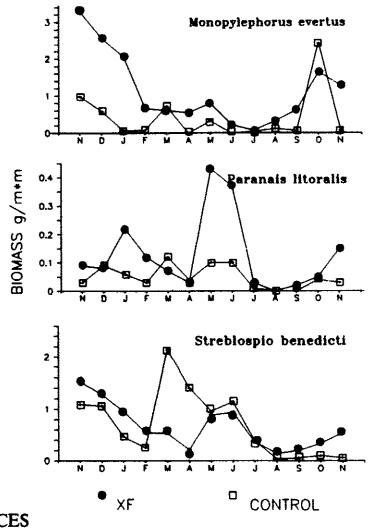
The seasonal pattern was the same in all creeks. Density of macrofauna peaked in early summer, decreased abruptly in July/August and increased again in the fall. Diversity of fauna in all creeks through the years diminished from early spring to late summer and increases again in fall.

A change of species composition took place in the control creeks over the period of study, due to long term changes in bed sediments which are a result of colonization by *Spartina alterniflora*. Some species disappeared, including *Polydora ligni, Amphicteis gunneri, Pygospio elegans, Marenzelleria viridis* and *Leitoscoloplos fragilis* (POL), *Hydrobia totteni* and *Gemma gemma* (MOL) and *Edotea triloba* (CRU). Some species appeared in the late seventies: *Paranais litoralis, Limnodriloides sp.* (OLI), *Manayunkia aestuarina* and *Dinophylus gardineri* (POL). *Streblospio benedicti* (POL) is the most abundant species in the new assemblage.

No large difference in abundance, biomass and species composition between creeks were observed during the first year of experiment (1974). In 1975 biomass increased ten-fold in the highest fertilized creeks due to a suite of opportunistic species that responded to enrichment within 1 year of treatment: *Capitella capitata, P. ligni, A. gunneri, S. benedicti, P. elegans* (POL), *Monopylephorus evertus* (OLI) and *Nematostella vectensis* (CNI). Later on the continued enrichment accelerated an important switch in species composition, when most of those species were displaced by *M. evertus* and *P. litoralis* (OLI).

Enrichment of salt marsh thus results in transient increases in invertebrate biomass, and also fosters growth and colonization by *Spartina alterniflora*. Long term fertilization stabilize faunal composition in those creeks, accelerating the switch observed in control areas, by the dominance of oligochaete species.

Meanwhile the control creeks are actually colonized by a S. benedicti population with a variable fauna associated through the year, the fertilized creeks are based in a mores stable faunal composition based in two oligochaetes populations: *P.litoralis* in spring-summer and *M. evertus* the rest of the year, (fig. 1).



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E-II1

Heavy metals in a shallow estuary of the Venice Lagoon

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The understanding and description of the processes which occur in shallow water estuaries is a question of fundamental importance to evaluate the environmental impact of pollutants transported by rivers into the Lagoon of Venice. The contribution of pollution from rivers and channels flowing into the lagoon is significant and it occurs in zones where water exchange due to tides is less with respect to other parts of the lagoon.

A study of the chemical-physical characteristics of the water-sediment environments was made in the estuarine area of the most polluted river flowing into the northern lagoon. The scope of the research is to give a complete explicative picture of environmental conditions and the definition of chemical and physical mechanisms which determine the transport, sedimentation, mobility and diffusion of heavy metals in shallow brackish water.

The entity and evolution of the saline field generated by tide in the estuary are observed through temperature and, especially, salinity measured in pre-fixed points in the area. This facilitated the description of the different water mass movements in response to the tidal wave under different conditions.

The variation of heavy metal distributions in river waters, close to the mouth, was analyzed by the P.I.X.E. technique at different depths and by granulometric separation. Salinity and pH were used as reference tracers of the saline intrusion along the vertical profile of the river.

Heavy metal concentrations were analyzed by the A.A.S. technique in the upper sediment layers (5 cm) in the area of the river mouth. These reflect - on average - both the interactions occurring at the water-sediment interface and the dynamics of fresh and marine waters which influence the net flow at the interface. The method allowed to directly take into account the concentration gradients existing between the interstitial and surface waters, which influence the mobility of heavy metals, and thus determine the role of sediments as pollution sources, even in long-term effects.

Correspondingly, the geochemical speciation of sediment samples collected give indications on the release of sediment to water environments and on the possibility of using concentrations present in this latter by the biota.

The physical and geological nature of estuarine sediments was determined by granulometric analyses and by measuring the redox potential and the compaction indices on surface sediment samples.

The final aim of the research is to construct a simulation model of the mechanisms involved, which would allow to control environmental conditions by monitoring some physical-chemical and toxicological parameters at a restricted number of points in a shallow estuarine area.

E-II2

Relationship between Foraminifera and sediment distribution (Po River Delta, Italy)

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A study has been carried out about benthic foraminiferal assemblages collected in the "Canarin" lagoon (Po river delta) and from the shoreline to the 10m isobath during 1972, 1973, 1974 and 1985 (fig. 1).

The grain size and analyses permit the plotting of maps (Shepard and Nota textural classification).

A significant visualization of the foraminifera frequency and the areal, textural and depositional variations of sediment is obtained only with the Nota classification (fig. 2).

The Shepard classification do not shows good results.

The aim of this poster is to indicate the use of a textural classification that is not famous but very useful in many

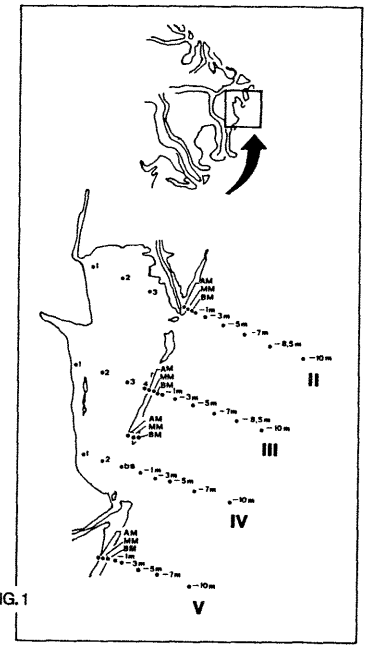
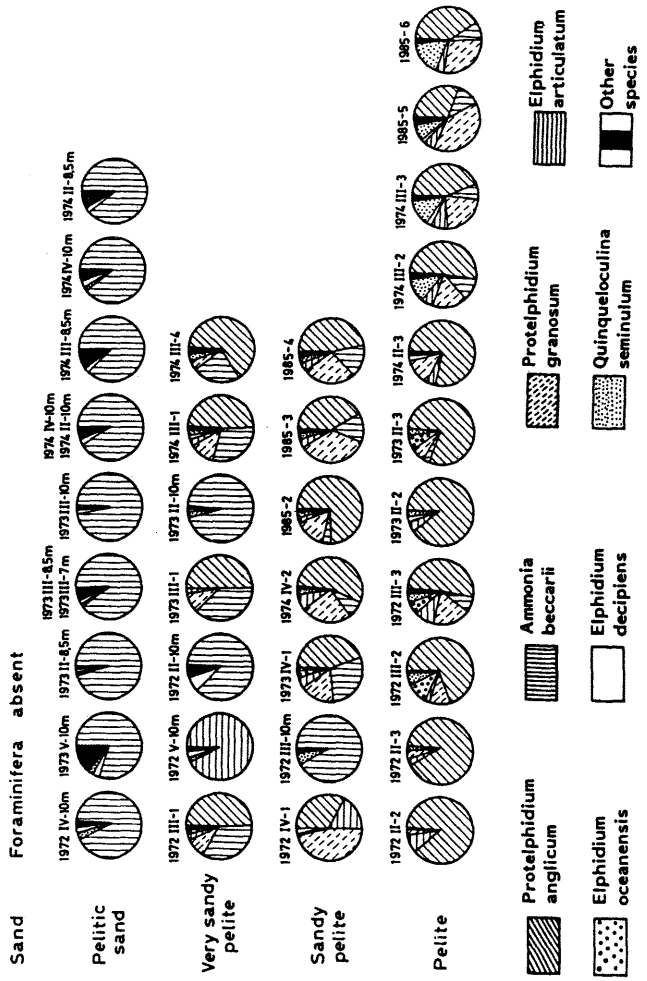


FIG. 1



Water mass characteristics and degree of eutrophication in a shallow water embayment of the Ionian Sea : Amvrakikos Gulf

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Amvrakikos Gulf is a shallow water (max. depth 60m.) semi-enclosed embayment, in the Ionian Sea. It is connected with the Ionian Sea through a narrow channel. The bulk of the run-off is supplied by the Rivers Arachthos and Louros (Fig. 1), both draining agricultural areas. The annual mean flow rates of the Arachthos and Louros Rivers are about 70 m^3/s and 19 m^3/s, respectively.

Seasonal temperature and salinity data from selected depths, were obtained in 1987, from a total of 46 stations, using conventional instrumentation. In addition, measurements of inorganic nutrients were made. The methods adopted have been described by Friligos [1].

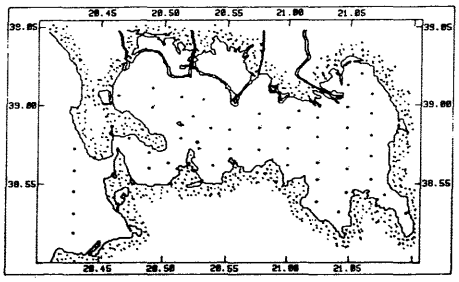

Fig. 1. The study area, showing the location of the oceanographic sampling stations.

Water property distributions suggest, that surface salinity remains very low throughout the year (22.4-32.4‰ in winter, 16.8-26.8‰ in spring, 26.4-28.8‰ in summer and 26.6-34.8‰ in autumn), resulting in strong stratification, in the upper layers. Density gradiends are particularly stronger in spring (due to increased flow of the rivers) and in summer (due to high surface temperatures; 28.8-29.9 °C). Horizontal and vertical variations of the water property in the Bay are great, throughout the year, suggesting that the various sea areas are influenced to a varying degree from the freshwater discharge of the rivers. The northeastern part of the study area is subjected to the greatest influence (owing to the freshwater discharge of the River Arachthos), whilst the least freshwater influence is seen in the southeastern section of the Bay.

To estimate the extent of eutrophication in Amvrakikos Gulf a comparison is made with previous data collected in different polluted coastal waters of the Aegean Sea. The same background values were used in various regions of the Aegean waters. The relative factors of increase from background following the same methodology are summarized in Table I.

TABLE I. RATIO OF TOTAL NUTRIENT PER STUDIED AREA TO BACKGROUND NUTRIENTS

Area	PO_4-P	SiO_4-Si	NH_4-N	NO_2-N	NO_3-N	IN	Reference
Elefsis Bay	5.11	4.15	15.80	3.05	7.00	9.67	[1]
West. Saronikos Gulf	2.25	2.85	2.50	1.11	6.38	4.00	[2]
Inner Saronikos Gulf	2.50	1.38	4.10	1.55	2.80	3.97	[3]
North Euboikos Gulf	2.07	13.20	1.86	0.49	10.20	5.27	[4]
Kavala Gulf	1.80	1.49	1.00	0.51	1.41	1.10	[5]
Alexandroupolis Gulf	1.32	3.28	1.00	0.85	6.21	3.27	[5]
South Euboikos Gulf	1.46	1.41	0.65	0.48	1.17	0.86	[4]
Pagassitikos Gulf	1.02	2.80	2.60	1.25	2.36	2.28	[6]
Thessaloniki Bay	5.33	3.35	4.50	3.63	3.86	4.14	[7]
W. Thermaikos Gulf	2.09	3.81	2.91	2.40	3.80	3.22	[7]
E. Thermaikos Gulf	1.18	2.21	1.97	1.53	2.20	2.00	[7]
Amvrakikos Gulf	3.87	12.99	1.13	0.60	3.90	2.28	

Elefsis Bay, the most industrilized area in Greece, showed a tedency to concentrate all nutrients, but especially ammonium (up to 16 times background). Elefsis Bay, Amvrakikos Gulf and Thessaloniki Bay showed the highest values of phosphate. The northwestern part of Thermaikos Gulf, Thessaloriki Bay and Alexandroupolis Gulf contained three times as much silicate as background, owing to the contribution of rivers. Eastern Thermeikos Gulf, Pagassitikos Gulf and South Euboikos Gulf presented only slightly greater concentrations of nutrients than those of the Aegean Sea. North Euboikos Gulf displayed a marked accumulation of nitrate and silicate, due mostly to the great depths and underwater springs, whilst Amvrakikos Gulf presented the same accumulation of silicate due to the contribution of the rivers and the morphology of the area. All nutrients were present in all areas at levels well above background. The quality of the receiving waters, with respect to nutrients, depended on the different sources of nutrients, the morphology of the area and the water circulation.

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Endemism of Limonium (Statice) in Yugoslav halophytic vegetation

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RÉSUMÉ : Endémicité du Limonium (Statice) dans la végétation halophile de Yougoslavie. Limonium (Plumbaginaceae) est un genre très remarquable des marais salés et îlots qui est en Yougoslavie le plus riche en espèces halophiles y inclus 7 endémiques adriatiques. Il y est présenté par L. serotinum, L. oleifolium, L. bellidifolium, L. ferulaceum, L. cancellatum, L. anfractum, L. vestitum et plus récémment on y a enregistré aussi L. hungaricum, L. hirsuticalyx, L. asterotrichum, L. dubium, L. tommasinii, L. diomedeum, L. visianii et L. dictyophorum dont la synécologie est étudiée.

INTRODUCTION. The Limonium (Statice pro parte, fam. Plumbaginaceae) is a very remarkable genus of the European salt marshes and skerry seashores, and among the halophytic genera in the Mediterranean coasts and islands it is justly the most diversified one, including the numerous coastal species and local endemics. Despite its considerable biogeographical and phytocoenological importance, along the East Adriatic it was quite scarcely known, and this is the first special paper devoted to the Limonium of Yugoslavia. Thus in the classical floras covering E Adriatic prior to 1980ies, the presence of its 7 species only has been registered: L. serotinum, L. oleifolium, L. bellidifolium, L. ferulaceum, L. anfractum, L. cancellatum and L. vestitum. The recent detailed prospections in the field added 8 other taxa of E Adriatic whose vouchers are in Herbarium ADRZ: L. hungaricum, L. dubium, L. hirsuticalyx, L. asterotrichum, L. tommasinii, L. diomedeum, L. visianii, and L. dictyophorum. Thus Yugoslavia includes at least 15 different Limonium species, that is rather comparable with other Mediterranean countries.

Among the 7 Adriatic endemics, L. visianii and L. dictyophorum may be the primitive prototypes of a considerable evolutionary interest, for being the distinctive halophytic shrubs with the candelabriform woody branches, and with terminal rosette leaves. Its other Adriatic endemics are L. cancellatum s.s., L. vestitum, L. diomedeum, L. anfractum, and L. tommasinii.

RESULTS. The related saltmarsh species growing chiefly in the alluvial lagunar shores (Salicornietea s.lat.), in Yugoslavia are presented by 5 Limonium taxa:

1. L. serotinum (Rchb.) Pign. (Statice limonium auct. adr.) is widespread in E Adriatic salt marshes of Limonietalia Br.-Bl.

2. L. oleifolium Mill. (St. virgata Willd.) is frequent in E Adriatic salt marshes within the hypersaline Limonio-Artemisietum caerulescentis Hic.

3. L. bellidifolium (Gou.) Dum. (St. caspia Willd.) is also frequent in the Adriatic salt marshes, especially within the Arthrocnemetum fruticosi Br.-Bl.

4. L. tommasinii Pign. (St. confusa auct. adr.) is endemic to NW Adriatic salt marshes, from the Venice lagoons to the Punat lagoon in Krk island, growing mostly within the Salicornietum venetae Pign.

5. L. hungaricum Klok. (St. gmelinii auct. pannon.) is endemic to the inland salt marshes and salt springs of Yugoslavia and Hungary, growing there chiefly within the Limonio-Artemisietum monogynae Soo.

The beach species of the backshore nitro-halophytic vegetation (Cakiletalia Tx.) are presented by the next 3 taxa of Limonium:

6. L. hirsuticalyx Pign. (St. gmelinii auct. adr.) is an East Mediterranean halophyte, with its westernmost locality in the beaches (Euphorbion peplis Tx.) of Dugi island in Northern Dalmatia.

7. L. asterotrichum (Salm.) Salm. (St. latifolia hort. non Sm.) is native to West Black Sea, but it is cultivated in some Adriatic gardens and also sporadically naturalized in NE Adriatic beaches within the nitro-halophytic vegetation of Cakiletalia.

8. L. dubium (Guss.) Lov. (St. smithii Ten.) is a Central Mediterranean taxon of the Italian coasts, presented also in NE Adriatic islands Cres, Krk, Pag, and in the Ravni Kotari peninsula, in the beaches within Limonio-Goniolimonetum dalmatici Hic.

The skerry coast species of subhorizontal stony shores (Crithmo-Limonietalia Mol.) include only two taxa of East Adriatic:

9. L. ferulaceum (L.) Ktze. (Myriolepis ferulacea M.G.) is a South-Mediterranean halophyte with its northernmost sites in SE Adriatic especially in the isles Korčula, Elafiti, and in Pelješac peninsula, within the alliance Microrrhinion litoralis (Hic.) Lov.

10. L. cancellatum (Bernh.) Ktze. s.str., is the subendemic Circum-Adriatic halophyte, and the very most frequent Limonium across the Yugoslav coast and islands. Its typical form grows within the Plantagini-Limonietum cancellati Hic. in semiexposed skerry shores.

The seacliff species of the stormy aerosaline escarpments (Euphorbietalia dendroidis Zoh.) are the most interesting group of 5 suffrutescent or shrubby endemics, that previously have been generally confused within the pseudonyme "Statice cancellata" auct. s.lat.:

11. L. anfractum (Salm.) Salm. is endemic in the stormy seacliffs of the Aurinio-Capparion Lov. along Eastern Adriatic, from the northernmost Kvarner islands along the Dalmatian mainlands to Albania. It is a suffrutescent taxon to 40 cm tall.

12. L. vestitum (Salm.) Salm. is a stenoendemic undershrub restricted to the remote Mid-Adriatic islets Jabuka, Kamik and Brusnik, within the stormy aerosaline cliffs of Puccinellio-Centaureetum crithmifoliae (Lov.) Lov.

13. L. diomedeum Brullo is also stenoendemic to the Mid-Adriatic islets of Tremiti (loc. class.), with the new sites in islets Palagruža and Sušac within the stormy aerosaline cliffs of Aurinio-Brassicetum frutescentis Lov.

14. L. visianii (M.G.) Lov. (L. adriaticum Lov.) is also a Mid-Dalmatian endemic of the islands Vis, Hvar, Lastovo and of the adjacent minor islets, growing in the stormy seacliffs of alliance Aurinio-Capparion. It is the distinct shrub to 50 cm with a trunk to 2 cm Ø thick, with the candelabriform woody branches, grey-pubescent evergreen leaves in terminal rosettes, and with the suberect inflorescences.

15. L. dictyophorum (Tsch.) Deg. s.str. non al. (L. croaticum Lov.) is stenoendemic to NE Adriatic and restricted to the excessively stormy isles Prvic, Grgur, Goli, Baška, and to NW Velebit coast of mainland, within the aerosaline seacliffs of Aurinio-Astragaletum dalmatici Lov., overexposed to the strongest Bora winds. It is a shrub to 60 cm, trunk to 3 cm Ø with woody candelabriform branches, big evergreen glabrous leaves to 5 cm in terminal rosettes, and the inflorescences intricated angulate-reticulate.

E-II5

Botanical peculiarities of Dalmatian Lagoons in Neretva Delta

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RESUME : Singularités botaniques des lagunes dalmates du delta de la Neretva. Le delta de la Neretva est le plus grand et le plus diversifié du littoral yougoslave, compte tenu des étangs salés et lagunes typiques bien conservés. Les végétaux les plus intéressants sont Botomus junceus, Typha australis, Fimbristylis illyrica, Taraxacum tenuifolium et les communautés remarquables Arundino-Typhetum australis, Taraxaco-Fimbristyletum illyricae, Limonio-Artemisietum caerulescentis et Batrachio-Potamogetum siculi.

INTRODUCTION. The coastal Karst rivers of SW Yugoslavia have mostly the deep canyon estuaries with rocky shores, and the unique true swampy estuary there is Neretva delta in Middle Dalmatia. Although the western part of this delta is very degraded by the hydrotechnical regulations, agriculture and urbanizing, in its other parts persisted the most typical alluvial lagoons and salt marshes of Yugoslavia. It is of a considerable biogeographical and conservationist interest for its nesting sites of rare birds and of other threatened fauna, but also for its rich flora and vegetation so far few studied. Thus in the actual paper its neglected phytogeographical peculiarities are analysed. So far in the literature occured only some marginal botanical indications on this delta e.g. Lovric and Rac (1987), and this is the first special contribution on its vegetation.

RESULTS. The swamp flora of Neretva delta is only partly comparable to the well known West Mediterranean estuaries, for it includes a considerable number of the interesting Oriental and Balkanic subendemic taxa, being rare or absent westwards. Among its lagunar algae the most remarkable are some rare halophilic Charophyta e.g. the W Mediterranean Chara canescens Lois. ssp. salsa M.G., and the subendemic Adriatic one Ch. rabenhorstii A.Br. The most interesting dicots there are Bryonia cretica L. s.str. in its northernmost site, then the rare Nymphaea thermalis DC. (N. lotus auct.), and the East Adriatic endemic Taraxacum tenuifolium Hoppe (T. hercegovinicum M. G.). The monocots there present the most diversified swamp plants, including a series of the striking rare taxa (the related vouchers are in Herbarium ADRZ):

Butomus junceus Turcz. (B. scutariensis auct.) is a SW Asian taxon with its westernmost sites in Neretva delta and Skadar lake.

Fimbristylis illyrica M. G. is endemic to coastal swamps of Eastern Adriatic.

Najas graminea Del. has here its northernmost native site.

Potamogeton siculus Ten. s.str. (P. subflavus Lor.) is a disjunctive halophyte of the Central Mediterranean lagoons, with its isolated NE outposts in Neretva, Cetina and Raša estuaries of Eastern Adriatic.

Triglochin laxiflorum Guss. has here also its northernmost site.

Typha australis Schum. & Thon. ssp. angustata (Bory & Chaub.) M.G. (T. domingensis auct. p.p.) is a relict palaeotropical taxon, with its NW outposts in Neretva and Krka estuaries of Dalmatia.

The original natural vegetation in this delta includes the next 8 remarkable phytocoenoses (symbols used for species presence: I = 1-20% samples ... V = 80-100% ones):

1. Agropyro-Inuletum crithmoidis Br.-Bl. (alliance Euphorbion peplis Tx.) occurs in the shingle islets and undisturbed beaches of this delta.

2. Juncetum maritimi-acuti Hic. (all. Juncion maritimi Br.-Bl.) is frequent in the lagunar shores of Neretva delta.

3. Bolboschoeno-Scirpetum litoralis Br.-Bl. (all. Bolboschoenion maritimi Soo) is also frequent in the interior subsaline swamps within this delta.

4. Arundino-Typhetum australis Lov. (all. Bolboschoenion) is probably a most distinctive community in Dalmatian estuaries, covering extensive areas of the interior subsaline swamps in Neretva delta and being there a thermophilic swampy climax. It forms the robust dense reeds 3-5m tall, marked by Arundo donax IV, Typha australis V, Butomus junceus IV, Baldellia ranunculoides IV, and Holoschoenus australis V.

5. Taraxaco-Fimbristyletum illyricae (Hic.) Lov. (all. Fimbristylion Hic.) is the endemic Dalmatian community of the subsaline or lime-saturated, periodical dessiccating tarns, developed e.g. in the internal swamps of Neretva delta. Its indicators are Fimbristylis illyrica V, Taraxacum tenuifolium IV, Bolboschoenus compactus V, and Heleochloa schoenoides IV.

6. Limonio-Artemisietum caerulescentis Hic. (all. Halo-Artemision Pign.) is very characteristic of the dessiccating hypersaline marshes in the seaward parts of delta.

7. Coleogeto-Zannichellietum maritimae (Hart.) Soo (all. Ruppion cirrhosae Lov.) is the main community of infralittoral benthos across the lagunar bottoms of delta, marked by Coleogeton marinus V, Zannichellia maritima (Z. major) V, Ruppia cirrhosa (R. spiralis) III, Althenia filiformis II, Chara canescens IV, Tolypella spec. div. V.

8. Batrachio-Potamogetum siculi (Hic.) Lov. (all. Ruppion maritimae Br.-Bl.) occurs in the subsaline running waters of estuarine channels between the lagoons of this delta. It is marked by Potamogeton siculus V, Pot. loeselii IV, Batrachium drouëtii IV, Nymphaea thermalis II, Caldesia reniformis II, etc.

In more disturbed western parts of this delta, the precedent vegetation is mostly eliminated, and there may persist only sporadically some isolated fragments of Juncetum and Bolboschoeno-Scirpetum. Other degraded habitats include the different secondary communities of a synanthropic lagunar vegetation, absent in E parts of delta: Cynodonti-Plantaginetum coronopi (Hic.) Tx. replacing Agropyro-Inuletum in shingle, then Althaeo-Calystegietum sepii Beef. along the polluted lagunar shores, Salicornietum europeae Tx. and Suaedetum maritimae Pign. instead of Limonio-Artemisietum in salt marshes, Scirpo-Phragmitetum Br.-Bl. instead of Arundino-Typhetum, and Zosterelletum noltii (Herm.) Giac. replacing the Ruppietalia in lagunar bottoms, etc. The most devastated and over-polluted westernmost lagoons closely to the Kardeljevo (Ploče) harbour include only Salsoletum sodae Slav. in salt marshes, then Chaetomorpho-Valonietum aegagrophilae (Feld.) Giac. on muddy bottom, and Enteromorphetum proliferae-intestinalis (Zal.) Hart. on the shingly one.

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E-II6

Growth and reproduction of Mytilus galloprovincialis (LMK) in two greek districts (Kyparissi Lagoon and Elefsis Bay)

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SUMMARY

The growth and reproduction of Mytilus galloprovincialis was studied using a modified version of the von Bertalanffy equation. The difference in growth was attributed to the nutrient supply and pollution. Reproduction extended throughout the year, the main spawning occuring in the winter.

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METHODS

The growth and reproduction of Mytilus galloprovincialis was studied for approximately one year in Kyparissi lagoon and Elefsis bay. In the first case the mussels were collected from a pole culture; the ones from Elefsis bay were kindly supplied by Dr. Panayotides of greek N.C.M.R. who was carrying out a settlement experiment in the area at the time.

Length (L) and total wet weight (TW) were used as indices of growth. The von Bertalanffy equation was used as applied by Gulland (1969) and Thiesen (1973). The L_∞ is derived from the graphic method of Ford Walford (1946). Reproduction was studied by histochemical methods according to Griffiths (1977).

RESULTS AND DISCUSSION

The allometric equation $W=a*L^\beta$ was estimated at every sampling period. The exponent β was always lower than 3.00 and ranged in Kyparissi from 0.82 in January to 2.89 in September. The low value is associated with gametogenesis and spawning. In Elefsis bay, ranged from 2.07 to 2.54. In Kyparissi, L_∞ was estimated to L_∞ =9.97 and the von Bertalanffy was $Lt=9.97*(1-e^{k})$, $k=-0.10*(t+0.10)$. In Elefsis bay L_∞=5,57 and $Lt=5,57*(1-e^{m})$, $m=-0.18*(t+0.20)$. The growth rate in Kyparissi is considerably faster than that in Elefsis. In fact it is higher than any other rate mentioned in the literature (Bayne 1976). The most likely explanation is the high concentration of nutrients in Kyparissi due to a nearby fresh water spring. The low growth rate in Elefsis may be due to the pollution of the area which receives the domestic sewage and industrial wastes of Athens.

The reproduction of Mytilus galloprovincialis was continuous throughout the year, but the main spawning occurred in winter, thus the larvae benefit from the abundance of food available at the beginning of spring. Whilst the gametogenesis and spawning in Mytilidae is documented in the Atlantic and other sea areas, there is very little information available regarding the populations in Greek waters. In addition, the advantage of this study is that the exact age of the mussels was known.

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Recherches expérimentales sur les communautés benthiques le long d'un gradient d'estuaire dans la lagune de Venise

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INTRODUCTION

Des substrats expérimentaux en bois de sapin (20 x 30 x 2 cm) ont été employés pour étudier la structure et la dynamique spatiale et temporelle des communautés benthiques intertidales dans un estuaire. Les prélèvements ont été effectués dans le bassin Nord de la lagune de Venise le long du parcours lagunaire de la rivière Dese (Fig.1). Cette rivière, bien que d'un faible débit, permet de reconnaître des gradients écologiques importants, par la présence de marées d'une amplitude peu commune en Méditerranée (80-100 cm).

Le macrobenthos sessile a été suivi dans trois stations, en fixant sur des poteaux en bois appelés "bricole", qui balisent les canaux navigables, une série verticale de 5 panneaux (marqués, à partir du niveau supérieur, par les lettres A, B, C, D, et E) (Fig.2). De cette façon la zone intertidale est entièrement couverte: le bord inférieur du panneau B coïncide avec le niveau de mi-marée. Les panneaux étaient remplacés tous les deux mois, de mars 1985 à novembre 1986.

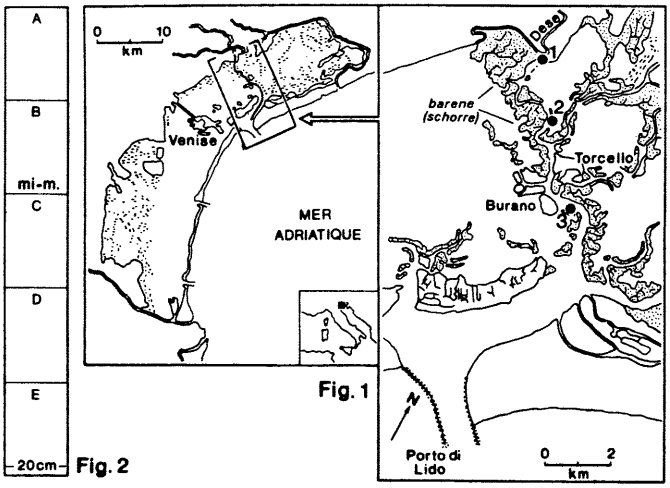

Fig. 1

Fig. 2

Le recouvrement a été calculé en superposant au panneau une grille à maille carrée d'un centimètre de côté. La surface limitée par chaque maille est considérée comme la superficie unitaire de recouvrement, à l'intérieur de laquelle on évalue uniquement la présence-absence de chaque espèce.

Sur ces panneaux nous avons identifié 7 Algues, 5 Spongiaires, 5 Hydraires, plusieurs Actiniaires, 3 Pélécypodes, 5 Serpuliens, 3 Cirripèdes, 8 Bryozoaires, 6 Ascidies.

DISCUSSION

a) Si l'on exclut le panneau A, le plus haut, couvert seulement par pleine mer de vive eau et par conséquent pauvrement colonisé, l'on constate entre B et les autres panneaux la présence d'une discontinuité biocénotique verticale marquée, puisque le découvrement encore prolongé élimine de B plusieurs éléments.

b) Quant au gradient d'estuaire, les trois stations considérées montrent des communautés benthiques structurellement bien différenciées. Nous avons pu y reconnaître deux groupes d'espèces. Le premier groupe, à écologie plus typiquement d'estuaire, caractérise le secteur le plus dessalé (station 1, salinité de 0 à 15 ‰.).Il comprend les Bryozoaires Bowerbankia gracilis et les Victorellidés, les Hydraires Cordylophora caspia et Garveia franciscana, le Cirripède Balanus eburneus.

Le second groupe comprend par contre des espèces substantiellement marines, incapables de tolérer d'importantes dessalures. Ces espèces, dont les Bryozoaire Tricellaria inopinata, le Spirorbidé Janua pseudocorrugata, les Ostreidés, les Ascidies,les Spongiaires et la Rhodophycée Porphyra umbilicalis, colonisent surtout la station 3, à salinité variable entre 18 et 30‰. .

La station 2, aux conditions écologiques intermédiaires, présente des éléments appartenant aux deux groupes écologiques. Son peuplement est caractérisé par le Bryozoaire Conopeum seurati et par des Actiniaires.

c) La colonisation des substrats expérimentaux montre une allure saisonnière rythmique: pendant l'hiver les panneaux n'hébergent que des colonies rares et petites ou quelques individus isolés, alors qu' en été, lorsque tous les taxa subissent une forte poussée colonisatrice, les substrats disponibles sont complètement couverts et de multiples épibioses conduisent à un recouvrement pouvant atteindre 200 à 300%.

d) En fin d'été, lorsque le milieu atteint son potentiel maximal de colonisation, la station 3, la plus marinisée, présente des valeurs de richesse spécifique et de diversité supérieures aux autres stations.

e) Cependant, ces différences s'atténuent aux niveaux supérieurs, où l'exposition prolongée à l'air exerce une action limitante et banalisante, qui estompe le gradient écologique de l'estuaire.

Eutrophie et dystrophie dans la lagune de Goro (Sacca di Goro)

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La "Sacca di Goro" est une zone lagunaire située au sud du delta du Pô. Elle s'étend sur une surface de 32 km^2 avec une profondeur moyenne d'1,3 m.

Les eaux douces de détournement fluvial se jettent dans la lagune et, grâce à une bouche de 3 km, elle est en communication avec la mer ouverte.

En juillet 1987, de graves phénomènes dystrophiques ont provoqué la mort, par anoxie, d'une grande partie des Moules élevées dans des parcs. Un programme de recherche a alors été entrepris afin de cerner les causes et l'évolution du problème.

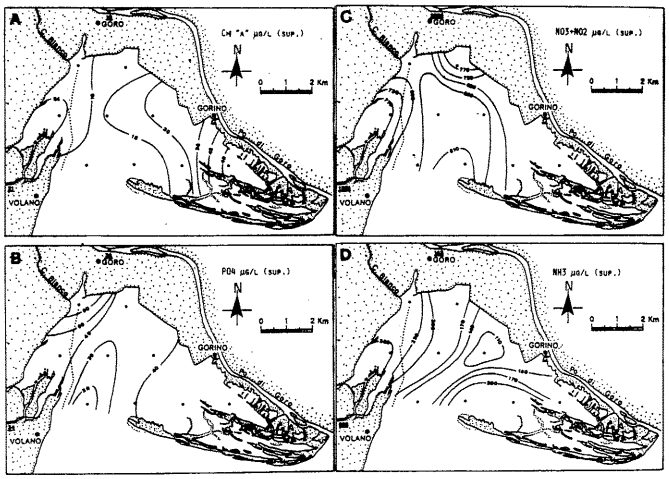
Il prévoit la réalisation d'analyses et de prélèvements en neuf stations situées à l'intérieur de la lagune et en deux autres sur les principaux affluents (Pô de Goro et Burana Volano). Lors des opérations de contrôle, effectuées tous les quinze jours, les paramètres physico-chimiques de base (température, salinité, pH, oxygène dissous et transparence des eaux) ont été mesurés. Des échantillons ont été prélevés pour la détermination en laboratoire des substances nutritives, de la chlorophylle "a" et du phytoplancton, du point de vue qualitatif et quantitatif.

L'examen effectué le 22 juillet 1987, à l'occasion d'un grave état d'anoxie, a montré que cette condition dystrophique a affecté les eaux profondes de toute l'étendue lagunaire, tandis que celles de surface était en état d'hypoxie. Ces conditions ont été relevées ainsi qu'un grave processus d'eutrophisation, essentiellement dû au développement des Diatomées et à des conditions météorologiques et climatiques caractérisées par des températures très élevées, une forte irradiation et la stagnation des eaux (absence de vent).

Les analyses successives ont montré le retour aux conditions normales d'oxygénation, même si le niveau trophique (des substances nutritives) est toujours resté proche de l'hypertrophie.

Les données qui ont été rassemblées durant ces six mois de recherche révèlent que :

1. du point de vue de la concentration des substances nutritives, pendant toute la période sous examen (juillet-décembre 1987), la "Sacca di Goro" présentait des conditions d'hypertrophie. Elles sont créées, en majeure partie, par les apports fluviaux du Burana Volano, qui se jette dans la lagune, à l'ouest, et du Pô de Goro à l'est. Il faut y ajouter les eaux de pompage en provenance de zones agricoles (il s'agit d'eaux particulièrement riches en nitrates) ;
2. les concentrations élevées en substances nutritives perdent leur pouvoir eutrophisant (en termes de productivité primaire), lorsque d'autres facteurs, tels que température et irradiation, jouent un rôle limitant la croissance des Algues ;
3. les phénomènes dystrophiques (conditions d'anoxie et d'hypoxie des eaux) ne se vérifient que durant l'été, lorsque la présence de grandes quantités de substance organique (constituées par des micro-algues mortes, si la période suit ou coïncide avec un "algal bloom") est accompagnée de températures élevées et de conditions hydrodynamiques statiques (échanges limités avec l'eau de mer et mouvement ondulatoire insuffisant).



Valeurs moyennes (juillet-décembre 1987) en µg/l de Chlorophylle "a" (A), de PO4 (B), de NO3+ NO2 (C) et de NH3 (D) dans les eaux de surface.

E-II9

Size variations of Sphaeroma serratum (F.) (Crustacea Isopoda) along a North-Adriatic estuarine gradient

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From November 1984 up to November 1985 four different populations of *Sphaeroma serratum* (F.) were studied monthly in the middle zone of the Dese estuary throughout the northern Lagoon of Venice (fig. 1), where this species is one of the main component of the Peracarid community.

When captures were sufficient, at least 100 random subsampled "not males" were measured every month in each site. Males were not measured, because they are usually too rare to allow a significant statistical comparison.

Different sex-ratios among the collecting sites might have altered the mean sizes, as males are usually bigger than female.

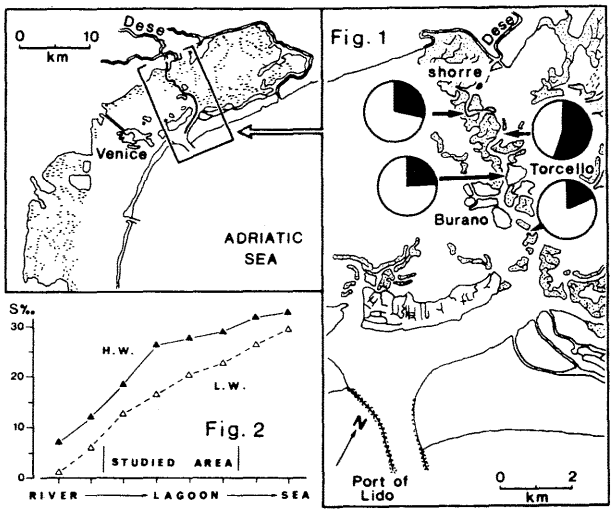

Fig. 1 - The lagoon course of the river Dese. The pie-diagrams show mean percentages of *S. serratum* on total Peracarids within the investigated area.
Fig. 2 - Mean salinities at low and high water at the surface.

Except for the reproductive period in summer, when the juvenile lengths were homogeneous in all population, the minimum sizes were found in the upstream population, the maximum in the downstream one (fig. 3), with highly significant statistical differences. Life cycles show parallel dynamics.

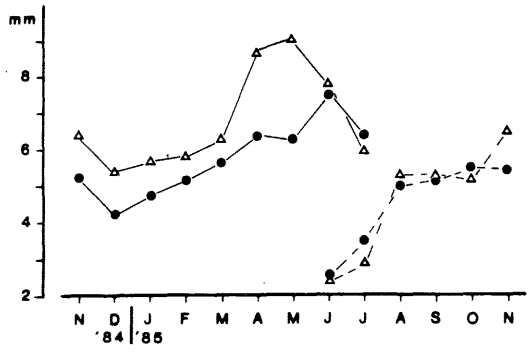

Fig. 3 - Seasonal variations of the mean sizes of *S. serratum* "not males" at the opposite ends of its distribution range: ● upper site; Δ lower site.

In the upper limit of the range of *S. serratum* distribution, dwarf sizes are probably due to the low salinities at low water (fig. 2), that cause a remarkable osmotic stress in the Isopod and strongly reduce its growth rate. In fact in the upstream portion of the investigated area, where salinity is very low (fig. 2), the "marine" species *S. serratum* is rare or absent, the macrobenthic community being only characterized by true estuarine species, i.e. the Hydrozoan *Cordylophora caspia* (Pallas) and the Bryozoan *Victorella pavida* s.l. Saville Kent (SCONFIETTI & MARINO, in press), together with the Amphipods *Echinogammarus pungens* (M. Edwards), *Leptocheirus pilosus* Zaddach, *Corophium orientale* Schellenberg, and the Tanaid *Heterotanais oerstedi* (Kröyer) (SCONFIETTI,1987). Here *S. serratum* is replaced by *S. hookeri* Leach.

On the contrary, in the lower portion a better vivification from the sea through a wide and deep navigable canal, allows the settlement of an almost marine community, and favours the reaching of maximum sizes in *S. serratum*, no longer stressed by unfavourable salinity patterns (GUNTER, 1961).

However, though the chemical-physical features are near to the physiological optimum for *S. serratum*, its population density is there reduced by an increased interspecific competition.

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E-II10

Observations on the Development of Artemia population in the Salt Lake of Larnaca in relation to the abiotic parameters of the Lake

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INTRODUCTION: The purpose of this study was to collect information on the development of the Artemia population inhabiting the Salt Lake of Larnaca. Long term observations were made on the abiotic parameters of the Lake water and the annual cycle of the Lake was described. The development of the Artemia population was correlated to the function of the Lake.

SITE DESCRIPTION: The Salt Lake of Larnaca is the biggest and lowest in a series of lakes situated to the southwest of Larnaca town. It covers an area of 5.1 sq.km and its lowest part lies 2.16m below the sea level. Natural catchment area is about 5.7 sq. km.

MATERIALS AND METHODS: Observations on the abiotic parameters of the Lake started in 1981. Measurements in 10 stations included maximum water depth, temperature, salinity, pH and Dissolved Oxygen.

Artemia were sampled and preserved in formaline. They were then counted under a microscope and categorized under cysts, nauplii, pre-adults and adults. Adults were sexed and females were classified according to their reproductive state. Couples were also counted.

RESULTS AND DISCUSSION: The basin of the Lake is dry and covered with a salt crust in the dry season.Water appears usually in November and evaporates in July or August. The mean monthly values of the 1981-1986 measurements showed that the maximum water depth of the Lake reaches its highest value of 38.2cm in February. Mean monthly temperature for the same period ranges from 19.0°C in November to 13.8°C in February and 32.5°C in August. Salinity decreases from a mean of 177ppt in November to 99ppt in February and increases towards dessication in August. pH increases from 7.56 in November to 7.77 in February and decreases to 6.60 in August.

The fluctuation of the above parameters reveal a pronounced annual cycle of the Salt Lake. This cycle can be divided into two periods:

a) The first period starts when water appears in the Lake and ends when the water depth attains its maximum, in February. During this period the water parameters depend on the water intake. Depth and pH increase, while temperature and salinity decrease.

b) The second period starts in February and ends when the Lake dries. During this period the water parameters depend on the temperature, which creates high evaporation rates. Depth and pH decrease in this period,while water temperature and salinity increase.

Wide deviations from the five-year mean monthly values were observed in the values of the parameters in a given annual cycle, i.e., 1986-87. Maximum water depth reached 75cm in March 1987; at the same month the water temperature decreased to 12.3°C and salinity to 54.8ppt. pH increased from its minimum value of 6.91 in December ,1986 and attained its maximum of 8.12 in March,1987.

The described annual cycle of the Salt Lake and the wide deviations of the parameters, occuring in certain years, create a highly uncertain habitat for the Artemia population in the Salt Lake of Larnaca. As a result, adaptations of the population were developed to ensure its survival in the existing environment.

From the table below it can be seen that hatching occured at the end of December. The pH value was considerably lower than the described as the essential range of hatching 8.0-9.0 (Sorgeloos et al, 1986).Given that the pH values rarely exceed 8.0, the adaptation on this respect ensured the onset of the population's development, the other parameters being relatively favorable.

TABLE: Composition of the Artemia population in the Salt Lake of Larnaca in 1986-87.
Mean numbers per liter are extrapolated to a m3 of water.

Artemia category / Sampling date	Cysts	Nauplii	Pre-Adults	Males	Non ovig. Fem.	Coupl.	Oviger. Femal.
7 Nov., 1986	20300						
17 Nov., 1986	9000						
2 Dec., 1986	10000						
29 Dec., 1986	252400	32400	200				
15 Jan., 1987	15800	1160	500				
3 Feb., 1987	35800	2800	-	400	200		
20 Feb., 1987	14000	40800	14400	200	400		
18 Mar., 1987	27500	15500	2000	1380	1630		
31 Mar., 1987	10670	26330	8220	1890	3560	220	330
14 Apr., 1987	249000	156430	18290	8500	3650	1290	5000
28 Apr., 1987	123000	4670	3160	16830	4330	1000	9670
14 May, 1987	49400	-	2600	17500	3500	600	15200
29 May, 1987	27500	-	-	-	100	-	-

After hatching the development of the population was very slow; for more than a month the population was exclusively composed of nauplii and pre-adults. The slow development of the population can be explained by genetic adaptation in response to environmental factors.

The dominance of cysts in almost all the collected samples reveals selection of the strain against ovoviparity. According to Lenz and Dana (in press) the production of cysts consists a major survival mechanism in populations inhabiting periodically unfavorable conditions. Browne et al(1984) also concluded that oviparity is preferred by bisexual strains inhabiting uncertain habitats.

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E

Influence du facteur salinité sur la nématofaune d'une lagune sud-méditerranéenne

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RESUME

L'incidence du facteur salinité sur les peuplements de nématodes en milieu lagunaire a été suivie à l'échelle spatio-temporelle. Au plan temporel, la salinité est effectivement un facteur écologique fondamental même si d'autres paramètres interviennent sur les caractéristiques biotiques. Au plan spatial, la salinité n'est plus qu'une composante secondaire provoquant une réduction de la taille des nématodes dans les zones littorales. D'autres facteurs dont la granulométrie fine du sédiment jouent un rôle essentiel dans la caractérisation de 4 zones bionomiques.

E

INTRODUCTION

Comme le fait remarquer BIANCHI (1984),la classification des lagunes côtières reste peu satisfaisante. Deux modèles de classification s'opposent :

* le premier, le "système de Venise" (1958), le plus utilisé, considère que la salinité représente le paramètre essentiel déterminant l'existence de gradients hydrologiques et biologiques dans les lagunes ;

* le second, celui de GUELORGET et PERTHUISOT (1983), controversé, se base non plus sur la salinité mais sur le "confinement", fonction du temps, qui discrimine à lui seul des zones bionomiques au sein des milieux à salinité variable.

Sans parti pris pour l'une ou l'autre des deux théories, nous avons voulu tester l'influence du facteur halin sur les communautés de nématodes peuplant la lagune de Bizerte. Ce plan d'eau communique largement, au nord, avec la mer par un chenal profond. L'oued Tindja, qui se déverse dans sa partie ouest, fait communiquer la lagune étudiée (assez profonde) avec le "lac" Ichkeul (milieu moins profond à salinité plus variable). Une analyse spatiale de la nématofaune a été réalisée dans la lagune, à partir de 10 stations de prélèvement échelonnées selon un transect ouest-est, dans le but de déceler un gradient de salinité croissant vers la partie orientale. En outre, des prélèvements mensuels effectués durant une année au niveau d'une seule station sont destinés à évaluer l'influence du facteur salinité à l'échelle temporelle, certains paramètres lagunaires pouvant varier dans le temps et non dans l'espace. Nous avons calculé un coefficient de corrélation, pour chaque couple de caractères, selon la formule de Bravais-Pearson afin d'estimer l'importance respective de plusieurs paramètres physicochimiques et biologiques.

RESULTATS A L'ECHELLE DU TEMPS

La salinité, avec une moyenne annuelle de 36°/°°, apparait assez fluctuante au cours du temps puisqu'elle oscille entre un minimum de 31.6°/°° en avril et un maximum de 40.2°/°° en août. Cette variabilité du facteur salinité influe sur la structure communautaire et coénotique du peuplement de nématodes suivi durant 13 mois. Si aucune relation n'a pu être établie par le calcul entre la salinité et l'abondance des nématodes également variable, une corrélation négative significative est enregistrée entre la biomasse totale du peuplement et la salinité. Le calcul permet aussi d'apprécier l'incidence de la relation unissant la composante haline aux paramètres biologiques structuraux (nombre d'espèces S, richesse spécifique R.S, indice de diversité de Shannon...). Les valeurs des coefficients r hautement significatives révèlent que l'augmentation de salinité en été provoque une diminution de la diversité spécifique. Cet appauvrissement spécifique noté en août s'explique en partie par l'explosion démographique des représentants de la famille des Xyalidae, toujours bien représentée tout au long de l'année. Il n'est donc pas étonnant de mettre en évidence une corrélation positive entre la salinité et l'abondance de cette famille.

RESULTATS A L'ECHELLE SPATIALE

Malgré la distance séparant les 10 stations (8km), les écarts de salinité restent faibles (pas plus de 2°/°°). L'absence de gradient de salinité sur le plan horizontal confère une certaine homogénéité à la lagune de Bizerte. Seule la biomasse individuelle des nématodes est corrélée significativement à ce paramètre, la taille des nématodes apparaissant plus petite quand la salinité s'élève, notamment dans les zones littorales. D'autres facteurs biotopiques jouent un rôle prépondérant : ce sont la profondeur, la température, le pourcentage de fraction fine f.f, la hauteur de la couche oxydée et l'indice de classement So rendant compte de l'hydrodynamisme. Quatre zones bionomiques de superficie très inégale, caractérisée chacune par certaines caractéristiques granulométriques (f.f, So...) et biologiques (S, R.S, et surtout les espèces dites dominantes dont la dominance est supérieure ou égale à 1%), peuvent être définies sans le concours du facteur salinité.

CONCLUSION

Dans le cadre restreint de la lagune de Bizerte, milieu où la salinité parait variable au plan temporel mais homogène au plan spatial, le facteur salinité n'est fondamental qu'à l'échelle du temps. Les résultats obtenus argumentent en faveur de la thèse de GUELORGET et PERTHUISOT, la caractérisation de zones bionomiques étant induite par la résultante de plusieurs facteurs interdépendants (notamment les paramètres sédimentaires).

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Cycle annuel du phytoplancton dans une saline Sicilienne

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Abstract

The paper contains results concerning the phytoplankton (density and biomass) in connection with the temperature and salinity in three ponds used as salt-works.

The results led to ascertain a prevalence of Diatoms in the phytoplankton population. Statistical valutations pointed out that not only the biomass of Diatoms, but also that of Dinoflagellates, was highly respresentative of these environments, and that these biomasses were not affected by the salinity.

Introduction

En Italie il y a plusieurs salines qui sont très souvent à l'abandon ou mal exploitées. Ces milieux sont subdivisés d'habitude dans une série de bassins dont le premier se trouve tout proche de la mer ("vasca fredda") et les autres, vers l'intérieur, sont progressivement moins profonds et plus salés.

Dans le but d'une éventuelle utilisation de ces bassins pour l'aquiculture, nous avons entrepris des recherches sur les biocénoses planctoniques et benthiques dans une saline située près de Trapani (Sicile occidentale, Italie). Notre travail concerne seulement les résultats relatifs au phytoplancton.

Matériel et Méthodes

Nous avons effectué les prélèvements tous les mois, à partir de Janvier jusqu'à Décembre 1985. Pour nos recherches nous avons considéré seulement les premiers trois bassins à partir de la mer (S1, S2, S3), car les autres étaient trop salés et peu profonds (5-10 cm). Dans les bassins choisis nous avons fixé plusieurs stations pour l'étude du phytoplancton (densité et biomasse) par rapport aux variations de la température et de la salinité. Pour l'observation des échantillons biologiques nous avons suivi les mêmes méthodes précédemment utilisées (Andreoli et Tolomio, 1985).

Résultats et Discussion

Pour ce qui concerne la température nous n'avons pas relevé de différences remarquables entre les trois bassins,tandis que pour la salinité nous avons mesuré des valeurs beaucoup plus hautes dans le bassin le plus éloigné de la mer (S3) (Fig.1).

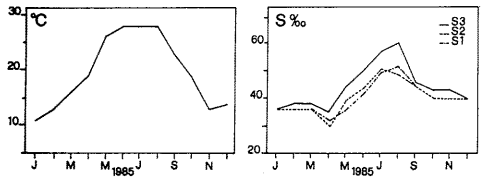

Fig.1 - Fluctuations de la température et de la salinité dans les trois bassins.

Le phytoplancton, comme déjà observé dans des milieux semblables (Sortino et al., 1985), est caractérisé par un petit nombre d'espèces, qui diminue progressivement vers l'intérieur (S1=64 espèces; S2=54 espèces; S3=35 espèces). Les Diatomées sont plus nombreuses que les autres groupes systématiques (Dinophycées, Coccolithacées, Chlorophycées et Nannoplancton (Microflagellées)), avec la prédominance des formes tychopélagiques. Parmi les Chlorophycées il faut remarquer la présence, plutôt insolite dans ce milieu, d'une forme du genre Pediastrum (P. cf. clathratum).

Si l'on analyse les fluctuations des valeurs de la densité phytoplanctonique et de la biomasse, on peut relever des différences remarquables entre les trois bassins ; les données quantitatives (Fig.2) sont bien plus élevées dans le bassin le plus salé (S3). Le plus souvent les variations ont été produites par les mêmes espèces ; toutefois, pour ce qui concerne les formes les plus impliquées, il existe une certaine différence entre les trois bassins.Dans le bassin S3 dominent quelques espèces qui appartiennent aux genres Navicula et Amphora et, uniquement au mois de Mai, Cyclotella sp., Dunaliella salina et le Nannoplancton ; dans le bassin S2, au contraire, il faut signaler quelques espèces du genre Licmophora (en Février), Cocconeis scutellum (en Juin) et deux Dinophycées qui n'ont pas été classées (en Septembre);dans le bassin S1, enfin, on met en évidence encore les deux Dinophycées mentionnées (en Septembre) et, en Juin, Cyclotella sp. et Cocconeis scutellum.

Les valeurs élevées de la biomasse enregistrées dans le bassin S3 aux mois de Juin et de Décembre sont dues à la présence de Pleurosigma formosum et de P. subsalinum, qui, même s'ils ne sont pas très abondants (15.000 - 27.000 cell/l), toutefois jouent un rôle important dans la biomasse grâce à leur volume cellulaire remarquable (387.850 et 137.712 μm^3 respectivement).

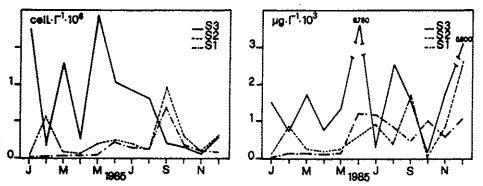

Fig.2 - Fluctuations de la densité (cell/l) et de la biomasse (µg/l) du phytoplancton dans les trois bassins.

L'analyse des variables qui décrivent les fluctuations temporelles dans les trois bassins a mis en évidence une corrélation presque toujours significative ($0,5 \leq R \leq 0,96$) entre la biomasse et la densité relatives aux divers groupes du phytoplancton. Cependant ces paramètres, rapportés uniquement aux Diatomées et Dinophycées, peuvent expliquer 98% de la variance totale de chaque bassin; donc ils sont très représentatifs. Toutefois nous n'avons pas obtenu,sur la base des données précédemment mentionnées (Figs 1 et 2), de corrélations significatives parmi ces valeurs et la salinité. Par conséquent il est fort probable que cette situation n'est pas imputable aux variations de la salinité mais plutôt à d'autres facteurs, comme, par exemple, la diminution progressive du volume d'eau dans les trois bassins, à la suite de leur utilisation.

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E-III3

Nutrient dynamics and dystrophy in a Brackish Coastal Lagoon (St. Andre, SW Portugal)

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St. Andre (150 ha, ca. 1.5m average depth, SW Portugal) is a land-locked lagoon isolated from the sea except during a short period in Spring (1/2 - 1 1/2 months) when a man-made channel is opened through the sand barrier. Such feature makes it an ideal system for the study of lagoonar metabolism.

Chemical parameters variation from March 84 to March 86 (Fig. 1) shows low nutrient concentrations except for two types of periods: 1)late Autumn-Winter and 2)Summer.

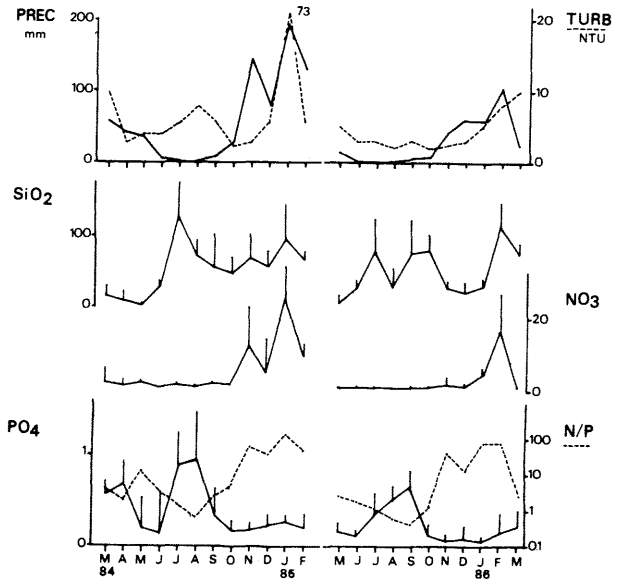

Fig.1. St.Andre lagoon - parameters variation during a two years survey. No values for March and April 85 when the lagoon was connecting with the sea. Chemical values expressed in µgat/l.

1. Late Autumn-Winter - Nutrient Income

During the raining period high concentrations of Silicate (SiO_2) and Nitrate (NO_3) coming from the watershed are observed. The highest concentrations of NO_3 in the lagoon water are observed after intense rainfall periods - Jan.85 and Feb.86 - and a strong correlation ($p<0.001$) exists between NO_3 and precipitation. No raising of phosphate (PO_4 - dissolved reactive phosphorus) is observed for this period. However it is well known that predominant form of incoming phosphorus is not dissolved but particulate (particularly sorbed to clay). During the reported period, precipitation correlates ($p<0.01$) with turbidity which is caused by particulate (silt+clay) material. The only other turbidity peak value is observed in Aug.84 when a high phytoplanktonic biomass was recorded (CANCELA DA FONSECA *et al., in press*).

2. Summer - Nutrient Sediment Release

For Summer months high concentration of PO_4 and SiO_2 were detected. As no loading of SiO_2 from the watershed is developing during the dry months, these peak values must be explained as the result of internal recycling.

Sediment has a high organic content (12-15% monthly average and 48% maximum values) and, as temperature raises, intense oxidative processes develop. The high macrophytic biomass develops intense photosyntesis during the day but contributes to the nocturnal oxygen consumption and prevents adequate mixing of the whole water column causing some diurnal low bottom dissolved oxygen values. Under oxidative conditions of sediment-water interface no nutrient release from the anoxic layers to the water occurs. When anoxic conditions prevail phosphorus trapped in the sediment (eg. in iron compounds) passes rapidly into the water above at a rate as much as 1000 times faster than releases from oxygenated sediments (GOLDMAN & HORNE, 1983). Oxygen also plays a role in the control of SiO_2 which is also released in reduced conditions (VANDERBORGHT *et al.*, 1977).

According to CHASSANY DE CASABIANCA (1979) the evolution of N/P ratio makes possible the prediction of dystrophic phenomena. The behaviour of N/P in Fig.1 compared with PO_4 and SiO_2 clearly traces the sediment anoxic-reduced conditions. The lower values of the ratio were recorded in Jul.-Aug.84 when large fish mortalities and a set of environmental conditions usually refered to as "dystrophic crisis" occured (BERNARDO *et al., in press*). In Sep.85 fish mortalities were detected by local fisherman corresponding again to a low N/P value.

Low values of N/P ratio agree with high water phosphate and silicate concentrations. A whitish water layer attributable to iron compounds was observed indicating the release of these compounds from the sediments when anoxic conditions occur. Fish mortalities can also be related with iron hidroxid precipitation which could recover its gills and asphixiate them (MACHADO CRUZ,1969). The fact that this precipitation occurs in the presence of O_2, could explain the mortalities observed at noon (BERNARDO *et al., in press*). So, low N/P values could be better explained by a sudden raise of phosphate concentration (normally low in these productive environments where dissolved phosphate is rapidly transfered to the vegetal biomass) than by a great decrease of nitrate. The high sediment release of SiO_2 under the reduced conditions of the dystrophies gives to this compound a real interest in the prediction of this phenomena.

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E-III4

Occurence of a bloom of Gymnodinium catenatum Graham in a Tyrrhenian Coastal Lagoon

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Gymnodinium catenatum Graham (Dinophyceae, Pyrrophyta) is an unarmoured, chain-forming dinoflagellate. The chains can be formed by a few (2-4), or up to more than 30 individuals 24-35µm long and 30-41µm wide. This species is known to have caused paralytic shellfish poisonings (PSP) in humans in Mexico, Spain and Australia (Campos et al., 1982). Extensive information concerning the toxicological properties of this species is given by Mee et al., 1986.

Gymnodinium catenatum has a wide geographic distribution (Pacific coast of America, Japan, Australia, and the Atlantic coast of Spain), but its ecological characteristics are as yet insufficiently known (Hallegraeff & Sumner, 1986; Hallegraeff et al., 1987; Campos et al., 1982).

In early September 1987 a bloom of Gymnodinium catenatum was observed at Fusaro lagoon, located on the Southern Tyrrhenian coast of Italy. Fusaro is a euhaline coastal lagoon, showing low spatial and temporal variations in salinity, due to both a good connection with the sea and a scarce inflow of fresh water. In recent years, the lagoon has undergone heavy domestic pollution and extensive dredging that have drastically modified its morphological and ecological characteristics. As a consequence, anoxic conditions are often observed, particularly in the area subject to dredging, where the present bottom reaches down to more than three times (13m) the average depth of the basin (4m).

Since this is the first report of a bloom of Gymnodinium catenatum for the Mediterranean Sea and for a coastal lagoon, we believe that its presence may be considered interesting from both an ecological and an applied point of view (shellfish farming), considering that Gymnodinium catenatum exerts toxic effects at concentrations of 10^3 cells/l (Estrada et al. 1984).

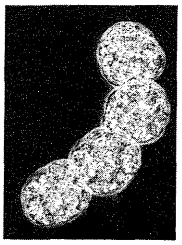

FIGURE 1.

Figure 1 shows a chain of Gymnodinium catenatum collected on September 9th and preserved in 4% neutralized formol. It is worth noting that preservation techniques have a strong influence on the variability of some morphological features of this species (Graham, 1943; Balech, 1964).

When the bloom occurred, Gymnodinium catenatum reached total densities of $1.7 \cdot 10^6$ cells/l (46% the entire population). The remaining phytoplankton population consisted of about 30% phytoflagellates and 18% diatoms. Some physico-chemical parameters, measured at three stations along the main axis of the basin during the occurrence of the bloom are given in Table I.

Previous observations in the same lagoon (1985, unpublished data) indicate the presence of this species from June through September. In these samples Gymnodinium catenatum, which at times occurred at higher concentrations (≈6 x 10^6 cell/l) than in September 1987, accounted for no more than 42% of the entire population. The remaining part was composed by diatoms (38%-78%), and phytoflagellates (17%-34%).

The considerations of Bravo (1986), who suggests that the blooms observed in the Ria de Vigo may originate from cysts present in the bottom sediments, may represent an appropriate basis for hypothesizing that the Fusaro blooms are a possible consequence of the continuous resuspension of the lagoon sediments, and hence of the cysts, by dredging.

Despite the lack of information regarding the toxicity of its population, the presence of Gymnodinium catenatum in the Fusaro lagoon may represent a possible complication for the reclamation programs aimed at restoring in the lagoon ecological conditions compatible with its century-long tradition in shellfish farming.

TABLE I

ST. #	h	Temp. °C	Sal. PSU	O_2 ml/l	O_2 %sat	$N\text{-}NO_2$ µM	$N\text{-}NO_3$ µM	$N\text{-}NH_4$ µM	$P\text{-}PO_4$ µM	SiO_4 µM	Chla µg/l	Phaeoa µg/l
17	15.30	28.44	38.19	6.41	146.1	0	0.52	1.06	0.45	9.91	20.68	3.73
24	16.03	28.45	38.18	5.99	136.7	0.10	0.10	1.07	0.49	16.43	21.50	11.53
29	16.23	28.61	38.15	5.58	127.6	0	0.63	1.30	0.26	12.03	22.06	8.76

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E-III5

Dynamique des populations d'Ulvacées et cycles du Carbone et de l'Azote (lagune du Prévost, France)

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Mots clefs : Ulvacées, lagune saumâtre, composition élémentaire des thalles, matériel particulaire, biomasse, sels nutritifs, étang du Prévost, Languedoc-France.

E

Dans une lagune saumâtre méditerranéenne, l'évolution saisonnière d'un système à Ulves flottantes est étudié par des mesures hebdomadaires en zone bordière d'accumulation . Les mesures de biomasse en milieu naturel sont doublées par des expérimentations en cages in situ. Etant donnée la variabilité du milieu, cette étude est centrée sur l'analyse, dans l'espace et dans le temps, de la composition élémentaire en C et N des thalles d'Ulves et du matériel particulaire des eaux ; les divers paramètres hydrologiques et climatiques sont suivis parallèlement.

*

* *

Les populations d'Ulvacées ont été suivies durant 7 mois, en lagune, par des mesures hebdomadaires en zone proche du bord (étang du Prévost, Languedoc, France).

1°. Des mesures quantitatives effectuées sur les populations naturelles, et des expérimentations en cages "in situ", et des examens microscopiques des thalles, il ressort :

a/ Les thalles d'*Ulva rotundata* (Blinding), espèce la plus représentée, sont amenés dans la zone proche du bord par des courants, après leur croissance maximale ; la biomasse d'Ulves flottantes (4500 g P.H. /m2) succédant à des populations d'*Enteromorpha proliphera* se maintient d'avril à juin, les thalles sous-jacents étant plus actifs.

b/ Les processus des dégradations apparaissent dans les Ulves de surface en mai puis sur l'ensemble de la masse algale jusqu'à dégradation totale fin juillet.

2°. Le suivi des cycles du carbone et de l'azote dans les différentes fractions de l'écosystème à Ulva apporte les résultats suivants :

a/ La composition élémentaire des Ulves (moyenne des échantillons de surface et de fond), montre au cours du temps un pourcentage décroissant en carbone (29,7% à 23,85) et croissant en azote (1,18 à 2,10%), le C/N variant de 21,78 ± 9,4 à 13,81 ± 7,80. D'autre part, le C/N des Ulves de surface varie de 25,4 ± 8,9 à 18,8 ± 9,5 et le C/N des Ulves de fond de 15,2 ± 9,09 à 9,8 ± 0,8 d'avril-mai à juin-juillet.

b/ Ces rares données sur le matériel organique particulaire en étang font ressortir l'importance de cette fraction organique en milieu lagunaire. Le carbone et l'azote particulaire des eaux montre trois principaux pics dont le premier de 20mg/l de C et de 2,6 mg/l d'N est situé un mois après le pic de biomasse algale. Le C/N du matériel particulaire (7,99 à 7,75) moins élevé, mais non significativement différent de celui des Ulves, confirme son origine ; néanmoins on observe une diminution du C/N en passant des thalles à l'état de matériel particulaire.

c/ L'analyse des sels nutritifs des eaux montre de faibles teneurs en nitrites et nitrates, élevées en phosphates, avec un N/P inférieur à 1, typique de ces lagunes méditerranéennes peu profondes et eutrophes.

3°) On conclut à la rapidité de dégradation des thalles d'Ulves, et à l'importance des transformations de la matière organique des thalles en matériel particulaire avec augmentation du pourcentage d'azote et diminution du pourcentage de carbone, au cours du temps, comme dans l'espace, de la surface vers le fond.

D'autre part, la méthode générale d'étude par l'analyse des différentes fractions azotées et carbonées du système, parallèlement à la dynamique des populations, est une approche interessante du fonctionnement de ce type d'écosystème variable.

E-III6

Lagune de Mellah, Algérie : étude spatio-temporelle des paramètres hydrobiologiques

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***Résumé** : L'étude s'appuie sur les deux atouts essentiels du lac :*

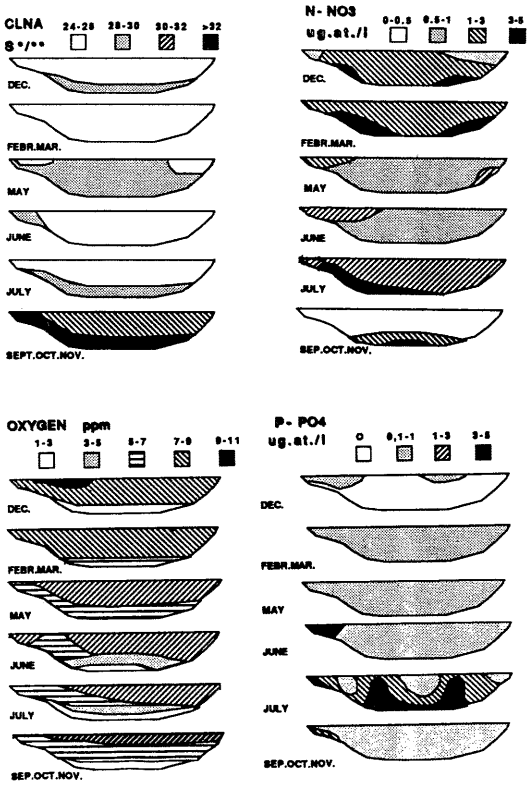
1) sa topographie et son régime qui en font un véritable modèle de lagune saumâtre méditerranéenne tectonique ; ceci permet la mise en place d'un suivi spatio-saisonnier des paramètres hydrologiques (température, salinité, O_2, SiO_2, NO_3, PO_4, NH_4, chlorophylle) et permet de définir mouvements d'eaux, stratification et gradients.

2) son absence exceptionnelle de pollution, ajoute un intérêt supplémentaire au suivi des nutrients et à la valeur du pic estival de phosphates (5 uatg/l).

***Mots-clef** : lagune méditerranéenne, hydrologie spatio-saisonnière, nutrients*

Au Nord-Est de l'Algérie, près de la frontière tunisienne, à une dizaine de kilomètres à l'ouest d'El Kala s'étend une lagune saumâtre d'origine tectonique, le lac Mellah, (865 hect., 5m20 de profondeur maximale). Relié à la mer au Nord, par un long chenal, (900 m), le lac reçoit au sud et à l'ouest les apports d'eau douce intermittants des oueds.

Cette étude rend compte de 8 périodes de prélèvements effectués au cours de l'année 1980 sur le grand axe du lac, allant du grau de l'étang à son extrémité Sud, où ont été positionnées 7 stations, sur 7 km. Aux différentes stations ont été mesurés en surface et tous les mètres en profondeur : température, oxygène et salinité à l'aide d'une sonde, tandis que des échantillons d'eau ont été parallèlement recueillis pour l'analyse des phosphates, nitrates, silicates, et chlorophylle .



A partir de l'ensemble des données, on dresse des coupes verticales de la lagune selon le grand axe du lac, représentant les principaux paramètres, dont certains sont figurés ici (ClNa, O2, PO4, NO3). En dépit d'une certaine variabilité, apparaissent les principaux mouvements d'eau, stratification et gradients suivants :

1) La pénétration estivale de la mer par "coin salé" s'observe sur le fond de l'étang (teneurs > 32 S°/∞ au delà de 4m de fond) ;

2) L'importance de la stratification estivale se traduit par une baisse d'oxygène s'accusant vers la fin de l'été et de la surface vers le fond (teneurs < 3ppm au delà de 4m de fond de juillet à novembre) ;

3) La montée estivale des orthophosphates s'observe du fond vers la surface ; on note un pic très élevé (5 µatg/l en juillet), malgré l'absence apparente de pollution ancienne résiduelle ;

4) Pendant la période hivernale d'apports d'eau douce, s'observe, avec la baisse de salinité, une plus grande homogénéisation des eaux de surface, cependant qu'une zone anoxique de salinité élevée persiste au delà de 4m de fond, (teneurs en oxygène < 3ppm) ;

5) Le pic de Chlorophylle (11µatg/l) se situe en juillet, en surface, selon un gradient comparable à celui de l'oxygène.

E-III7

The Calich Lagoon (NW Sardinia) : general ecological observation and fry migration

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RESUME'-Les données d'une étude sur la migration trophique de jeunes poissons d'intérêt économique sont fournies dans ce travail, conduit dans la Lagune de Calich (Sardaigne). Les résultats ont démontré que, malgré les précaires conditions écologiques du bassin, le phénomène se présente régulièrement.

The Calich Lagoon for its area is the third largest salt-marsh in NW Sardinia (Fig.1). It has been recognized for a long time not only for its great naturalistic importance (included by the CNR in the list of protected environments-MONTALENTI, 1967) but also as an economic resource for commercial fishing activities (FATICHENTI et al.,1978;CHES SA, 1980). After reclamation work in 1938-40 the lagoon has become increasingly polluted by both chemical and microbiological factors due to the development of modern agricultural-zootechnical activities and industries present in the watershed area (400 times greater than the lagoon surface) and for the increased anthropic pressure. It has been ascertained that the input of suspended matter is approximately 10 times larger than the output with an accumulation of about 10,000 t/y of suspended matter (OREN et al.,1980).

In consideration of all these facts the "Regione Sardegna" decided in 1978 to carry out a series of reclamation work to improve the fishing productivity.

In order to evaluate how the ecological state of the marsh affects the entrance of Teleosteans fry, we have carried out from November 1985 to October 1986, a research "ad hoc". It was observed during this period that a large amount of the ungrazed filamentous alga Enteromorpha intestinalis (L.)Link was present, interfering with water exchange between the lagoon and the sea. For the fry sampling we used small "trawl-net" (15 meters long) and a "fyke-net with rings"; to catch the glass-eels we also used "bundles of myrtle branches". Samplings were effected over a 24 hour period and the fishing gear controlled every 6 hours, once a month. A set of environmental parameters along a transect between the entrance and initial part of lagoon has been recorded at surface and close to the bottom (data non included). The water temperature of the lagoon varies between 9°C (December) and 27°C (August), while the salinity values are between 6‰ and 40‰.

The Mullet fry showed the highest abundance: 99% of the total yearly samplings (Fig.2). The dominant species were Liza ramada (Risso)(2,145 specimens) and Liza aurata (Risso) (1,275 specimens)(Fig. 3). The size at the March, April and May entrance for L. ramada were 18.38 ± 1.3 mm; 18.16 ± 1.3 mm and 18.78 ± 0.9 mm respectively; while for L. aurata 21.9 ± 4.2 mm, 27.8 ± 5.6 mm and 24.07 ± 3.6 mm respectively. For L. ramada our data correspond well with other sites in the Mediterranean, both for size and appearance period (TORRICELLI et al.,1982; ZISMAN & BEN TUVIA,1975). For L. aurata the peak of abundance in the Calich lagoon is anticipated with regard to that found in the North Tyrrhenian area (GANDOLFI & TORRICELLI,1978), but is delayed to that of the Israeli coasts (ZISMAN & BEN TUVIA, 1975): thus the thermal conditioning phenomenon is evident. Liza saliens (Risso) appears in the March sampling (40 specimens), while 6 specimens of Mugil cephalus L. were collected between November and December. Regarding the other Teleosts, 35 specimens of Anguilla anguilla (L.), Sparus aurata L. and Dicentrarchus labrax (L.) were sampled as a whole (Fig. 4).

In spite of its precarious ecological state, the entrance of Mullet fry in the Calich lagoon is good and comparable from a qualitative and quantitative stand point with that of other lagoons in the central and southern Italian areas. The lack of previous data, though partial, of this kind for the Calich lagoon, makes a comparison impossible. From the data of CHESSA (1980) relative however to the adulte stage, it can be shown that the Mullet are the quantitatively dominant group (69.9%) while species of greater economic value such as gilthead and bass constitute only 1.2% of the total catch.

We think that the ecological conditions and therefore the migration of fry in the lagoon can be greatly improved by the opening of a second mouth; in fact the particular shape of the marsh long and narrow is one of the most critical aspects of this sub-system. The opening of a new mouth could be made in a point to the East, but near the present mouth (Fig. 1). At the end of the reclamation work, "in progress", a replication of this study is recommended as this could show the real biological potential "yield" of Teleosts fry, thus giving indication for its exploitation and rational management.

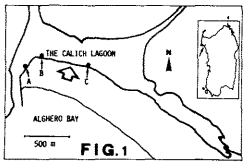

FIG. 1

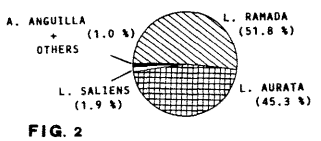

FIG. 2

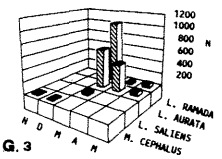

FIG. 3

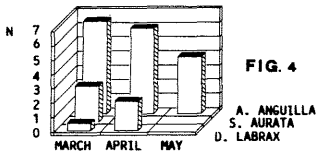

FIG. 4

Fig. 1 - A,B,C: Fishing gear location (A:"myrtle branches";B:"fyke-net";C:"trawl-net")
⇧: position of the 2nd mouth proposed.

Fig. 2 - Species dominance of Teleosts fry (one year's data - no specimens found in November, December and from July to October).

Fig. 3 - Number of individuals of Mullet fry collected monthly (no specimens found from July to October).

Fig. 4 - Number of individuals of fry, of commercial value, collected monthly. - Not sampled in January, February and June -

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E-III8

Distribution spatiale du phytoplancton de l'étang de Thau (lagune littorale du Languedoc) en 1986-87

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Les mesures réalisées dans l'Etang de Thau en 1986-87 avaient un objectif prioritaire: définir quel type de réseau de stations, quel rythme de prélèvements, quel choix de variables serait le mieux adaptés pour comprendre les processus à l'intérieur de chaque compartiment trophique et leur poids relatif dans le fonctionnement général du réseau. Mais il est évident que répéter en quatre occasions (juin et octobre 1986, février et mai 1987) un réseau de 63 stations sur une lagune littorale de 7500 hectares en suivant 28 paramètres représente une densité d'information exceptionnelle en milieu paralique, qu'il importe aussi d'analyser en temps que tel. C'est ce que nous présentons ici pour le compartiment des producteurs primaires photosynthétiques en nous appuyant principalement sur l'analyse spectrofluorimétrique des chlorophylles *a*, *b* et *c* et de leurs produits de dégradation. Ceci permet d'aborder l'aspect biomasse avec une grande précision mais également d'approcher la structure des communautés par cette voie ataxinomique; cet aspect sera d'ailleurs complété par une analyse des taxons les plus représentés et de la diversité spécifique.

1 Distribution spatiale de la biomasse chlorophyllienne

La distribution de la chlorophylle *a*, basée sur l'ensemble des quatre campagnes spatiales, met en évidence un remarquable gradient croissant le long de l'axe principal de l'étang, du SW vers le NE, avec des isolignes "diagonales". Les teneurs sont inférieures à 1.7 mg. m^{-3} dans le tiers sud-ouest, entre 1.7 et 2.4 mg. m^{-3} dans la partie médiane et supérieures à 2.4 mg. m^{-3} vers Sète. *A priori*, cette distribution peut correspondre à deux hypothèses distinctes si l'on admet, compte tenu des faibles apports terrigènes, que les sels nutritifs constituent le régulateur principal de la production primaire:

- le développement actif du phytoplancton à partir d'un point source de sels nutritifs situé au sud-ouest, le gradient spatial étant l'image du temps de latence de développement du phytoplancton.
- un "enrichissement" passif en phytoplancton, la source étant marine. Un tel transit océan - étang semble irréaliste vu l' oligotrophie méditerranéenne. Cependant, l'eau "méditerranéenne" entrante est celle de l'arrière port de Sète dont nous ignorons les caractéristiques chimiques et la teneur en phytoplancton.

Cette répartition de la Chl *a* est calquée sur la bathymétrie. Mis à part les bordures de l'étang partout peu profondes, la profondeur s'accentue au fur et à mesure que l'on approche de Sète. Si l'on exprime la biomasse chlorophyllienne non plus par unité de volume mais en l'intégrant sur toute la hauteur d'eau sous 1 m^2 de surface, le gradient s'accentue considérablement. Cette observation qui n'avait rien d' évident *a priori*, entraîne un certain nombre de conséquences:

- pour des filtreurs aptes à profiter de toute la colonne d'eau, la nourriture disponible est de 6 à 8 fois supérieure dans les zones profondes.
- malgré la fréquence de vents forts, le brassage vertical et les échanges horizontaux qui en découlent, la répartition spatiale de la chlorophylle est fortement hétérogène.
- il semble y avoir une liaison entre l'intensité des apports d'énergie auxiliaire (liés au vent) et la production primaire, même si cette relation est difficile à interpréter.

2 Causes de cette distribution spatiale

Ceci confirme que les écosystèmes sont, avant tout, des systèmes physiques. Apte à répondre rapidement à toute stimulation extérieure grâce à son taux de renouvellement élevé, le phytoplancton dépend de l'énergie solaire directe (photosynthèse) ou de l'énergie auxiliaire (température, vents, turbulence) qui en dérive. Il est donc logique, particulièrement dans une lagune où les apports en sels nutritifs par le bassin versant sont faibles, de rechercher les forces physiques qui régissent la production et la distribution du phytoplancton, communauté à faible contrôle interne.

Dans l'étang de Thau, la circulation et les échanges avec les systèmes extérieurs dépendent du régime météorologique: précipitations, vents et pression jouant sur la marée. Parmi ces caractéristiques agissant sur le système lagunaire de Thau, les apports extérieurs lors des crues peuvent être négligés car ils sont occasionnels, limités en raison de la petitesse du bassin versant (280 km^2) et épisodiques (climat méditerranéen); ils n'ont pas eu d'effet en 1986-87.

Quant aux échanges avec la mer, ils agissent de deux façons:

- en modulant indirectement et avec un effet-retard plus ou moins accentué sa production 1) par action de la turbulence (donc de l'histoire lumineuse des algues) sur la production, cet effet étant beaucoup moins prononcé qu'en mer 2) en modifiant le degré de fertilisation en sels nutritifs à partir du milieu marin et du sédiment 3) par un éventuel "ensemencement " d'espèces marines.
- en jouant directement sur sa distribution spatiale: entrée ou sortie de biomasse par les graus, homogénéisation ou stratification verticales, création de zones d'accumulation ou de faible concentration.

Il reste à prendre en considération le régime des vents et la circulation qu'il induit, dans les deux à trois jours qui précèdent chacune des campagnes. Quand il n'y a pas de vent bien établi (juin 1986 et de mai 1987), la circulation a peu d'effet sur la distribution du phytoplancton. La cartographie de la Chl *a* diffère par contre lors des campagnes précédées par un vent de W-NW ayant permis l'établissement d'une circulation à trois cellules; ainsi, en octobre, les isolignes de chlorophylle sont presque parallèles à l'axe longitudinal de l'étang sans que soit remis en cause le gradient croissant de Marseillan vers Sète qui tient à une dynamique de production différentielle et permanente. Il faut voir dans cette structure un effet des courants avec, à côté de la cellule de circulation qui isole la région proche de Sète, deux cellules longitudinales tournant en sens inverse: un courant axial NE-SW et deux courants de retour le long des deux bordures de Thau.

3 Structure des communautés à partir des rapports pigmentaires

Schématiquement, la présence de chlorophylle *b* traduit celle des Chlorophycées (influence continentale?), la présence de chlorophylle *c* celle des Diatomées (influence marine?). Quelques tendances apparaissent ainsi à l'examen notamment du rapport Chl *b* / Chl *a*:

- l'élévation de ce rapport dans la partie la plus continentale au SW de l'étang: *b* / *a* généralement supérieur à 0.05 (octobre 86), parfois à 0.2 (juin 86) voire 0.3 (mais 87).
- la dominance totale des Diatomées lors de la floraison observée en février 87, le rapport restant, dans toute l'étendue de l'étang, en-dessous de 0.05.
- l'importance des Chlorophycées dans toute la zone des parcs à huîtres, en fin de printemps (surtout net en 1987), même si les biomasses atteignent seulement des valeurs moyennes.

Ecological dynamics and main criteria for the rehabilitation of a littoral marsh (Albufera of Majorca, Balearic Islands)

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Introduction

The *Albufera* of Majorca has an approximate extension of 24 km². It lies to the northeast of the Island and has been recognized by the UICN, INRB and ICBP as an area of conservational interest.

During the last century it was almost completely dried up and transformed from a zone of divergent waters that formed many small ponds into a group of channels where the waters are forced to reach the sea through the shortest and fastest way (fig. 1). This criterion, while useful for desiccation, is the less natural for the normal course of the waters. When the potential energy is low the waters tend to spread out and occupy the widest area before arriving to the sea.

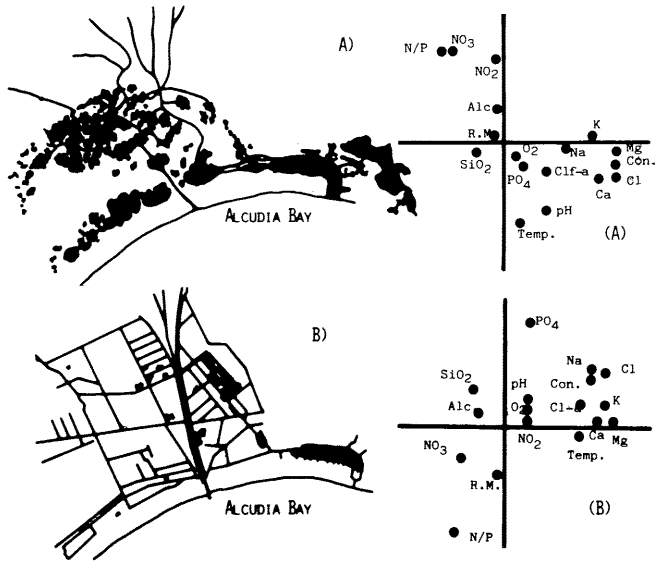

Fig.1.- (A) Before 1859
(B) 1988

Fig.2. (A) Coastal lagoons
(B) Channels

The environment of the *Albufera* include artificial and natural lenitic zones as well as artificial lotic zones. Both types of environments have been studied separately by means of factorial analysis to understand the general features of the system.

Coastal lagoons

Parameters related to the salt contents are strongly correlated and offer high charge coefficients over the first axis which can be related with marine influence.

As factors of positive charge the second axis shows the nitrogen components and as negative the pH and the temperature. This axis can be interpreted as a production gradient. In fact, higher temperatures, an increasing in the pH and a decreasing of nutrients take place in moments of active photosynthesis (fig. 2).

It could be expected that the phytoplanktonic chlorophyll "*a*" would be much more related to the temperature and the pH. The reason comes from the fact that primary production is carried on mainly by aquatic macrophytes which compete advantageously with phytoplankton. Therefore the second axis must be linked to the performance of phytobenthic communities.

Channels

The charge factors of the first axis are similar to those described for coastal lagoons and the second axis presents phosphates as the principal positive charge factor, and the relation nitrogen-phosphorus as the main negative charge factor. Nutrients are originated in two different areas. From the upper part of *Albufera* arrives the contribution of the crop fields and from the lower part arrives a direct input of urban origin. The gradient that appears in the second axis is established between these two extremes (fig. 2).

Rehabilitation criteria

Coastal lagoons depend on natural processes, salinity variations and macrophyte activity. Lotic environments also depend on marine influence but also are affected by an artificial influence.

Desiccation has caused an increase of helophytic vegetation, which occupies nowadays 96% of the humid zone. Filling of lagoons and geometrical arrangement of currents forces submerged vegetation to be lotic adapted while other species, more adapted to lenitic environments, are decreasing or have disappeared, as *Trapa natans* or *Nymphaea alba* (MARTINEZ TABERNER, 1986).

Basic criteria for rehabilitation would be the following:

1. Reassure the present dynamics of the lagoons and eliminate those disturbing factors of the lotic environments.
2. Increase free water zones by progressively restoration destroyed lagoons in order to achieve a rise in food resources and in the number of habitats (AGAMI & WAISEL, 1986; BJÖRK, 1972; ENGEL, 1984).
3. Change water circulation pattern in order to fractalize its route.
4. Avoid environment regularity and try to smooth the gradient so that it can be occupied by a great number of species with different environment tolerances (LYNCH & GABRIEL, 1986).

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The Albufera of Valencia, an hypertrophic stressed ecosystem

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INTRODUCTION

The Albufera of Valencia is the largest oligohaline coastal lagoon in Spain. It is a shallow water body (mean depth of 1 m) with a surface of more than 22 km². Historically it has suffered important human impacts which can be summarized as: (1) transformation of marsh-lands into rice fields mainly during XIX century; (2) industrial development and population increase since 1960. The Albufera receives the flow of about 50 channels coming from adjacent ricefields and a few streams, all of them heavily contaminated with domestic and industrial sewage waters. In the last 25 years this lagoon has shifted from a transparent and clear water body above macrophyte prairies to an opaque green water body over a anoxic black sediment. The intention of the present paper is to show and to evaluate the factors causing this change. Previous papers (Soria et al, 1987; Oltra and Miracle, 1984; Serra et al, 1984) have been dedicated to the state of the Albufera since 1981. The present paper is an integrated study comparing the limnology of the inflowing channels with that of the lagoon.

RESULTS AND DISCUSION

Samples have been taken during an annual cycle (year 1985) from the mouth of channels arriving from the Northern part heavily contaminated by sewage and from the Southern part comprising agricultural waters with some domestic effluents. Samples were taken also from several points inside the Albufera. Table 1 shows mean values for these three sets of samples. Domestic and industrial effluents are loaded with phosphorus and ammonia, while agricultural waters are rich in nitrates. On the other hand, the waters inside the Albufera have relatively low concentrations of nutrients. However, the stress, produced in the lagoon, by the nutrient load, is shown by the extremely high chlorophyll contents and primary production values. Other parameters associated with primary production such as pH and alkalinity, vary accordingly; they are respectively high and low inside the lagoon. Primary production is limited to the surface, because the high phytoplankton density (c.a. 2 million individuals/ml or their biomass equivalent, 300 mg/l) determines the light extinction coefficient (secchi disk values vary around 0.1-0.2 m). Maximum primary production in late spring reaches 7 g C/m² .day and the minimum in winter is arround 2 g C/m².day. A principal components analysis (fig. 1) was made with the samples characterized by the physicochemical and biological variables indicated in fig. 1A. The first component can be associated with eutrophy: photosynthetic pigments, seston and oxygen have the highest loadings at the positive end while nutrients, alkalinity and light penetration have the highest loadings at the negative end. This component separates the Albufera samples from the channel samples. The second factor is determined by orthophosphate, ammonia, alkalinity and salinity at the positive end versus nitrate, nitrite oxygen, redox and light penetration at the negative end. It separates the Northern from the Southern channels. Phytoplankton in the channels is dominated by chlorophyceae or diatoms, but the lagoon is densely populated throughout the whole year by continous blooms of cyanobacteria and heterotrophic bacteria.

In conclusion, the Albufera functions both as a quimiostat and a sewage purificative treatment pool. Great amounts of nutrients and organic matter enter into the lagoon, whose outflow is almost free of limiting nutrients. On the other hand, in the lagoon, nutrients and organic matter are converted into biomass, which is removed from the system into the sediment, but some fraction of it is exported through the outflows to the sea.

Table 1. Annual means for 1985 of nutrients and other parameters associated with phytoplankton growth inside the Albufera and in the most representative inflow channels. The primary production inside the lagoon is 1 g C/m²h in the surface and 0.05 g C/m²h at 0.5m. Nitrate, ammonia and orthophosphate in µmol/l, alkalinity in meq/l and chlorophyll in µg/l.

	NO_3^-	NH_4^+	O-P	Alk.	pH	Chlor.a
Industrial + domestic sewages (North)	9	1300	113	4,3	7,9	70
Agricultural waters (South)	390	50	5	3.9	7.7	10
Albufera	32	10	0.1	2.3	9.0	340

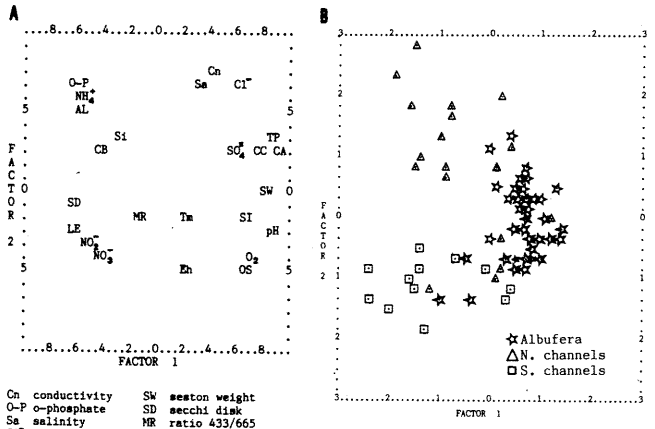

Fig. 1. Principal components analysis. (A) Factor loadings of the physicochemical parameters. (B) Plot of samples in the space dimensioned by the first two factors.

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E-III11

Résultats préliminaires d'une étude hydrobiologique sur l'estuaire du fleuve Magra (Ligurie, Italie). II. Zonation benthique

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ABSTRACT - FIRST RESULTS OF A HYDROBIOLOGICAL STUDY ON THE RIVER MAGRA ESTUARY (LIGURIA, ITALY). II: BENTHIC ZONATION.

Four organismic assemblages were found in the estuary and in the facing marine tract. Their distribution is mainly related to sediment types and bottom water circulation and is consistent with that known for Mediterranean coastal lagoons.

L'écologie des estuaires a été moins étudiée en Italie par rapport à celle des lagunes, étant donnée la diffusion majeure de ces dernières (SACCHI, 1979) et la rareté de véritables estuaires "à marée". Dans un but de comparaison nous avons donc entrepris l'étude du benthos de l'estuaire de la Magra, un petit fleuve qui se jette en Mer Ligure orientale.

Le benthos a été prélevé en 10 stations, dont six le long de l'estuaire, et quatre dans la zone marine en face, deux à gauche et deux à droite de la bouche du fleuve. Les échantillonnages ont été effectués par dragues du type "anchor dredge"; le tamisage s'est fait sur une maille de 1 mm. Quatre peuplements, se succédant de la mer vers l'intérieur, ont été reconnus (Fig.1).

Dans la zone marine devant l'embouchure, sur des sédiments de sable terrigène, on rencontre la typique biocoenose "des Sables Fins Bien Calibrés" (SFBC); les espèces caractéristiques les plus abondantes sont les mollusques *Spisula subtruncata*, *Acanthocardia tuberculata*, *Sphaeronassa mutabilis* et *Neverita josephina*, les polychètes *Owenia fusiformis* et *Nephthys hombergii*, les crustacés *Diogenes pugilator* et *Liocarcinus vernalis*.

Dans l'embouchure, les sédiments deviennent plus vaseux. La présence d'une endofaune dominée par *Tapes decussatus* et *Venerupis aurea* rappelle la biocoenose des "Sables Vaseux de Mode Calme" (SVMC). A celle-ci, cependant, se superpose une moulière à *Mytilus galloprovincialis*, avec une riche faune sessile associée, constituée par des cirripèdes (*Balanus amphitrite* et *B. perforatus*), des serpuliens (*Pomatoceros triqueter*, *P. lamarckii* et *Vermiliopsis striaticeps*) et des ascidies. La composition et l'organisation de ce peuplement hétérogène correspondent bien à la communauté "rhéophyle des graus et des chenaux" décrite par BIANCHI (1987) pour les lagunes italiennes.

En amont, sur des fonds sable-vaseux, s'établit une biocoenose "Lagunaire Euryhaline et Eurytherme" (LEE), caractérisée par les mollusques *Cerastoderma edule* et *Abra ovata* et par le serpulien *Ficopomatus (=Mercierella) enigmaticus*; cette biocoenose s'étend sur la plupart de l'estuaire bien qu'en présence d'une salinité qui ne s'éloigne pas des valeurs marines. GUELORGET et PERTHUISOT (1983) avaient déjà remarqué que l'installation des communautés saumâtres dépend du "confinement", fonction du renouvellement hydrique par rapport à la mer, plutôt que de la salinité.

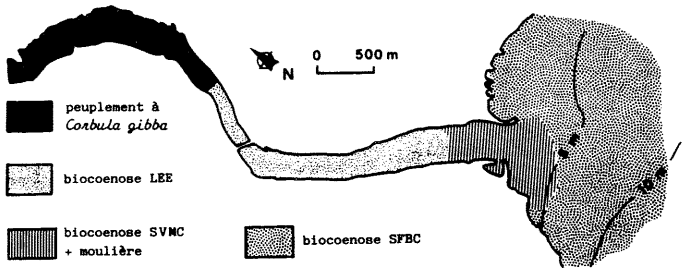

Fig. 1 - Schéma de la zonation benthique observée dans l'estuaire du fleuve Magra.

Encore plus en amont, les sédiments deviennent silteux et très riches en matière organique et sont habités par des polychètes capitellidés et par le mollusque *Corbula gibba* qui, d'après SALEN-PICARD (1985), est un indicateur des "fonds de décantation". Il s'agit là d'un peuplement plus "marin" par rapport au précédent, ce qui entraînerait une inversion dans l'échelle de confinement.

Il ressort de ces premières données qu'il existe dans l'estuaire de la Magra une zonation benthique complexe et correspondant, dans ses traits essentiels, à celle connue des milieux lagunaires, ce qui témoignerait en faveur de l'unité du monde "paralique" (GUELORGET et PERTHUISOT, 1983).

Les recherches en cours sont destinées à contrôler la validité de la zonation benthique observée, en étudiant en particulier sa persistance dans le temps et ses variations saisonnières.

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E-III12

Résultats préliminaires d'une étude hydrobiologique sur l'estuaire du fleuve Magra (Ligurie, Italie). I - Hydrographie

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ABSTRACT - FIRST RESULTS OF A HYDROBIOLOGICAL STUDY ON THE RIVER MAGRA ESTUARY (LIGURIA, ITALY). I: HYDROGRAPHY

The estuary is of the "highly stratified" type. The salt wedge inflows more than 5 km upstream with a low current speed (< 5 cm·sec^{-1}) and exhibits oscillatory movements with a frequency higher than the tidal one.

Avec un bassin versant d'environ 1686 km^2 et un débit moyen de 40.6 m^3·sec^{-1} (mais pouvant atteindre 1440 m^3·sec^{-1}), la Magra est l'un des plus grands fleuves se jetant en Mer Ligure. Son estuaire débouche dans la partie orientale de cette mer, près de la limite entre Ligurie et Toscane, et s'étend sur plus de 5 km pour une largeur de 0.5 km dans sa partie terminale.

Les premiers résultats d'une recherche sur les caractéristiques écologiques de ce milieu sont reportés en ABBATE et alii (1988), tandis qu'une étude hydrogéologique de la zone a été conduite par ANTONELLI (1977).

Notre travail a pour but la définition du système de circulation et de mélange des eaux, de laquelle puisse ressortir une caractérisation hydrographique de cet estuaire.

Des mesures de salinité ont été effectuées par sonde CTD le long de profils verticaux de la surface au fond, en différentes stations espacées l'une de l'autre d'environ 500 m. Dans quelques stations sélectionnées ont été en outre effectuées des mesures de vitesse et de direction du courant par des correntomètres Aandera, laissés en place pendant 10 heures; en même temps on évaluait l'amplitude de la marée, par maréographe, près de l'embouchure.

La distribution de la salinité a mis en évidence que l'estuaire de la Magra est du type "hautement stratifié" (BARNES, 1974): en régime de crue (Fig.1a), en particulier, on peut distinguer très bien les deux couches d'eau, la superficielle presque douce qui coule vers la mer et la profonde marine qui forme un véritable "coin salé". Dans des conditions de moyen (Fig.1b) et faible (Fig.1c) débit cette stratification est moins marquée et l'estuaire s'approche du type "partiellement mélangé".

En n'importe quelle condition du fleuve, il persiste au fond une couche d'eau à salinité proche à la marine d'en face (S = 31-36‰). D'après les valeurs de courant, il résulte que cette couche d'eau marine se déplace comme une seule masse, avec des mouvements oscillatoires alternativement vers l'amont et vers la mer. Les inversions de ce mouvement se produisent avec une fréquence plus haute que celle liée à la marée. La vitesse moyenne journalière est très faible, étant inférieure à 5 cm·sec^{-1}, avec direction vers l'amont. Ce type de circulation est dû en partie à la morphologie du fond, comportant l'existence de fosses profondes plus de 10 m dans la partie haute de l'estuaire: ceci détermine des analogies avec la circulation des fjords (McCLUSKY, 1981).

Ces caractéristiques ont une grande importance du point de vue biologique, permettant la pénétration d'une faune franchement marine, et liée aux "fonds de décantation", très à l'intérieur de l'estuaire.

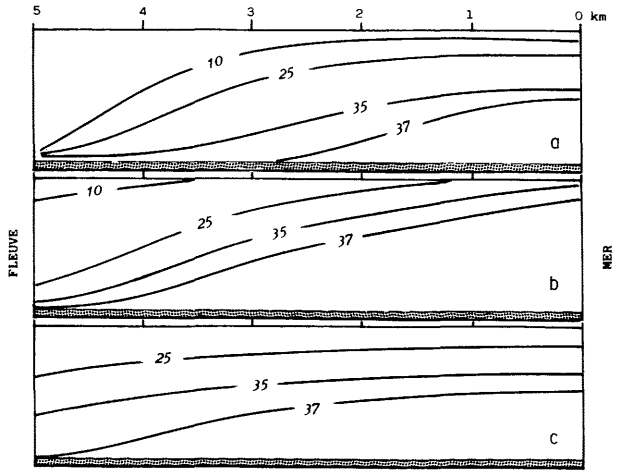

Fig.1 - Profils longitudinaux de la salinité, en trois différentes situations de débit: haut (a), moyen (b) et faible (c).

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Evolution de la turbidité des eaux de la lagune de Ghar El Melh (Tunisie)

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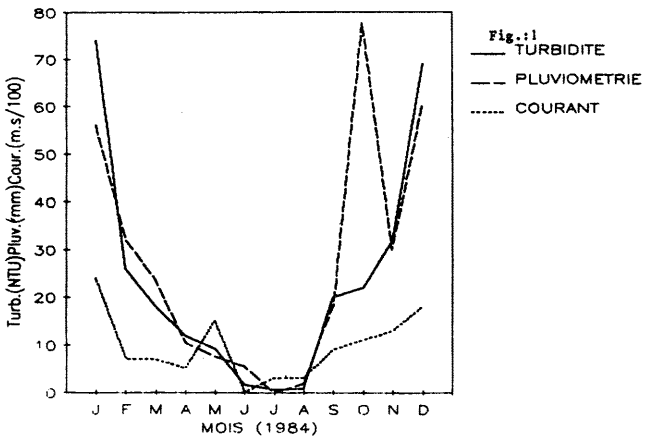
Abstract : Water tubidity varied between 0,6 and 74 NTU in the center of the lagoon; the result have shown a clear dependance between rainfall,wind,current and the turbidity of the lagoon, precipitation delivers sediment from riverine source and strong winds produce currents which, by their action maintain the particulate matter in the water column.

Résumé : La turbidité des eaux a varié entre 0,6 et 74 NTU dans le centre de la lagune, les résultats ont montré une nette dépendance de la turbidité avec les précipitations qui ventilent les eaux chargées dans la lagune et avec les vents forts qui provoquent la remise en suspension des sediments et des particules fines par la création des courants.

E

La lagune de Ghar El Melh (Tunisie septentrionale), littorale euryhaline d'environ 3000 ha. de superficie et d 1 mètre de profondeur moyenne reçoit les déversements de 5 oueds à régime torrentiel drainant la basse vallée de la Medjerdah; cette lagune reçoit aussi les eaux de ruissellement d'un bassin versant de 10500 ha.,ces eaux ont acheminé en 1984 environ 1,7 million de mètres cube d'eau vers la lagune dont la charge solide varie entre 0,9 et 5g/l.



La turbidité des eaux lagunaires est principalement régie par ces apports;en effet elle a fluctué entre 0,6 et 74 NTU dans le centre de la lagune et entre 0,9 et 296 NTU plus à l'Ouest; ce paramètre a évolué au cours des saisons avec des maxima en hiver et des minima en été (Fig.1). La répartition spatio-temporelle a montré des gradients décroissants de la turbidité d'une part de l'Ouest vers l'Est à partir des débouchés des oueds et suivant la direction privilégiée des vents forts, sachant qu'un vent de 6m/s peut engendrer une turbidité de 0,6 à 5 NTU (L.C.H.F.1978a) et d'autre part du Nord vers le Sud en direction des graus, du côté de la mer les vagues arrivent à mettre en suspension même le sable fin (L.C.H.F.1978).

La turbidité est fortement correlée avec les précipitations(r=0,75) et avec les courants (r=0,86), qui assurent respectivement l'apport des matériaux fins, et le maintien en suspension de ces particules par l'effet dynamique des courants; sachant que dans cette lagune les courants sont essentiellement régis par les vents (ROMDHANE 1985).

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Recherches bionomiques expérimentales dans l'étang de Is Benas (Prov. Oristano, Sardaigne)

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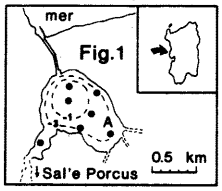
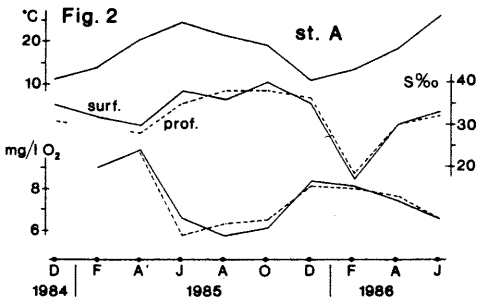
Le "Stagno de is Benas" (fig. 1) est une petite lagune laminaire (superficie 120 ha, profondeur moyenne 1.5 m) qui se trouve sur la côte occidentale sarde et n'est reliée à la mer que par un long canal artificiel. Le grau en est fréquemment ensablé; les apports d'eaux continentales sont pratiquement inexistants et les rapports avec une vaste étendue salée astatique, dite "Sal'e Porcus", sont limités et irréguliers. Température et salinité de la lagune (fig. 2) dépendent donc surtout du régime ombrothermique de la région. Une masse d'eau si exiguë est complètement soumise à l'action de brassage exercée par le "maestrale", vent du IV quadrant régnant et dominant. L'absence d'une végétation benthique importante permet d'ailleurs d'enregistrer de faibles rythmes nycthéméraux dans les facteurs mésologiques (fig. 3). Le fond de l'étang est entièrement constitué de sédiments incohérents, où dominent les sables riches en calcaire des dunes environnantes, vivantes ou fossiles. Seule une restreinte zone centrale a un fond vaseux. Avant 1983, lorsque débutèrent d'importants travaux de réaménagement du grau et du secteur nord de l'étang, la coopérative locale de pêcheurs dénonçait un produit annuel brut de 350 q de poisson, très loin des valeurs enregistrées en d'autres lagunes sardes à égalité de superficie et de profondeur, bien qu'inférieur à la réalité pour des raisons fiscales. Il s'agit là essentiellement de muges et de quelques autres espèces à écologie lagunaire, car la récolte de bivalves (*Cardium glaucum* Lam. et *Tapes* sp.pl.) n'est pratiquée qu'au niveau artisanal dans une zone restreinte au sud-ouest, le long d'un court phytolittoral à *Phragmites australis* Trin. La faune benthique de l'étang était déjà très pauvre avant les travaux de réaménagement: elle était dominée, sur quelques cailloux épars, par *Monodonta articulata* Lam., ensuite disparue; les moules ne colonisaient pas l'étang, malgré quelques efforts, infructueux, de mytiliculture.

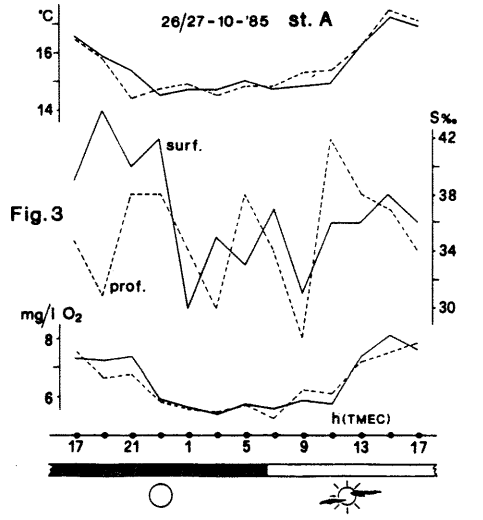


Après l'achèvement des travaux de dragage, nous avons fixé dans les 7 stations indiquées en Fig. 1 des substrats artificiels en PVC, constitués par des sections de tubes cylindriques dont la superficie extérieure équivaut aux standards communément adoptés pour les panneaux plats (600 cm^2). Une série complète de cylindres était prélevée et analysée tous les deux mois, tandis que d'autres substrats étaient examinés après 6, 12, 18 ou 24 mois.

Cette recherche a permis de confirmer que le peuplement local ne suit pas la tendance à un équilibre dominé par *Mytilus galloprovincialis* Lam. et *Balanus* sp.pl., que l'on considère généralement comme typique des lagunes du type "tyrrhénien". A la fin de l'experience biennale le recouvrement total du substrat, tant à l'extérieur qu'à l'intérieur des cylindres, restait au-dessous de 70%, ne consistant qu'en une couche "bidimensionnelle" due presque exclusivement au Bryozoaire encroûtant *Cryptosula pallasiana* (Moll), toutefois rare sur les panneaux bimestriels, et au Spirorbidé *Janua pseudocorrugata* (Bush), qui domine au contraire sur ceux-ci.



Parallèlement, le peuplement des fonds détritiques de l'étang ne semblait pas encore orienté vers une reconstitution des équilibres primitifs. Parmi les Gastéropodes, on n'y retrouve que de rares Rissoidés et quelques *Cerithium*. En été, le benthos est dominé, à côté de rares algues, par le Bryozoaire de grande taille *Zoobotryon verticillatum* (Delle Chiaie), qui ne s'est pourtant jamais fixé sur nos substrats experimentaux. Les causes de la pauvreté et du faible



dynamisme des peuplements benthiques doivent être recherchées dans le confinement topographique et écologique d'is Benas, traduit par une vivification marine irrégulière et aléatoire et par une tendance marquée à la sursalure estivale.

E-III15

Les milieux hyperhalins Sardes. II - Présence et variabilité de Pirenella conica (de Blainville) (Gastropoda Prosobranchia)

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Sardaigne et Sicile sont les seules régions italiennes où vit avec certitude *Pirenella conica*. Cette espèce, décrite sous le nom de *Cerithium conicum* (de BLAINVILLE, 1826, *Faune Française*, p.158) a été ensuite considérée comme un ensemble de plusieurs espèces distinctes, que PRIOLO (1956, *Atti Acc. Gioenia Catania*: 272-273) reconduit toutefois à l'espèce de Blainville, polymorphe en taille, sculpture et ornement du test. Cependant quelques Auteurs (D'ANGELO et GARGIULLO, 1978, *Guida conchiglie mediterranee*, Fabbri Ed., Milano; NORDSIECK, 1982, *Europ.Meeres- Gehaeseschnecken*, Fischer, Stuttgart) soutiennent encore la présence de plusieurs Pirénelles en Méditerranée, où elles représentent la famille tropicale des Potamididae. Pour l'Italie, on reconnaîtrait deux espèces, *P. conica* et *P. tricolor*, dont la dernière avait été décrite, au niveau sous-spécifique, par PALLARY (1904, *Journ. de Conchyliologie*, Paris, 52: 212-248), Auteur bien connu par sa tendence à multiplier les espèces sur la base de caractères assez flous. Cette note, limitée aux caractères de la coquille - les seuls utilisés par de Blainville comme par Pallary - résume les résultats d'une étude de plusieurs années, réalisée sur un abondant matériel de la Sardaigne méridionale (fig. 2), qui peuvent être condensés dans les points suivants:

a) *écologie des Pirénelles sardes*. Ces Prosobranches ne peuplent que des eaux qui, toute l'année ou pendant plusieurs mois, ont une salinité supérieure à celle de la mer, vivant sur des fonds sablo-vaseux ou finement détritiques. Il s'agit là, soit d'étangs entièrement hyperhalins (Porto Botte, Porto Pino, salins de Carloforte) soit de secteurs confinés de lagunes littorales ou de petites baies (Mistras, Marceddì, Malfatano).

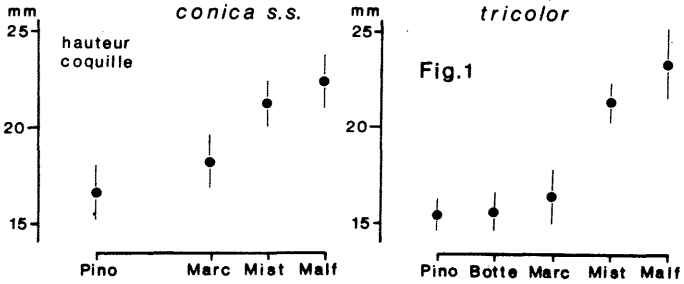

Fig.1

b) *variations de taille*. Bien que considérables (fig. 1) ces variations sont essentiellement dues au volume des tours, surtout des derniers, car leur nombre total reste constant, autour de 13 à 14. Les plus gros individus vivent à Malfatano, au fond d'une baie entaillant profondément la côte et à proximité d'affluents à débit saisonnier (hiver). Dans cette station, les Pirénelles sont graduellement remplacées, en allant vers des eaux ouvertes, des salinités moins élevées et un fond plus sableux, par *Cerithium vulgatum* Bruguière. Les "géants" se doivent probablement à un trophisme local plus favorable. Les tailles adultes minimales s'enregistrent dans les étangs sursalés de Porto Pino et Porto Botte.

c) *polychromatisme et sculpture de la coquille*. Ces caractères ont servi à Pallary pour créer sa nouvelle entité. En réalité, plusieurs stations

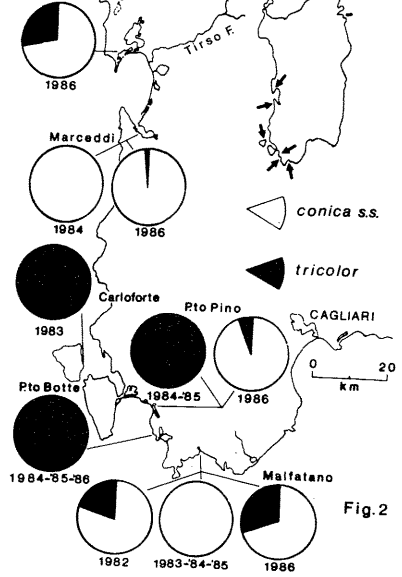

Fig.2

présentent, constamment ou épisodiquement, une morphe identifiable avec la ssp. *tricolor* de Pallary (fig. 2). Cette morphe peut même être la seule présente (Porto Botte). Aucune substantielle différence de microdistribution écologique n'a pu être démontrée entre la morphe *tricolor* et la morphe unicolore. Position et nombre des tubercules du dernier tour ne permettent pas non plus de confirmer la diagnose différentielle de l'Auteur nord-africain.

d) *une seule espèce polymorphe* vit donc en Sardaigne, d'après l'écologie et les caractères de la coquille;

e) *Pirenella tricolor* doit ainsi rentrer, selon nos données, dans l'espèce *P. conica* (de Blainville) comme simple morphe *tricolor* (Pallary).

E-III16

Etude et surveillance des phénomènes de "malaïgue" par télédétection aérienne. Bilan d'expérimentations réalisées sur l'étang de Thau (Hérault, France) et perspectives

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ABSTRACT : From experiments about observation of dystrophic crisis in a mediterranean lagoon, with a small remote-sensing airborne system, some characteristics of this phenomena are noticed. For special interest about phenomena's start, a thereal infrared survey is suggested to detect early its first signs and to test methods intended for protecting lagoon activities.

Dans les milieux lagunaires méditerranéens, les phénomènes de malaïgue, ou crises dystrophiques, peuvent être considérés comme des processus naturels d'autorégulation de l'écosystème. Ils représentent cependant une véritable nuisance, un effort d'aquaculture intensive pouvant être anéanti en quelques heures. De plus, si certains facteurs hydrologiques ou météorologiques en favorisent le déclenchement, d'autres, moins naturels, peuvent être raisonnablement soupçonnés d'en accentuer la fréquence ou l'ampleur. C'est pourquoi, si une quelconque solution peut être envisagée pour préserver les élevages, des moyens doivent être mis en oeuvre pour réaliser une surveillance du milieu, afin de chercher et tester des méthodes de prévention ou de protection, et ceci dans le cadre d'une réelle gestion des milieux lagunaires.

Pour être en mesure de déterminer les probabilités de crise, ou simplement détecter les premiers indices, il est nécessaire de bien comprendre tous les processus de déclenchement et de propagation, et de réaliser une surveillance efficace de l'étang. Les mécanismes physico-chimiques et biologiques mis en jeu sont en ce sens relativement bien connus, tandis que l'observation et la surveillance d'une malaïgue par des méthodes classiques de terrain posent, en général, quelques problèmes. En effet, les mesures sont souvent insuffisantes par leur ponctualité dans un milieu aussi vaste, présentant une grande variabilité dans l'espace et dans le temps. Ce phénomène, au déclenchement soudain et localisé, à évolution rapide, est par lui-même difficile à saisir, d'autant plus qu'il apparaît très lié à la masse d'eau au sein de laquelle les modifications s'opèrent, et donc à la qualité et à la dynamique de cette masse d'eau bien individualisée.

Enseignements des expérimentations (*) de 1982 et 1983

Face à ce phénomène difficile à appréhender, la télédétection apparaît tout d'abord comme un moyen efficace pour surveiller l'étang, globalement, rapidement et de façon systématique.

Ces expérimentations ont été l'occasion de poursuivre les développements d'une méthodologie d'observation aérienne, basée sur un ensemble aéroporté léger, qui repose principalement sur sa souplesse (optimisation de la répétitivité en fonction des évolutions du milieu, des phénomènes ou de la météorologie), et sa complémentarité avec les mesures "in situ" (résolution et fréquence d'observation compatibles, coordination permettant d'associer en temps réel l'observation aérienne et la "vérité-terrain").

La réalisation de cette opération durant deux saisons estivales a permis également de dégager certains enseignements intéressants sur les phénomènes de malaïgue :

- leurs conditions propices, avec des situations météorologiques ou hydrologiques favorisant un certain confinement. Des indices précurseurs ont pu être détectés : proliférations algales, bloom phytoplanctonique, turbidités anormales.
- leurs conditions de déclenchement et les lieux d'apparition, avec la mise en évidence de l'association du phénomène à une masse d'eau bien individualisée, d'où la notion de "foyers" qui naîssent soit dans les eaux profondes, dans les eaux superficielles (zones peu profondes ou isolées), ou dans des endroits caractérisés par une faible agitation ou par une surcharge organique chronique (zones d'accumulation ou de biodéposition : en particulier les zones conchylicoles).
- leurs conditions de propagation et de dissipation, avec à nouveau le rôle primordial de la dynamique des diverses masses d'eaux en présence, qui favorise ou non la contamination d'autres masses d'eaux, la généralisation du phénomène, ou au contraire le renouvellement des eaux par les échanges mer-étang, les risques étant modulés en fonction de la situation météorologique.

Perspectives

Cette opération a permis de montrer l'intérêt d'un tel système de surveillance, qui doit donner la possibilité de tester des modes d'action vis à vis du phénomène et de ses conséquences, mais aussi d'évaluer les risques éventuels et informer rapidement les professionnels. Pour cela, il semble important de s'intéresser particulièrement aux conditions de son déclenchement.

Ainsi, la thermographie (informations sur la qualité et la température superficielle de l'eau, de jour comme de nuit) semble spécialement adaptée à l'étude des mécanismes : les crises se déclenchant dans des masses d'eaux individualisées et réchauffées, par temps calme, et en liaison avec une surconsommation d'oxygène (ces deux dernières conditions étant souvent réunies en fin de nuit en période estivale). Une observation aérienne en thermographie permettrait une surveillance aussi bien diurne que nocturne, une cartographie précise des différentes masses d'eaux individualisées dans l'étang, une détection des changements de qualité d'eaux ou des élévations anormales de température (avant même toute modification de l'aspect visible de ces eaux), et donc une localisation des endroits propices au déclenchement. Alors pourraient être estimés les risques possibles (en liaison avec les prévisions météorologiques, l'observation de l'hydrodynamique de l'étang, et toutes les autres informations et mesures qui peuvent être recueillies sur l'étang), et des interventions rapides, en des endroits bien précis, destinées à limiter la propagation ou les dégâts, devraient être testées.

Enfin, un tel système de détection précoce des phénomènes de malaïgue, s'il doit déboucher sur la recherche de solutions concrètes vis à vis du phénomène, devrait également pouvoir servir de façon systématique au suivi de cet étang de Thau et concourir ainsi à une meilleure gestion de celui-ci.

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(*) années avec le financement et les moyens de plusieurs organismes, notamment l'IFREMER et le CEPRALMAR.

Chemistry of Lake Burullus
1 - Changes in Nutrients Chemistry between 1970 and 1987

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Nutrient components were measured in Lake Burullus (Fig.1) during the period Jan. - Dec. 1987. The results are compared with other observations reported in the literature.

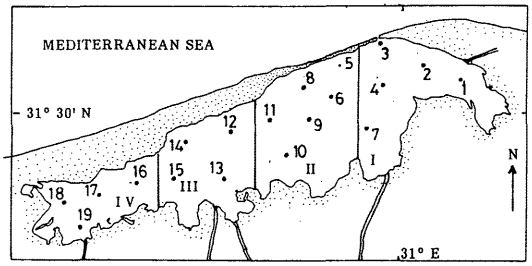

Fig. 1. Location of sampling stations and the 4 subdivisions (basins) of Lake Burullus.

Table 1, summarizes the annual average values of different nutrient components observed for the different regions of the Lake during 1987.

Table 1. Mean values of nutrient salts in Lake Burullus during 1987.

	NO_3	NO_2	NH_3	RPO_4	$RSiO_2$	Ch/a
			ug at/l			mg/m^3
Zone I	1.58	0.46	7.10	1.26	58.6	6.61
Zone II	1.29	0.21	4.18	0.73	54.11	4.31
Zone III	5.20	1.00	6.48	2.32	71.00	10.82
Zone IV	8.15	1.68	5.97	2.13	83.60	4.85

Higher averages observed in zones III and IV reflect the effect of large amounts of drainage water discharging into both zones (> 75 % of the total amount of drain water reaching the Lake). It is worth to mention that this effect was mostly localized to the southern boundaries of the Lake i.e. few kilometers off the outlets. However, the levels of nutrients in the other zones are probably controlled by dynamical conditions between drain water supply and marine water invasion through the Lake openning. Lower concentrations may be also related to consumption of nutrients by aquatic plants which are densily populating these areas.

The average concentration of DIN in the Lake was 10.8 µg at/l constituting about 28% of TN. Ammonia constituted the larger part of DIN (about 55%) followed by NO_3 (36 %) and NO_2 (9 %). However, the dissolved orgainc nitrogen fraction constitutes half of the dissolved nitrogen in the Lake water which in turn represent about 55% of the total nitrogen content.

On the other hand, dissolved phosphorus contributes more than 65% of the total phosphorus content of Lake Burullus. The organic fraction of the dissolved phosphorus (average 1.35 µg at/l) represents between 43 - 57 % of the total dissolved phosphorus (TDP), while particulate phosphorus (average 1.56 µg at/l) constitutes no more than 40% of the total phosphorus content of the Lake water.

The low inorganic N/P ratio i.e. 6.7 : 1 calculated for the Lake water may indicate that nitrogen could be more critical than phosphorus for phytoplankton growth and production in the Lake. Compared with studies on other northern Delta Lakes, Table 2 shows that Lake Burullus followed the highly productive Lake Manzallah in the abundance of nutrients.

Table 2. Mean N/P & Si/P ratios in different Nile Delta lakes.

Locality	L. Idku	L. Manzalah	L. Mariut	L. Burullus	L. Burullus	L.Burullus
				1970-71	1978-79	1987
N/P	2:1	11:1	2.4:1	16:1	17.12:1	7:1
Si/P	132:1	73:1	5.4:1	562:1	114:1	41:1

Signficant changes had taken place in the nutrient chemistry of the Lake since 1970. The levels of nitrogen (mainly nitrate) and silicon have decreased by one and three times since 1970, while on the contrary, the concentration of reactive phosphorus has increased about four times. Not only the levels of these elements have changed, but also their ratios have drastically declined (Table 2). The probable cause of such variations is the increased rate of drainage water entering the Lake draining nearby reclaimed lands. The reduction and complete cessation of rich-silicon Nile water reaching the Lake opposed by the continual invasion of marine water through the Lake - Sea connection. However, these changes were reflected on the present status of phytoplankton population and consequently on the fish yield of the Lake. Recorded data on the average phytoplankton biomass (El-Sherif, personal communication) show a remarkable decline in the total number of species during the last 10 years.

Trace elements status in surficial sediments of Lake Manzalah (Egypt)

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Introduction

Lake Manzalah is the largest of the four Nile Delta lakes in Egypt (surface area about 900 km^2). It provides more than 70% of the total inland fisheries of the country. In view of the increased role of drain water reaching the lake, in the last 20 years, important changes have taken place in the water and bottom sediments quality which needed to be evaluated and documented. The total anuual fresh and drain water inflowing into the lake is 6680×10^6 m^3. 75% of this water is discharged by Hadus (agricultural drain, 50%) and Bahr-El-Baqar (domestic and industrial sewage, anoxic, 25%) which opens into the southern basin of the lake.

Material and Methods

Using a modified Ekman grab, surficial bottom sediments were collected during April 1982 from 25 stations. Additional samples were collected from the mouths of different drains. Exchangeable metals fraction were determined using 1 M NaOAC at pH 8.2 (Gibbs, 1973; 1977) while the residual form was determined according to Tessler et al. (1979). The concentrations of Al, Fe, Mn, Zn, Cu, Cd, Pb, Co and Ni were determined using Model 34000 ICP-emmission spectrometer. The precision and accuracy of the methods were checked against Standard Reference Material 1645 River Sediment from NBS and found satisfactory.

Results

The areal distribution of exchangeable and residual forms of the elements showed a common feature of increasing levels towards the southeastern basin of the lake, the area highly affected by drainage water. Values tend to decrease gradually towards the lake center. This trend matchs with the basinward increase in grain size. The frequency distribution of residual forms showed that >50% of Al, Zn, Cu, Pb & Co felt in the concentrations range 40-50 mg/g, 60-80 µg/g, 20-40 µg/g, 40-60 µg/g and 20-30 µg/g, respectively. On the contrary, the concentrations range of Fe, Mn, Ni & Cd occupied wider scale reflecting high irregularity and patchiness.

The increase in the levels of residual metals at the lake-sea connection is mostly due to coagulation of colloidal species to produce particulate form in the mixed zone, some of which may be lost to the sediments.

The relative abundance of elements as observed from their average concentrations (Table 1) was: Al>Fe>>Mn>Zn>Pb=Ni>Cu>Co>>Cd. The average exchangeable / residual elements percents were insignificant for Al (0.029%) and Fe (0.03%), low for Ni (11.7%), Cu (9.0%) & Co (4.1%) but valuable for Mn (37.3%).

Table 1. Mean residual metals concentrations (µg/g) in Lake Manzalah surficial sediments.

	Al	Fe	Mn	Zn	Pb	Ni	Cu	Co	Cd
NW	38,533	32,267	717	59	54	47	48	22	6.3
L.P.	43,497	36,487	716	67	51	53	42	26	7.5

Discussion

The geochemistry of Lake Manzalah sediments reflect to a great extent several conditions resulting from water inputs and different characteristics of bottom sediments. Generally, all metals are enriched in the area affected by main drains. At the mouth of Bahr-El-Baqar drain the prevailing anaerobic conditions reduces the solubility of reactive metals which are subsequently expected to precipitate as sulphides. This is reflected on the relatively low Cu content of the overlying water and enrichment in sediments. The enrichment of some metals like Co in the sediments of anoxic stations is probably due to their co-precipitation with metals on sulphide sediments.

On the contrary, at the mouth of Hadus agricultural drain, with overlying oxic conditions, high values of residual Fe and Mn were observed. In such waters the solubilities of both metals decreased due to formation of higher oxidation states or lower solubilities of oxides and hydroxides. Many soluble species in water could be scavanged due to oxide formation. This explains the elevated levels of Ni, Cd and Pb in these stations.

Both Fe and Mn are known to be closely associated in their geochemical cycle. This is clear from the positive correlation relating both elements in Lake Manzalah ($r=0.6747$, $p<0.001$). Significantly positive correlations between studied elements in suspended matter and sediments indicate the interaction between both phases. However, the concentrations in suspenssion (µg/g) for all elements were higher than those of sediments indicating the role of suspended matter in carrying these elements to the bottom.

In comparison with 1968 sediments (McComas, 1983), results showed a remarkable increase in the levels of Al, Pb and Cd. Increased water discharge of highly industrialized areas surrounding the lake may explain such elevated levels. Compared with other Nile Delta lakes, Lake Manzalah is generally enriched in nearly all studied elements. However, when matching the average values of differnt elements with those of standard shale, we observed that Cu, Pb, Cd, and Co are highly accumulated in lake sediments and thus could be a source of environmental problems.

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E-IV3

Dans le lac de Bafa, une pêche intéressante grâce à une méthode originale

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Le lac de Bafa est l'un des lacs les plus importants de la région d'Anatolie Ouest (Fig.1). La superficie de ce lac est de 65 km^2 (1), la profondeur maximale est d'environ 19 m, et la salinité varie entre 2.98 ‰ et 5.62 ‰.

Dans ce lac d'origine alluviale à faible salinité certaines espèces catadromes ont pu s'introduire (Muge, Bar, Anguille) (2). Toutefois sa basse salinité rend possible le développement d'espèces d'eau douce: carpe, silure, poisson d'Ulubat (espèce endémique de Turquie, *Acanthobrama mirabilis*). On trouve également, en très faible quantité, d'autres espèces assez rares de milieux salins et aussi d'eau douce comme *Chondrostoma nasus, Barbus capito, Pomatoschistus marmoratus, Atherina boyeri, Gambusia affinis, Lipophrys pavo.*

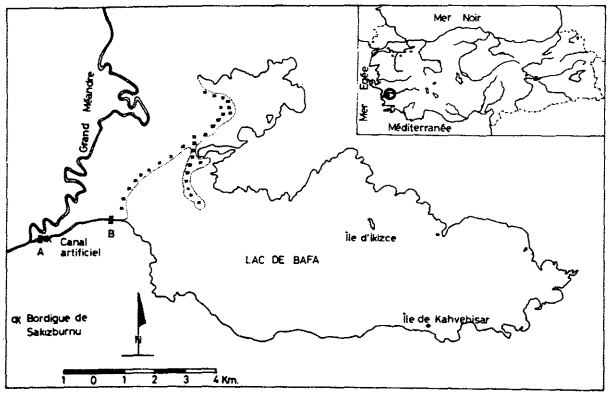

Fig. 1 : Carte de localité du lac de Bafa et configuration de la zone de pêche.

Actuellement, les six espèces de poisson d'intérêt économique de ce lac sont les suivantes: *Cyprinus carpio, Mugil cephalus, Liza ramada, Anguilla anguilla, Dicentrarchus labrax, Acanthobrama mirabilis.* Mais les epèces les plus pêchées sont les muges et le poisson d'Ulubat.

La pêche est faite par des professionels qui se sont regroupés en une coopérative de 800 membres. L'essentiel des captures est obtenu dans la bordigue, cependant les pêcheurs utilisent également dans le lac des nappes à petites mailles, des filets fixes et des trappes à poisson. Cependant, leurs utilisations sont interdites entre le mois de mais et de juillet sauf pour la capture de l'anguille. Cette bordigue qu'on appelle Sakızburnu se trouve dans un canal artificiel de 3 à 6 m de largeur et de 3 km de longeur qui rejoint la rivière de Büyük Menderes (Grand Méandre).

La bordigue est efficace surtout en juin, juillet et en septembre, octobre où l'on capture respectivement *Mugil cephalus* et *Liza ramada*. Le muge capiton *(Liza ramada)* procure la majeure partie de la pêche annuelle d'environ 75 à 100 t (3). L'importance de la quantité pêchée par cette méthode de la Bordigue de Sakızburnu dans le lac de Bafa prouve l'intérêt que l'on doit y porter.

Pour migrer, les muges capiton pénètrent du mois de septembre à octobre dans le canal de communication entre le lac et la Büyük Menderes, puis la mer Egée. Cependant, cette migration se fait en faible quantité de façon naturelle aussi, pour la provoquer,on crée un courant d'eau douce pompée du Büyük Menderes et stockée entre deux digues A et B (Fig.1) dans un premier temps, ensuite, ultérieurement, libérée par l'ouverture de la porte métallique de la digue en communication avec le lac, générant ainsi un fort courant d'eau qui attire alors en grande quantité les bandes de muges qui remontent jusqu'à la bordigue. Alors que la première partie de cette opération est réalisée pendant la journée, la seconde se fait la nuit.

Cette méthode effectuée pendant seulement 4 à 6 semaines, permettant cependant une capture de 75 à 100 t, montre son efficacité surtout pour la pêche du muge capiton et permet ainsi une pêche intéressante dans le lac de Bafa.

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E-IV4

An expatriate population of Acartia grani G.O. Sars (Copepoda, Calanoida) in an experimental tank on the shores of the Dead Sea

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In the summer of 1984, a series of experimental tanks were built on the shores of the Dead Sea with the purpose of checking the eventual effects of a sea-water canal connecting this lake with the Mediterranean. Unfiltered seawater , collected from nearshore was pumped into cisterns and used to replenish a central control pond. From this pond, which suffered only the climatic influences of the Dead Sea valley (-397 m below M.S.L.), water was mixed with different rates of Dead Sea water(324 gram/l).

Even at the rate of 10% Dead Sea water, only hypersaline organisms, like Ephydridae larvae appeared.
However in the sea-water pond, a peculiar assemblage of marine animals developed. In this pond in which seawater has been filled only once , salinity was maintained through periodic addition of freshwater at an average Mediterranean level, but with fluctuations from 30.4 to 40.00 ppm.
In the sea water pond ,the calanoid copepod **Acartia grani** G.O.Sars 1908 stood out, as the only abundant zooplanktonic organism. To our knowledge, this species has not been reported yet from the Eastern Mediterranean.

The nearest locality from where information about this species is available, are the Southern estuaries of Portugal (Vilella, 1965,1972). According to this author who for the first time described the development of **A.grani**, this species is extremely resistant in pond-culture and develops between the temperature span of 17-21 C and at salinities of 34-35 ppm.

We can explain the odd appearance of **Acartia grani** at a distance of more than 100 km from the sea,first of all by the existence of resistant eggs, such as reported by several authors in other species of **Acartia**. Second, water temperatures in the experimental pond decreased during the winter to 10 C, a temperature uncommon in the open water of the Eastern Mediterranean. Indeed, during the summer, when the pond reached 30 C, **A.grani** was absent. Third, we assume that discrete populations of this extremely neritic species might have escaped biological collecting in the Mediterranean but were sampled by the pump of the cistern.

The peculiar low water temperatures combined with the capacity of laying resting eggs, enabled **Acartia grani** to bloom in such an unexpected environmental setting.

E

Preliminary study on phytoplankton-zooplankton relationship in Burollus Lagoon (Egypt)

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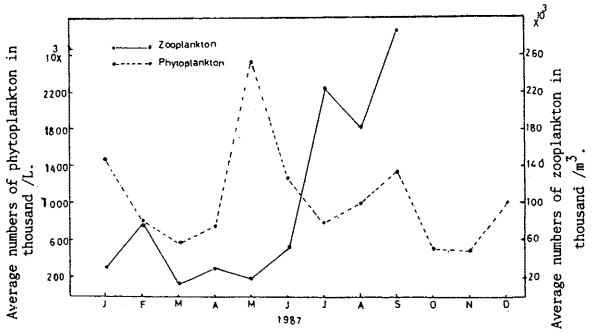
Lake Burollus is a shallow brackish water lagoon with an area of about 50,000 hectar, lying at the north of the Nile Delta, along the Mediterranean coast of Egypt. The present work deals with quantitative estimation of phytoplankton and zooplankton and their relationship as they represent the first and second trophic level in the food cycle respectively in the lagoon.

Estimation of the standing crop of phytoplankton was carried out monthly during year, 1987 from twelve stations representing the different habitats of the lagoon by using the sedimentation technique where the phytoplankton was calculated as their total number per litre. From the same stations the zooplankton samples were collected by filteration 250 L of water with standerd plankton net and calculated as their total number per cubic meter.

The phytoplankton community is mainly represented in Lake Burollus by members of Bacillariophyceae and Chlorophyceae which constituted about 49.11 % and 31.66 % by number of the total phytoplankton respectively. While Cyanophyceae appeared in small numbers (1.73 %). Other forms of Euglenophyceae and Desmokontae persisted also as rare forms but the appearance of one species of Flagellates with highest density at the eastern lake during May, raised the other forms to 17.5 % of the total phytoplankton. The average annual value of the total phytoplankton in the lake amounted to 1,039,641 U/L.

The zooplankton population in the lake was represented mainly by Cladocera, Rotifera and Copepoda, they constitued about 33.8 %, 26.5 % and 25.8 % by number of the total zooplankton respectively. Other groups of less frequency comprised Protozoa, Ostracoda, Malacostraca, free living nematodes and insects larvae were also recorded (13.9 %). The average annual of zooplankton in the lake reached 100,972 organisms/m^3.

The highest standing crop of both phytoplankton and zooplankton appeared in the western sector of the lagoon which reflects its eutrophic characters.



(Fig. 1) : Seasonal variations of the standing crop of phytoplankton in thousand per Litre and zooplankton population in thousand per cubic meter.

The variations of the phytoplankton - zooplankton standing crop are given in (Fig. 1). The highest numbers of phytoplankton were always accompanied with a low count in zooplankton; with exception of month of September. The species composition of the community plays an important role in the grazing process. As example the high count of Rotifera and Cladocera which are herbivorous was accompanied with low count of phytoplankton during July. On the contrary, during September the simultaneous increase of both phytoplankton and zooplankton can be attributed to the increased number of Cyclopoida which are mostly considered as carnivorous organisms. (Hartig, et al. 1982).

ACKNOWLEDGEMENT

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Plankton of Lake Maryut Outlet (West from Alexandria)

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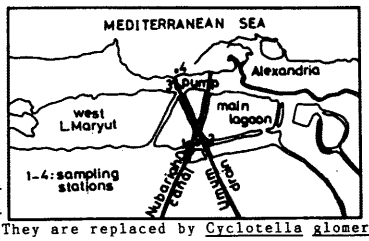
The eutrophic brackish water lagoon (Lake Maryut) is continuously pumped out to the sea through the outlet of Umum drain (Max pumping station, St. 3). The waters of the 2 canals crossing this lagoon (Umum drain and Nubariah canal) mix with the lagoon waters before reaching the sea.

In order to investigate the effect of mixing of lagoon waters with the drain and canal waters, samples have been regularly collected from two localities, immediately south of the lagoon (Unmixed drain st. 2 and canal st. 1) and from the outlet of the drain (st. 3) and adjacent inshore sea water (st. 4) (see map).

Comparison of the conditions in sts. 1-2 & 3 shows drastic changes caused by the mixing of agricultural drainage waters with the lagoon waters. The changes concern both the characteristics of the waters and the phyto and zooplankton associations. Mixing increases the S‰ only slightly (3.5-3.3 to 4.9 ‰). The pH shows little variation (7.8 to 7.7). The relative saturation in O_2 on the whole is low in the agricultural drainage waters (54.5 - 59.2 %). But mixing with the lagoon waters with their high load of organic matter further decreases the O_2 content to comparatively very low values (av. 36 %). The adjacent inshore sea waters show a recovery in the O_2 content (av. 68.1 %). The phosphate content rises to a very high value. In the agricultural drainage before mixing, it ranges from 0.25 to 3.2 $\mu M l^{-1}$. While at st. 3, the range was 2.2 to 6.8 $\mu M l^{-1}$. It is likely that, other nutrients become also enriched (see table).

The effects of eutrophication are reflected on the plankton biomass and composition. The composition is typically brackish, the number of species increases (from 26, st. 1, to 35 st. 3, for phytoplankton and from 35, st. 1, to 45, st. 3, for zooplankton). The phytoplankton increases from 19000 cell l^{-1} to 210000 and the zooplankton from 7000 to 90000 org.m^{-3}, Nitzschia spp., Biddulphia sp. and Bacillaria paradoxa are dominant at sts. 1&2. They are replaced by Cyclotella glomerata, Euglena spp. and Spirulina sp. Rotifers dominate the zooplankton at st. 3 (Brachionus calyciflorus, followed by B. angularis, B. urceolaris, B. plicatilis and Filinia longiseta). In the agricultural drainage waters, the dominance is shared between the same rotifer species and cladocera (Bosmina longirostris and Moina micrura) and copepoda (Mesocylops leuckarti).



The brackish plankton associations extend sea-ward to the middle of Max Bay. Beyond this area, a change is observed and Tintinnids are dominant.

Monthly average S ‰, pH, O_2 %, PO_4/P ($\mu M l^{-1}$) Phytoplankton (cells l^{-1}), Zooplankton (organisms m^{-3}.) and No. of phytoplankton and zooplankton species in the different localities (Average of 16 months).

	st. 1	st. 2	st. 3	st. 4
Av. S ‰	3.5	3.34	4.92	10.47
Av. pH	7.8	7.7	7.7	7.8
Av. Dissolved O_2 %	54.5	59.18	36	68.13
Av. PO_4/P $\mu M l^{-1}$	1.4	1.77	4.65	3.98
Av. phytoplankton cells l^{-1}	19000	1500	210000	222000
Av. zooplankton org. m^{-3}	7000	2400	90000	55000
No. of phytoplankton species	26	30	35	41
No. of zooplankton species	35	28	45	36

E-IV7

Fish populations in Lake Burullus, Egypt. I. Species composition in four fishing gears

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Introduction

Previously the species composition of Lake Burullus was studied by Libosvarsky et al. (1972), Libosvarsky and Darrag (1975). Hashem et al. (1973) studied the composition and abundance of mullets in the lake based on commercial and experimental catch data. The present study concerns a survey of fish species caught by four of the most common fishing gears used in Lake Burullus, namely Dora (fyke nets), Takem (Mullet trammelnets), Nasha (Tilapia trammelnets) and Gawabi (wire traps). The abundance of the commercial species in the catch per unit effort of each gear was calculated.

Material and Methods

Monthly samples were collected during the period from January to December 1987 using four types of fishing gears; Nasha, Balla, Dora and Gawabi. Catch per unit effort for Gawabi is the catch in weight of five units of traps with 18 mm mesh size set for 24 hours. CPUE of Nasha is 10 units joined together and set for 24 hours, each unit is 15 m long with mesh size of the inner layer ranging between 17 and 24 mesh bars per 50 cm. CPUE of Balla is 10 units, 15 m long with mesh size of the inner layer ranging between 26 and 32 mesh bar per 50 cm. CPUE of Dora is a 200 m long leader net, 35 mesh bar per 50 cm, set for 24 hours, combined with 6 fyke nets with mesh sizes ranging between 30 and 45 mesh bar per 50 cm.

Results and discussion

The ichthyofauna of Lake Burullus can be grouped into four major categories: tilapias, mullets, freshwater fishes and fishes of marine origin.

Altogether 29 fish species were identified in the catch of the four most commonly used gears of the lake. Mullets are represented by five species: Mugil cephalus, Liza ramada, L. saliens, L. aurata and Chelon labrosus. All seem to be indemic to the lake fauna, with the exception of L. aurata that was not included among mullets listed by Libosvarsky and Darrag (1975).

Freshwater fishes, other than tilapias, included 7 species, only three of which, i.e. Haplochromis desfontainesii, Bagrus bayad and Anguilla anguilla, have previous record in the lake. The other 4 species, i.e. Hemichromis bimaculatus, Clarias Lazera, Labeo niloticus and Dalophis imberbis, were only observed in the lake during the present study. It has to be mentioned that other species were recorded by Libosvarsky and Darrag (1975) and were not recorded during the present study. Their presence is uncertain, though not impossible, since they could have been missed by the 4 gears used during the present study.

Fishes of marine origin are temporarily present in the lake, especially in the area of the Lake-Sea connection. They do not contribute a considerable part in the fish population of the lake. Yet, it seems that at least four of them, i.e Dicentrarchus labrax, Solea vulgaris, Engraulis encrasicholus and Gobius sp., are consistant members of the ichthyofauna of the lake. However, there are other marine species that contribute much in the fish fauna of the lake, namely: D. punctata, Sciaena aquilla, Umbrina cirrosa and Crysophyris auratus, although not permanently represented in the catch.

Evidently, the list of fishes heretofore recorded mostly in the northern half of Lake Burullus is not exhaustive. Beyond doubt, more fish species, both marine and freshwater, could enter this part of the lake. However, the occurrence of other species recorded during the present study or in previous studies seem to be rare and sporadic.
In order to overcome the difficulties that may arise from this bias we will present the overall catch of the four gears as percentage average catch per unit effort as follows:

	Balla	Nasha	Dora	Gawabi	Average
Tilapia	17.31	88.31	8.99	73.64	47.07
Mullets	66.74	4.55	59.86	11.86	35.76
Marine	10.03	2.26	27.47	0.69	10.14
Freshwater	5.88	4.89	3.12	13.82	6.93

This shows that, tilapias constituted on the average 47.07% of the catch from Lake Burullus. The four tilapia species, although are more or less equally abundant, but tend to have the following order of abundance: T. zillii, O. aureus, S. galilaeus and O. niloticus.

On the other hand, mullets that constituted 35.76% of the total catch, were mostly represented by Liza ramada, that was the most abundant fish species constituting 27.7% of of the total catch of the four gears (77.4% of the mullet catch), followed by Mugil cephalus constituting 5.62% of the total catch (15.7% of the mullet catch). Among marine fishes, Solea vulgaris constituted 3.49%, followed by Crysophyris auratus (1.98%), Dicentrarchus punctata and D. labrax (constituting 1.6 and 1.54%, respectively). Among freshwater fishes, Clarias lazera was the most abundant in the catch of the four fishing gears (4.13%), while the rest of all freshwater fishes were less than 2%.

There are almost no data to compare our results with, except for the work of Libosvarsky and Darrag (1975) on Lake Burullus. However, their results were confined to four months only (January to April 1972). They have shown that, in the catch of fyke nets during that period, mullets, or rather Liza ramada constituted on the average 73.9%, while tilapias were only 5.3% of the catch.

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E-IV8

Fish populations in Lake Burullus, Egypt. II. Biology of Liza ramada in Lake Burullus, Egypt

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Introduction

The mullet population of Lake Burullus is composed of five species, viz: Mugil cephalus, Liza ramada, L. saliens, L. aurata and Chelon labrosus. Quantitatively, L. ramada constitutes 77% of the mullet population. The present study deals with the age composition, growth equations for length and weight, and estimates of rates of mortality in an attempt to throw light on the fisheries of this species in the lake.

Material and Methods

The present study was performed on 3835 individual of L. ramada caught from different areas of Lake Burullus. The sampling took place each month during the period from January to December 1987, using different fishing methods of various mesh sizes in order to cancel the effects of efficiency and selectivity of the fishing gears.

Random subsamples were taken each month for biological studies, during the whole period, a total of 497 fish, ranging between 80 and 350 mm in total length, were sampled. From each fish data on total length (measured to the nearest mm), total weight (weighed to the nearest gm), and scale samples were collected. Length weight relationship was computed according to the cubic relation $W=cL^3$. Length at age were computed from length distribution data (Gulland, 1983), and coefficients of total, natural and fishing mortalities as well as rate of exploitation were determined as given by Pauly (1984).

Results and Discussion

Age determination from scale readings revealed the presence of six age groups of L. ramada in Lake Burullus. Age length key constructed from these data were used for the transformation of the length frequency data of the 3835 collected fish into a length composition table from which the following mean lengths at ages were deduced: 12.87; 17.54; 23.09; 28.99; 32; and 34.67 cm, respective to age groups I to VI. These values are lower than those given for oter Egyptian waters, but are close to those given by Arne (1938) in the Gulf of Gascoyne, Ezzat (1965) in the etang de Berre. Moreover, Alebertini-Berhaut (1975), studying the growth rates of 0-age group of L. ramada in Marseille, found that it completes its first year of life at a length of 125 mm.

The percentage occurrance of each age group shows that among the six age groups represented in the catch, age group II constituted about 66%, followed by fishes of age group I (29.13%) and age group III (4.88%). Fishes older than 3 years constituted less than 0.5% of the population. Rafail (1968) analysing age composition of L. ramada, along the Egyptian coast of the Mediteranean Sea, found six age classes having the following relative frequencies: 55.6; 22.8; 10.4; 6.2; 2.9 and 2.1% (n=338) for respective age groups I to VI. Hashem et al. (1973) have shown that fishes of age group I constituted 84% of the population of L. ramada in Lake Burullus. This indicate that this age structure was the natural case for this species in the lake.

Linear growth of L. ramada in Lake Burullus was found to be expressed mathematically by the following equation:

$$l_t = 56.0366\ [1 - EXP(-0.1465(t+0.7455))]$$

The relation between total length (in cm) and total weight (in gram) for 497 individual of L. ramada ranging in length between 10 and 35 cm was found to be curvilinear and was expressed mathematically by the formula : $\log W = 3.0764 \log L - 2.2911$ (r=0.975)
The theoretical equation expressing growth in weight could thus be written as:

$$W_\infty = 1124.33\ [1 - EXP(-0.1465(t+0.7455))]^{3.0764}$$

Values of the exponent 'n' of the length-weight equation indicates that M. capito is in good conditions and that it grows heavier relative to its length in longer fishes. This value was higher than that given by various authors in other Egyptian waters and in the Mediterranean.

In a preliminary estimation of mortality rates exerted on L. ramada in the lake, using the Beverton and Holt equation the total mortality coefficient 'Z' was found to be equal to 0.6766. Meanwhile the natural mortality coefficient 'M' was computed using Pauly equation and was found to be equal to 0.5750. The fishing mortality coefficient was thus found to be equal to 0.1016. The rate of exploitation, or amount of death due to fishing, was found to be 0.0738. This figure indicates that the population of L. ramada is very weakly exploited, and that most of the mortality exerted on this population is due to natural causes. The age structure of the population of L. ramada indicates that fishes of age group I and younger are the most affected by this mortality. The length-weight relationships, on the other hand, showed that older age groups grow well under prevailing conditions in the lake. Whether these results reflect the actual state of the population of L. ramada in Lake Burullus needs more investigations.

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Anguilla fisheries in Lake Manzalah, Egypt

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Eels were fished by professional fishermen from Lake Manzalah using fyke nets, with bags of different mesh sizes (30, 40 and 45 mesh bars per 50 cm) during the period from December 1984 to the end of March 1985. To ensure the best possible catch, nets were set parallel to the lake-sea connection in three parallel sets, each consisting of a 200 m long leader combined with 23 fyke nets.

Silver eels were separated from the catch and for each fish total length and total weight were measured; sex was determined by both micro and macroscopic examination of the gonads and the eels were grouped into definite females and those with lobulated organs. After proper treatment of otoliths age determination was made by reflected light against a black background. In the present study the calculation of age started at the first opaque freshwater ring.

From the analysis of the catch of the experimental fyke nets used during the present study, it was clear that the catch of eels was at its maximum during December, when it constituted 31.95% of the total catch. It decreased sharply in January to almost half this value, i.e. 16.58%, then reached its minimum in February and March (9.24% and 7.91%, respectively). This may show that the season of migration of silver eels from Lake Manzalah starts early in November or even sometimes in October.

The study of sex ratio in the eels catch showed that males constituted less than 1% of landed eels in December, then increased gradually in the following months reaching 100% in March. This would clearly indicate that females start their migration and leave freshwater grounds earlier than males. According to El-Gayar et al. (1985) the opposite occurs in Lake Edku and Lake Burullus where males are found to start migration earlier than females. On the average of the season, females constituted about 88% of the eel catch in Lake Manzalah, while during the same season (1984-85), females were 82% of the total eel production in Lake Burullus, and only constituted 20% in Lake Edku (El-Gayar et al., 1985).

The analysis of the size composition of 550 male and 655 female showed that males ranged between 33 and 49 cm in total length and that 68% of them were between 37 and 41 cm. Females, on the other hand, were much larger in size, ranging between 42 and 87 cm. 60% of them were in the length range of 58-71 cm.

Interpretation of annual rings layed on otoliths of 99 males and 132 females (Table 1) showed that males reach their silver stage earlier than females, i.e. after 4 years of freshwater life, and that migrating males are represented by six age groups, while females start migration after 6 years of freshwater life and the older individuals were 13 years old (freshwater life). Wide differences in growth rates between males and females were observed, females being much longer than males at any given age. Furthermore, wide length range in each age group is obvious with considerable overlapping with the following age groups.

Absolute value of growth in length (Δl) show that, for males, the rate of increase in length decreases progressively with age until the age of 9 years when it increases slightly. In contrast, length increments in females show no constant trend in variation with age. The same observation is true for variations of weight with age for each sex.

Table 1. Length and weight data of silver eels caught from Lake Manzalah (1984/85).

Eels with small and lobulated gonads

Age	IV	V	VI	VII	VIII	IX
L (cm)	36.78	39.93	42.40	44.34	45.86	48.05
Wt (gm)	110.9	130.7	145.2	166.5	178.7	192.5

Females

Age	VI	VII	VIII	IX	X	XI	XII	XIII
L (cm)	47.07	54.24	62.10	69.7	74.3	79.08	82.46	85.7
Wt (cm)	227.8	300.8	565.0	774.3	977.0	1116.7	1336.1	1600

However, values of increment in weight relative to increment in length ($\Delta w/\Delta l$) clearly show an increase with age in the case of females, while it decreased in males. This would imply a state of deterioration in the condition of males as they grow longer.

The equations expressing the length-weight relationships of 148 males and 347 females were as follows:

$\log W = 3.1734 \log L - 2.9451$ for females (r=0.9656)

$\log W = 3.1934 \log L - 2.9911$ for males (r=0.9743)

The value of the slope of these equations indicate that females tend to grow heavier with respect to their length, while males tend to be very slim with growth in length.

For the calculation of the condition factor of silver eels we adopted the cubic relation $K=W/L^3$.

However, Frost (1945) tried to prove that eels do not obey the cube law because eels tend to become more bulky and heavier as they get longer. Yet, Burnet (1952) proved that eels obey the cube law in their length-weight relationship. In addition, Vladykov (1955) stated that the increase in fatness occurs in the eels at the stage when they descend to the sea.

Values of the condition factor of females showed progressive waves of decrease and increase with increasing length, while males showed a continuous decrease in condition with length. The average value of condition factor for each sex being 2.3661±0.2851 for females, and 1.9475±0.1718 for males. This again shows the high degree of robustness that females posess over males.

Comparison of values of condition factors with previous studies show that although they were all performed on yellow eels (Sinha and Jones, 1967; Ezzat et al., 1984), yet values of the exponent 'n' and the values of 'k' obtained in the present study lie within the normal range for this species.

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Detergents in Lake Borollos

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Harmful effects of detergents in natural waters may result from their general impact on the biogeochemical cycle of other pollutants and biogenic elements. It may also increase the solubility of many toxic substances. An increased concentration of surfactants in natural waters affects the exchange processes of gases and ions as well as colloid stability and formation of solid phases in natural aquatic systems. Here we present detergent concentration data measured by spectrophotometric method during the period January - December 1987 in Lake Burullus. Detergents content ranged between a maximum of 0.89 mg eq. LAS/l recorded in April and a minimum of zero recorded during winter months.

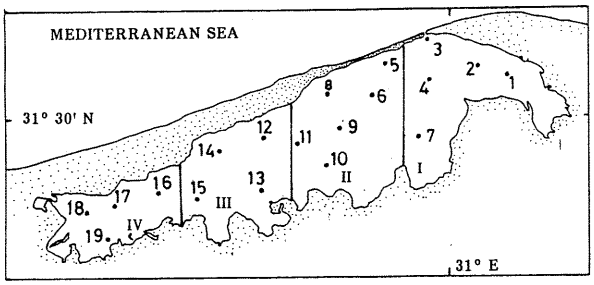

Fig. 1 . Location of sampling stations and the 4 subdivitions (basins) of Lake Borollos.

For the sake of the present discussion the lake was divided into 4 basins which are connected to each other (Fig. 1). Fig. 3, shows the monthly distribution of detergent concentrations during January through December 1987 at the four basins of the Lake Borollos. It can be noticed that basin I had the highest concentration especially during April and May. Fig. 4 represents the frequency distribution of the concentration of methylene blue active substances in Lake Burullus surface water during the year 1987.

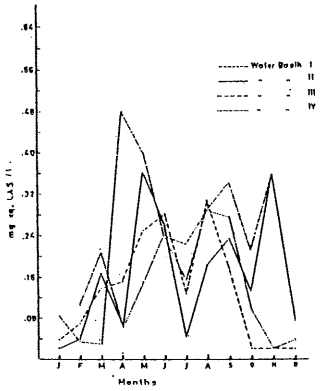

Fig. 3. The monthly change of detergents concentrations in Lake Borollos (mg eq. LAS / l)

The results indicate that Lake Burullus is not heavely polluted with detergents. Detergents concentrations was on the average of 0.17 mg eq. LAS/l. Parts of the lake in front of Boughaz area contained higher concentrations than any other parts of the Lake.

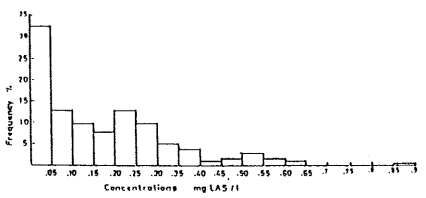

Fig. 4. Frequency distributiuon of concentration of detergents in Lake Borollos during January - August, 1987

It also shows that pollutions of sea water in the area of Alexandria, Abu Qir Bay west of the Boughaz area could be the main source of pollution. by detergents. The study also Points to the possibility of using detergnts as tracer for urban pollution for marine environment.

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Surface heat balance of Lake Burullus

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Studying the heat balance of lakes has various applications in limnology and meteorology. This balance determines the contribution of the different factors affecting the heat budget.

In the present work, different processes controlling the surface heat budget of Lake Burullus are studied; in addition , the monthly heat balance of the water body relative to the yearly mean temperature was computed. The different heat balance components (Q_r, Q_e, Q_c, and Q_w) were computed using semi-emperical equations.

The Lake is situated at the northern part of the Nile Delta between the two branches of the Nile (Fig.1). The Lake area is ca. 546 km^2; it is rather narrow and its breadth varies between 5 and 17 km. The sole connection with the Mediterranean Sea is a narrow opening (Al-Boghaz out let) through a sandy stripe of land , that separates the Lake from the Sea. The depth of the lake varies between 0.42 and 2.07 m, increasing westerly and northerly.

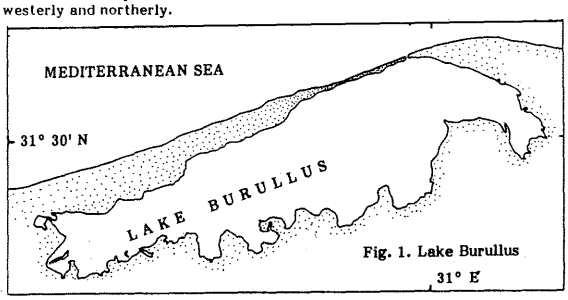

Fig. 1. Lake Burullus

During the year 1987 and Jan. 1988, 19 hydrographic stations were covered monthly. The mean monthly hydrothermal parameters were calculated. A direct measurement of the evaporation was carried out in one station, in order to get the evaporation coeffecient of the area under investigation (0.1695667×10^{-6}).

The annual surface heat balance of the water of Lake Burullus shows that the value of the heat gain at summer is less than the value of the heat loss at autumn and winter. The net heat loss in 1987 was calculated to be 5.54 k cal/cm^2. The main factor affecting the surface heat balance in Lake Burullus is Q_e as shown in Fig. 2. This heat loss from the surface must be compensated . This compensation follows a horizontal heat transport from the drainage water, pouring from six drains into the southern borders of the Lake. Moreover, Q_b which is the heat gain from the bottom of the lake, may be considered as another source of heat to the Lake water.

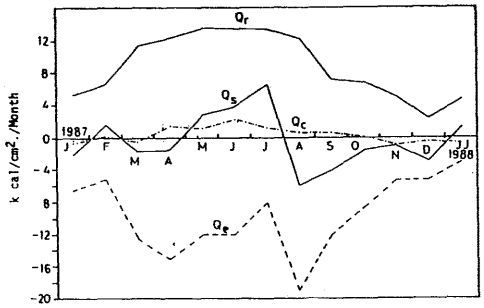

Fig.2 The monthly surface heat balance components.

From Fig. 3 , it is clear that Q_s and Q_w started their positive values in April. Q_s started to lose heat in August, while Q_w started to that in October. During the period fromAugust to October the Lake lost heat as a result of maximum evaporation occurring during this period. The lake water of high heat content was transported to the Mediterranean Sea through Al-Boughaz out let causing more heat loss during the same period.

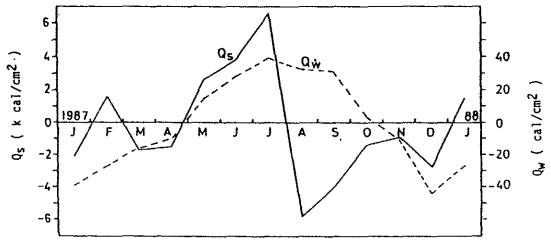

Fig. 3. The monthly surface heat balance (Q_s) and the monthly heat content of the Lake water (Q_w) in 1987.

Q_r: the absorbed solar radiation, Q_c: the heat loss or gain due to conduction

Q_s: the surface heat exchange, Q_e: the heat loss due to evaporation

Q_w: the heat loss or gain due to the vertical turbulance and horizontal movements of water bodies

E-IV12

Preliminary investigation on the levels of heavy metals in the sediments of Lake Burullus

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The Recent sediments of the bottom of Lake Burullus, Egypt, have a specific textural composition. Shells and shell fragments constitute a significant part of the sediments. Shelly materials seem to be a determinant factor in the distribution of grain size. Sands are represented mainly by shells, shell fragments, quartz, feldspars, ostracods and foram tests. Little amounts of heavy minerals form a minor part of the sediments. The fine fraction of the sediment is composed of silt and clay derived from the Nile Delta soils. According to Beltagy (1985) the carbonate content of the sediments of Lake Burullus, on the average, is less than 30%. The organic matter content varies between 1.0 and 2.0%.

The pH and Eh of the sediments were measured. The concentrations of Cd, Cu, Fe, Mn, Ni, Pb and Zn were studied in the different fractions of the sediments, viz: carbonate, 2N HNO_3 extract and the total sediments. The averages of the results obtained are presented in table 1. The contribution of the different components of the sediments to the total amounts of the metals studied was calculated and presented in table 2. The study indicates that, the biogenous and hydrogenous components contribute between 20 and 30 % of the total content of Fe, Zn and Pb; and between 40 and 50 % of Cu, Cd and Ni, while 81 % of the total Mn is contributed by the hydrogenous components. The relationships between Eh and both Mn and Fe in the extractable fraction are established and shown in Fig. 1.

Table.1.- Average Concentration of Heavy Metals in Different Components of the Sediments (ppm)

Component \ Element	Cd	Cu	Fe%	Mn	Ni	Pb	Zn
Total Sediment	4.3	66.8	3.46	826.0	63.9	110.2	129.7
2N HNO_3 Extract	1.9	30.7	1.04	671.0	30.1	24.3	26.4
Carbonate	4.2	8.6	0.07	159.7	13.9	27.5	9.3

Table. 2.- Percentage Contribution of 2N HNO_3 Extract to the Total Heavy Metal Content of the Sediments

Element	Cd	Cu	Fe	Mn	Ni	Pb	Zn
% Contribution	44	46	30	81	47	23	28

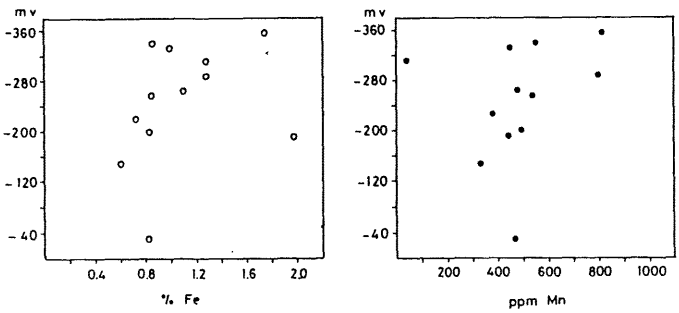

Fig.1.- Relationship Between Fe (o), Mn (•) and Eh (mv) of the Sediments

It is concluded that, the amounts of heavy metals contributed to the Lake are within the natural background levels and the shells of organisms contained higher amounts of Cd, Pb and Zn, and it could act as a sink for those elements in this well defined area. Biogenic carbonate also affects the relationship between both Fe and Mn and Eh, and results a pronounced scattering in the diagrame (Fig.1).

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Données concernant la communauté zooplanctonique d'une lagune fortement adoucie (la lagune Sinoie)

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La dernière vingtaine d'années, la structure qualitative du zooplancton de la lagune Sinoie a subi de profonds changements dus à l'adoucissement prononcé des eaux de la lagune. Après 1975-1980, période d'oscillations des conditions écologiques, on a constaté une tendance à leur stabilisation, reflétée aussi par une augmentation pondérale et numérique du zooplancton (1). C'est justement l'année 1984 la plus significative de cette période; aussi l'a-t-on choisie pour analyser la structure qualitative et quantitative de la communauté zooplanctonique.

Des échantillons quantitatifs de zooplancton ont été prélevés chaque mois, de mars jusqu'à septembre, des eaux de surface (0-25 cm), d'un réseau de 7 stations, à savoir: une station (numéro 1) à l'extrémité nord de la lagune, tout près de l'embouchure du canal d'adduction d'eau douce, suivie par d'autres selon l'axe longitudinal de la lagune (numéro 5, 6 et 7 à l'extrémité sud). Sur l'axe transversal, perpendiculaire au premier dans la station numéro 3, se trouvent encore deux stations: l'une à proximité du cordon littoral (4), l'autre devant le rivage ouest (2). On a fait des comparaisons avec la zone maritime voisine (l'horizon 0-10 m) en ce qui concerne la salinité,la densité des zooplanctontes, ainsi que le nombre d'espèces et l'indice de diversité (d'après SHANNON-WIENER):

STATION:	1	2	3	4	5	6	7	MER
MOIS				Salinité (g NaCl l^{-1})				
IV	0,31	0,38	0,24	0,28	0,62	0,67	0,69	-
V	0,29	0,40	0,38	0,43	0,57	0,48	0,64	10,41
VI	0,17	0,15	0,40	0,20	0,24	0,38	0,48	15,70
VII	0,26	0,47	0,44	0,61	0,61	0,58	0,58	-
VIII	0,61	0,58	0,62	0,57	0,72	0,91	0,57	13,66
IX	0,54	1,16	1,12	1,00	1,05	1,11	2,35	-
				Densité (1000 ex.m^{-3})				
IV	11	60	11	35	53	61	95	-
V	130	299	260	653	759	446	300	6
VI	145	146	2308	1193	1606	3644	3634	480
VII	22	57	41	118	97	128	185	-
VIII	261	399	381	130	338	259	112	135
IX	468	595	343	663	622	148	392	-
				Nombre des espèces				
IV	11	8	10	9	13	13	10	-
V	15	15	13	14	18	18	14	16
VI	10	11	13	14	13	16	12	17
VII	9	8	9	9	10	9	13	-
VIII	13	13	13	12	14	14	15	16
IX	15	16	13	13	12	13	15	-
				Indice de diversité				
IV	2,53	0,92	1,02	1,32	2,28	2,09	2,44	-
V	2,43	1,84	2,65	2,87	2,90	2,80	1,58	3,04
VI	2,30	2,13	1,03	1,28	1,35	1,21	1,05	2,46
VII	2,35	2,04	2,51	2,22	2,07	2,20	2,20	-
VIII	2,90	2,45	2,70	2,80	3,05	2,64	2,46	1,01
IX	3,08	2,79	2,61	2,20	2,57	2,81	2,30	-

On a déterminé 47 espèces,dont 44 holoplanctoniques (19 Rotatoria, 9 Cladocera et 16 Copepoda) et 3 méroplanctoniques (des larves véligères des bivalves, larves zoé de Rhitropanopeus harrisii tridentatus Maitland et nauplii de Balanus improvisus Darwin). Parmi celles-ci, seulement 3 espèces (Lecane sp., Daphnia longispina Müller et Heterocope caspia Sars) ont été présentes toute la période, dans toute la lagune Sinoie.

La densité moyenne du zooplancton a été de 515833 ex.m^{-3}, les valeurs minimales ont été rencontrées au printemps, tandis que les maximales en été, réalisées en proportion de 80-90 % par les Cladocères (Bosmina longirostris Müller, Cornigerius maeoticus (Pengo), Daphnia longispina).

Ajoutant à ces données l'analyse de l'indice de similitude (de SÖRENSEN), on peut délimiter dans la lagune quatre zones distinctes:

- La zone nord,fortement marquée par l'apport d'eau douce (stations 1 et 2) a eu une salinité moyenne de 1,80‰ (avec 35% plus basse que la moyenne de l'entière lagune). On peut y signaler durant toute la période le plus haut indice de diversité, le plus grand nombre d'espèces (34) et les plus réduites valeurs de densité. Pendant les crues printanières du Danube qui déterminent aussi dans la lagune un apport plus grand d'eau douce, ce n'est qu'ici qu'on a trouvé quelques espèces dulçaquicoles (Eucyclops macrurus macrurus (Sars),Acanthocyclops bisetosus (Rehberg), Argonotholca foliacea Ehrenb.).

- La zone à proximité de la mer Noire (stations 3 et 4), dont la salinité moyenne (3,43 ‰) a été 18 % plus élevée que celle de la lagune. La présence des nauplii de Balanus seulement en mai peut indiquer soit l'existence d'un noyau de géniteurs sur les fonds de la lagune, soit la pénétration des masses d'eau marine comme suite des orages qui ont eu lieu ce mois. Pendant le printemps, dans la zone marine voisine on a trouvé des copépodes de la lagune (Calanipeda aquae-dulcis (Kritsch), Eurytemora hirundoides Nordquist) indiquant une fuite d'eau vers la mer.

- La zone centrale de mixage (stations 5 et 6), dont la salinité moyenne (2,97 ‰) a été semblable à celle de toute la lagune. Les valeurs de l'indice de diversité ont été plus petites par rapport à celles de la zone nord. Parmi les 28-30 espèces déterminées pour cette zone,il y avait 23 qu'on trouvait dans tout le bassin.

- La zone sud (station 7) dont la salinité moyenne a été avec 4,5% plus haute que la moyenne générale. C'est ici qu'on a signalé les densités maximales du zooplancton, ainsi que les plus grands indices de diversité, une abondance d'espèces (33-34) et la présence de Brachionus calyciflorus var. anuraeiformis Brehm, Moina micrura Kurz, Acanthocyclops vernalis vernalis Fischer, A.nanus (Sars), Microcyclops varicans (Sars), M.bicolor (Sars)et Rhitropanopeus harrisii tridentatus, qu'on ne trouve plus dans les autres zones.

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Studies on the core sediments of Lake Edku, Egypt

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SUMMARY:- Core sediments were sampled from Lake Edku, an Egyptian shallow brackish water delta lake connected to the Mediterranean Sea, and the samples were subjected to some physico-chemical investigations. Contrary to water content, the density of wet mud increased with depth in most cores. The organic matter, the calcareous substances, the allochthonous materials and the diatom-silica were deposited in variable amounts at various depths of the cores. The quantitative distribution of these components was found to depend upon certain factors which were discussed.

Lake Edku, a shallow brackish water lake, is connected to the Mediterranean Sea through a narrow outlet. Its chlorosity varies according to locality and season. This lake receives huge amounts of drainage waters via three main drains. The lake bottom varies in structure from muddy to sandy mixed with silty materials. The present study deals with core sediments of Lake Edku to illustrate the vertical variations in their quantitative composition. Ten short cores were sampled at different regions of Lake Edku and the samples were subjected to some physical and chemical investigations

The external events have a considerable effect on the nature, composition and distribution of the lake sediments (Saad, 1976, 1978). The allochthonous sediments entering into Lake Edku with the drainage and sea waters are distributed by water movements throughout most of the lake; they were deposited in variable amounts at various depths of the cores. The recent allochthonous minerogenic materials cover the autochthonous organic sediments or mix with them. This hinders the exchange of nutrients between the sediments and the free water (Saad, 1970, 1976, 1984). Variations of water content of the lake sediments are due to the nature and type of these sediments. Lower amounts of water were found in deposits enriched with minerogenic materials. The decrease in the amount of water with depth in most cores was generally correlated with an increase in the amounts of allochthonous minerogenic materials. Contrary to water content, the density of wet mud increased with depth in most cores.

The amounts of different components of the lake sediments deposited at various depths of the cores depend upon several factors. The higher amounts of organic matter found in some sediment samples are due mainly to the great amounts of the autochthonous and allochthonous organic matter reached these sediments (Saad, 1984). It must be also assumed that the degree of preservation of the organic matter in these samples was high. Shells and shell fragments of calcareous organisms accumulate on a considerable portion of the lake bottom (Saad, 1978). The higher amounts of calcareous substances found in some sediment samples are related to the abundance of these shells (Saad, 1974, 1976, 1978). The diatomaceous silica gave variable amounts at various depths of the cores. The higher amounts found in certain sediments samples reflect the richness of these samples with diatom frustules (Saad, 1976, 1978, 1984).

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E-IV15

La dynamique du phytoplancton du lac sursalé Tekirghiol pendant les années 1984-1987

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Abstract: This work presents the development cycle of phytoplankton of lake Tekirghiol in the 1984-1987 period.

Dans nos notes antérieures (1979, 1981, 1983, 1984) nous avons présenté l'évolution hydrologique de ce lac et son influence sur la dynamique qualitative et quantitative du phytoplancton.

Pendant la période 1984-1987 on a constaté une stabilisation et même une amélioration de ses paramètres hydrologiques. Le niveau du lac baissa de + 131 cm (rép. mer Noire) en 1984 à + 102 en fin d'année 1987. Parallèlement, la salinité augmenta légèrement, de 53,5 g ‰ en 1984 (valeur moyenne annuelle) à 57,4 g ‰ en 1986. Mais, plus importante est la diminution incessante de la teneur en azote total qui, de 5,6 mg/l en 1984 baissa à 0,28 mg/l seulement en 1986. Diminua aussi la densité du phytoplancton, entraînant l'augmentation de la transparence des eaux de 180 cm environ en 1984 à 210 cm en 1986, avec une valeur maximale de 450 cm, fait qui favorisa le développement de l'algue Cladophora.

Le phytoplancton du lac est caractérisé par la dominance des espèces dulçaquicoles, à grande plasticité physiologique. Les espèces d'origine marine ou saumâtre sont moins nombreuses. Mais, d'extrême importance est le fait que, depuis 1981, quand a cessé la floraison chronique due aux Gloeobotrys clorinus (hiver) et Synechococcus curtus (été), on constate des apparitions et disparitions brusques de nouvelles espèces, dont quelques-unes peuvent se développer d'une manière explosive. Dans cette dernière période apparurent dans le plancton les espèces suivantes: Wolosznskia leopoliensis Thompson et Dictyosphaerium ehrenbergianum en 1984, Anabaena miniata Skuja et Dendromonas cryptostylis Skuja en 1985, Carteria multifilis Fresen, Wolosznskia neglecta Thompson et Gymnodinium eurytopum Skuja en 1986 et Trachelomonas hispida Stein et T. regularis Sk.V. en 1987.

Chaque année on peut distinguer de 3 à 4 associations végétales successives, en fonction de la saison. On trouve en 1984 les dominantes suivantes: Nitzschia closterium en hiver, Glenodinium gymnodinium au printemps, Characiopsis aristulata en été, Dictyosphaerium ehrenbergianum en automne. En 1985 dominantes furent Thalassiosira parva en hiver, Chroomonas caudata au printemps, Dendromonas cryptostylis et Wolosznskia leopoliensis en été - automne. Dendromonas reste dominante jusqu'au printemps 1986, quand elle est remplacée par Gymnodinium eurytopum et Chlorobotrys polycloris; mais il redevient dominant quand-même pendant toute la période été - automne. Enfin, en hiver 1987 le phytoplancton est dominé par Chroomonas caudata et Trachelomonas hispida, au printemps - Chlorobotrys polycloris, en été - Chroomonas - Trachelomonas, en automne les deux espèces du genre Wolosznskia: W.neglecta et W.leopoliensis.

Dans le plancton du lac on trouve chaque année un nombre réduit d'espèces, de 12 à 17 seulement. Sa dynamique quantitative est présentée dans le Tableau 1.

Tableau 1

La densité et la biomasse du phytoplancton du lac Tekirghiol pendant les années 1984 - 1987

Mois / Année	1984	1985	1986	1987
	Densité No.cell/l			
II	39.297.000	-	1.566.000	4.782.000
III	30.576.000	10.460.000	6.550.000	-
IV	37.383.000	12.243.000	8.687.000	4.196.250
V	23.944.000	2.100	8.040.000	125.660
VI	477.500	-	32.750	195.660
VII	156.800	171.400	935.000	79.000
VIII	3.137.000	2.125.700	-	1.187.140
IX	3.254.500	-	4.620.000	778.330
X	6.249.100	3.583.500	1.220.000	1.093.790
Moyenne	16.883.200	4.764.100	3.978.000	1.540.980
	Biomasse mg/m^3			
II	30.790,0	-	7.180,0	57.428,9
III	43.998,0	132.160,0	46.390,0	-
IV	81.812,0	167.230,0	43.560,0	33.136,0
V	122.037,0	9,6	20.540,0	123,7
VI	1.801,7	-	147,2	449,9
VII	92,6	513,8	904,2	501,2
VIII	4.560,0	9.612,4	-	13.318,7
IX	4.850,4	-	10.006,0	6.374,0
X	34.378,3	7.945,5	8.880,0	3.311,0
Moyenne	40.595,2	52.911,5	17.200,0	13.205,3

On constate que, faute de consommateurs, le phytoplancton s'accumule pendant toute la période automne - printemps. Dans le moment où apparaît la Artemia, elle consomme activement le phytoplancton en augmentant sa densité. Par la suite, le phytoplancton diminue brusquement. Ensuite, diminue aussi le consommateur en été. En ces circonstances, le phytoplancton commence de nouveau à s'accumuler. Cette dynamique serrée montre l'importance du phytoplancton dans la bioéconomie du lac, en tant que nourriture pour un important facteur de la péloïdogenèse du lac.

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E-IV16

Le rôle de l'Algue Cladophora vagabunda L. et du Phyllopode Artemia salina Leach. dans la péloïdogenèse du lac sursalé Tekirghiol en 1984-1987

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Abstract: Dynamics of the species Cladophora vagabunda L. and Artemia salina Leach. production is presented in the mentioned period.

Pendant les décennies passées (3) l'algue Cladophora était répandue sur toute la longueur des côtes du lac, jusqu'à 4,5 m de profondeur. Pendant l'automne elle forma de grandes plaques flottantes, accumulées par les vents dans les golfes en grandes quantités. Mais pour ces années on n'a pas d'évaluations quantitatives.

Après 1970 les eaux phréatiques firent rehausser le niveau du lac. Les falaises s'activèrent et le matériel terrigène colmata le fond rocheux dur. La diminution de la transparence des eaux jusqu'à 20-30 cm seulement, due tant aux suspensions qu'à la floraison incessante des espèces Gloeobotrys clorinus et Synechococcus curtus a eu pour conséquence la réduction de son étendue en profondeur. Pendant la première cartographie de 1976, l'algue cessa d'exister au-dessous de 1,5 m de profondeur.

Après 1981 le niveau du lac commence à baisser légèrement et la transparence a augmenté après la disparition des deux espèces mentionnées. L'aréal de l'algue a pu s'élargir incessamment, en gagnant de nouveau la profondeur de 4 m, ou même la dépassant en quelques points.

Les évaluations quantitatives, effectuées à l'aide du scaphandre autonome, en poids frais, furent de 1.655 tonnes en 1984, de 1.548 tonnes en 1985, de 2.054 tonnes en 1986 et de 1.315 tonnes en 1987 seulement, probablement à cause de la diminution de la teneur en azote des dernières années.

Etant conditionnée par la présence du fond rocheux non colmaté et d'une bonne transparence de l'eau, Cladophora constitue un chaînon très fragile de la production de l'écosystème, fait clairement démontré par la fluctuation de ses productions annuelles.

Le zooplancton du lac Tekirghiol est très pauvre en espèces. On rencontre quelques rotifères, cyclopides et harpacticides, ainsi que le phyllopode Artemia salina. C'est le principal consommateur du phytoplancton, ainsi que du zooplancton de petite taille. Les chaînes trophiques du lac sont courtes: phytoplancton - Artemia; phytoplancton - zooplancton - Artemia. Le dernier chaînon n'a pas de consommateur et, ensuite, ses cadavres contribuent à la péloïdogenèse.

Son cycle de développement est conditionné par le régime thermique de l'année. Pendant les mois froids, l'espèce est présente dans le plancton et le benthos du lac sous forme d'oeufs de résistance. A mesure que l'eau se chauffe, se produit leur éclosion. Apparaît la première génération de l'année, qui pond des oeufs parthénogénétiques. Se succèdent puis jusqu'en automne un nombre de 6 générations, qui atteignent le stade adulte (Tableau 1); la 7^e disparaît en hiver comme nauplii.

Tableau 1

Evolution du phyllopode Artemia salina au cours des années 1984 - 1987; de I à VII sont indiquées les générations successives en ex/m^3

Mois	Année	1984 Nauplii	1984 Jeunes	1984 Adultes	1985 Nauplii	1985 Jeunes	1985 Adultes
IV	I	51	0	0 I	14	0	0
V	I	80 I	560 I	150 II	19.965 I	410 I	3.920
VI	II	3.073	0 I	7.530 III	22.950 II	7.787 II	11.326
VII	III	88.325 II	453 II	702 IV	2.740 III	3.850 III	5.523
VIII	IV	6.070 III	1.383 III	1169 V	535 IV	771 IV	2.888
IX	V	1.705	0 IV	15	-	-	-
X	VI	9.430 V	1.184 V	261 VI	1.820 VI	2.820 V	271
XI	VII	10	0 VI	220	-	-	-
Biomasse		Artemia		1.170,43			4.813,23
(mg/m^3)		Zooplancton total		1.414,51			4.818,25

Mois	Année	1986 Nauplii	1986 Jeunes	1986 Adultes	1987 Nauplii	1987 Jeunes	1987 Adultes
III	I	4	0	0	-	-	-
IV	I	218	0	0 I	222	0	0
V	II	767 I	416 I	36 I	780 I	790 I	110
VI	III	249.520 II	18.640 II	448 II	45.448 II	6.385 I	93
VII	IV	12.037 III	253 III	263 III	9.591 III	295 II	58
VIII	V	460 IV	0 IV	0	0 IV	7.192 IV	320
IX	VI	1.722 V	1.405 V	230 V	1.040 IV	113 IV	143
X	VII	275 VI	173 VI	85 VI	1.568 V	308 V	625
Biomasse		Artemia		1.090,87			869,31
(mg/m^3)		Zooplancton total		1.093,24			870,60

En fonction de la quantité de nourriture dont l'espèce dispose, l'effectif de ces générations est très inégal. Après le développement intensif du début de l'été et après avoir consommé le phytoplancton jusqu'à sa disparition presque totale, l'effectif d'Artemia diminue brusquement. La population augmente un peu vers l'automne, en parallèle avec le phytoplancton. Parfois, en novembre apparaît la 7^e génération qui ne peut atteindre le stade mûr et disparaît à cause du refroidissement de l'eau. Aux biomasses moyennes réalisées, pour le volume de 70 mil.m^3 eau (1,2), les productions en poids frais furent de 590 tonnes en 1984, de 339 tonnes en 1985, de 76 tonnes en 1986 et de 56,5 tonnes en 1987. On constate donc la diminution de la population de l'espèce, qui suit fidèlement la dynamique du phytoplancton. Comme valeurs totales, le lac a produit 2.254 tonnes de matériel péloïdogène en 1984, 1.887 tonnes en 1985, 2.130 tonnes en 1986 et 1.368 tonnes en 1987.

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Etude des paramètres physico-chimiques et des sels nutritifs dans le lac de Bafa (Aydin, Turquie)

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INTRODUCTION

Le lac de Bafa, situé entre 37°31'N et 27°27'E au sud-ouest de l'Anatolie, est un lac d'alluvions de barrage. C'est une ancienne baie qui, dans l'Antiquité, a été séparée de la mer par les apports d'alluvions de la rivière Büyük Menderes. Actuellement, la rivière changeant de lit, passe à 1 km environ du lac (1, 2). La longueur maximale entre les deux points les plus éloignés est de 15,3 km, alors que sa largeur est de 4,5 km. La superficie du lac atteint 65,8 km^2 ; le lac est situé à dix mètres d'altitude et sa profondeur maximale est de 19 m (Fig. 1).

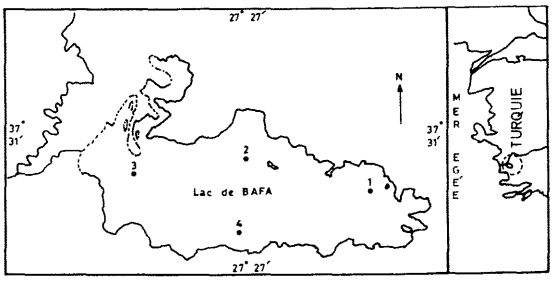

Figure 1. Localisation des stations.

MATERIEL ET METHODES

Dans ce travail, nous avons étudié quelques paramètres physico-chimiques et des sels nutritifs ; la salinité (‰), la température (°C), l'oxygène dissous (mg/l), le pH, les sestons (mg/l), NO_2^--N, NO_3^--N, NH_4^+-N, PO_4^{-3}-P(µg/l). Des prélèvements mensuels ont été effectués de septembre 1986 à août 1987, en surface, sur quatre stations caractéristiques du lac de Bafa. Tous les échantillons ont été faits dans des bouteilles en PVC et conservés dans le mélange glace-sel jusqu'au laboratoire. Les déterminations d'oxygène dissous, de température et de salinité ont été réalisées in situ. Pour les sels nutritifs, nous avons utilisé un spectrophotomètre Perkin-Elmer, Modèle 35 (3, 4).

RESULTATS ET DISCUSSION

Dans le Tableau 1 sont rassemblées les moyennes annuelles de chaque paramètre pour quatre stations.

	St. 1	St. 2	St. 3	St. 4
Salinité (‰)	4.21 ∓ 0.42	4.33 ∓ 0.32	4.49 ∓ 0.37	4.39 ∓ 0.37
Température (°C)	19.68 ∓ 5.29	18.42 ∓ 4.82	19.07 ∓ 5.03	19.75 ∓ 5.22
Oxy.dis.(mg/l)	8.75 ∓ 1.53	8.96 ∓ 1.35	9.87 ∓ 2.35	8.44 ∓ 1.36
pH	8.05 ∓ 0.21	7.93 ∓ 0.32	8.10 ∓ 0.29	8.15 ∓ 0.22
Seston (mg/l)	10.86 ∓ 3.75	13.16 ∓ 4.94	33.23 ∓32.49	12.44 ∓ 4.96
NO_2^--N (µg/l)	8.14 ∓ 2.06	3.50 ∓ 0.94	7.28 ∓ 4.09	4.77 ∓ 1.35
NO_3^--N (µg/l)	14.06 ∓ 8.07	13.35 ∓ 6.84	9.66 ∓ 7.24	11.77 ∓ 7.56
NH_4^+-N (µg/l)	94.84 ∓ 54.03	89.59 ∓ 49.51	110.12 ∓83.79	126.79 ∓100.07
PO_4^{-3}-P (µg/l)	16.63 ∓ 8.56	16.41 ∓ 10.67	17.97 ∓ 8.59	18.29 ∓ 18.45

Tableau 1. Moyennes annuelles des paramètres étudiés.

D'après le Tableau 1, on trouve, en surface, des concentrations identiques dans le lac de Bafa. Les résultats obtenus révèlent des concentrations de salinité (‰) de 2.93 à 5.62 ; de température (°C) de 9.7 à 31.5 ; d'oxygène dissous (mg/l) de 3.00 à 15.23 ; de pH de 7.05 à 8.70 ; des sestons (mg/l) de 0.20 à 179.70 ; des NO_2^--N, NO_3^--N, NH_4^+-N, PO_4^{-3}-P varient aussi de 0.00 à 49.61 ; de 0.24 à 41.00 ; de 0.00 à 504.46 ; de 0.00 à 93.93 µg/l.

Nous constatons que les sels nutritifs augmentent en hiver à cause des pluies. Nous pouvons donc conclure que le lac de Bafa est un lac constitué d'alluvions de barrage, présentant un caractère eutrophique similaire à celui des autres lacs d'Anatolie Occidentale (5).

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G-I1

Fifteen years of scientific deep drilling in the Mediterranean Sea : a review*

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Being almost totally surrounded by orogenic belts the present day Mediterranean Sea represents probably one of the best model of an in progress continent to continent collisions. Subduction/collision and related back arcs extensive evolution have combined in the creation (and destruction) of continental margins and related restricted oceans basins where tectonic, sedimentary and oceanographic processes have been closely and continuously interacting. The resulting geology has since many decades been particularly attractive for earth scientists and has lead to many scientific cruises and to the organization of three Deep Drilling expeditions.

Leg 13 of the Deep Sea Drilling Project (in 1970), Leg 42 A of the International Program for Ocean Drilling (in 1975) and more recently Leg 107 of the Ocean Drilling Program (in 1986) have been devoted to stratigraphic, regional and thematic geological targets in the Mediterranean Sea. This presentation intends to review the significant results derived from 27 drilled sites in order to help to focuse new global earth sciences problems that can be adressed in the Mediterranean Sea.

* Les condensés qui figurent ci-après sont ceux reçus à la date requise. Ceux parvenus ultérieurement feront l'objet d'une diffusion interne.

G-I2

Les changements paléohydrologiques du secteur Méditerranée-Atlantique de 18 000 ans BP à l'Actuel : apport de la micropaléontologie

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La zone d'échanges hydrologiques entre Méditerranée et Atlantique, de part et d'autre du détroit de Gibraltar a subit entre le dernier maximum glaciaire (18 000 ans BP) et l'actuel des variations importantes mises en évidence par des études microfauniques (Foraminifères benthiques notamment).

Les résultats présentés sont obtenus à partir de l'étude de diverses carottes implantées à l'Est du seuil de Gibraltar, en Mer d'Alboran et à l'Ouest du seuil, dans le Golfe de Cadix. Dans chacun des bassins, ces carottes sont situées à différents niveaux bathymétriques et plus particulièrement dans le domaine de profondeur de chacune des masses d'eaux existant actuellement dans ces régions : eau de fond Nord-Atlantique (NADW) et overflow mediterranéen (MOW) pour la partie Ouest, eaux méditerranéennes intermédiaires (MIW) et profondes pour la partie Est.

Les bassins profonds (1 200 - 1 400 m en Mer d'Alboran, 1 500 - 2 800 m dans le golfe de Cadix) présentent des évolutions paléohydrologiques opposées depuis 18 000 ans BP.

Riche en nutrients et bien oxygéné du maximum Glaciaire jusqu'à 13 000 ans, le bassin d'Alboran devient beaucoup moins favorable à la vie benthique de 13 000 ans à l'Actuel. La dégradation que l'on suit pendant le Bolling-Allerod et le Younger Dryas devient maximum entre 10 000 et 7 000 ans à la base de l'Holocène ; elle paraît synchrone des développements de sapropels en Méditeranée orientale.

Dans le Golfe de Cadix au contraire, des conditions peu favorables à la vie benthique existent à 18 000 ans. Elles sont la conséquence de l'arrêt de formation d'eaux profondes en Mer de Norvège et de la faible production d'eaux bien oxgénées aux latitudes nordiques. Les eaux profondes baignant le bassin de Cadix sont sous-oxygénées et très pauvres en nutrients comme d'ailleurs tout l'Atlantique N.E. Ce n'est qu'à partir du Younger Drias que les microfaunes benthiques témoignent de changements hydrologiques qui vont conduire aux conditions actuelles où NADW bien oxygéné baigne ces niveaux profonds.

Les domaines épibathyaux (500 - 800 m) de chaque côté du seuil de Gibraltar ont en revanche une évolution assez comparable à l'Est et à l'Ouest pendant toute la période de temps considérée avec des conditions écologiques favorables à la vie benthique. Il semble que la présence de microfaunes assez homogènes de part et d'autre du seuil à trois reprises : fin du stade isotopique 2, Younger Dryas, Holocène supérieur, puisse être interprétée comme la marque de l'accentuation temporaire des échanges Est-Ouest.

G-I3

Estimation of regional movements in the Southern and Central Italian Region and adjacent seas from aeromagnetic data

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Magnetic and palaeomagnetic data gave, during last decades, major contributions to the comprehension of the dynamics of many regions of the Earth.

As what regards palaeomagnetic data, the determination of the magnetic properties of sampled rocks together with age estimates, produced important results as far as the presence of rotational movements of tectonic plates or micro-plates are concerned (Tarling, 1971).

In oceanic areas, the observation of parallel bands of magnetic anomalies alternatively Northward and Southward directed, gave one of the main keys for understanding and evaluating the crustal spreadings (Vine and Matthews, 1963).

Moreover, also a shape analysis of magnetic anomalies caused by buried bodies, can be performed, in this context, for searching the direction (i.e. declination and inclination) of the total magnetization vector. In fact, if such direction is not corresponding to a N-S or S-N one, the abnormal shape of the anomaly can be directly related to rotational movements.

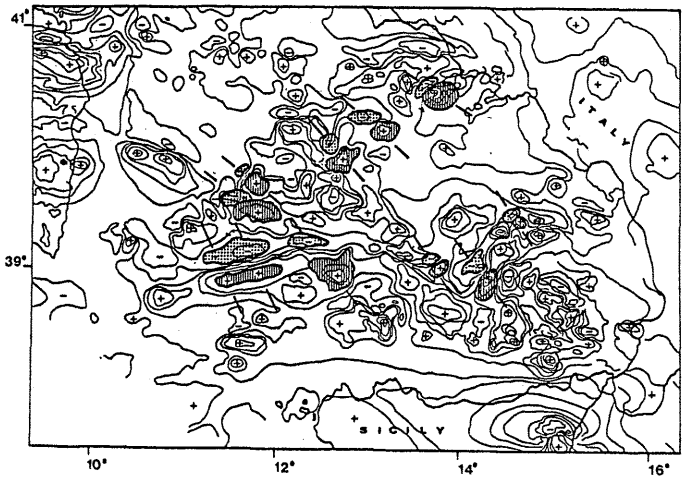

Fig. 1 : Aeromagnetic field of the Tyrrhenian Sea (Southern Italy), simplified from aeromagnetic data, AGIP, 1981. Magnetic anomalies with an abnormal direction of the total magnetization vector are drawn with a shaded area, for the maxima, and with points for the minima. For each anomaly is also indicated (by an axis) the estimated direction of the total magnetization vector (from Fedi and Rapolla, 1988)

A number of such anomalies were pointed out in the Southern-Tyrrhenian Sea (Fedi and Rapolla, 1988) analysing the aeromagnetic field measured by A.G.I.P. (1981). They were interpreted as due to an anticlockwise rotation of the region, of about 30-50° (Fig. 1). Enlarging the study to the available aeromagnetic data covering the remanent part of the Southern and Central Italian Region and adjacent seas, we were able to detect other abnormal direction anomalies, with angles of about -40° and 40°. This should furnish a valuable lecture key of the geodynamics of the region.

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G-I4

Messinian vegetation and climate

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Neogene Floras in the Mediterranean and their macrofloristic compositions and palaeoclimatic implications put forward doubts on the Messinian salinity crisis. The typical uppermost Miocene floras like for example from Carbonara Scrivia (Italy), Pikermi (Greece), Paghi(Kerkira) and Ankara-Beynam (Turkey) etc. are composed of deciduous or evergreen plant taxa of humid character (laurel,Acer,Glyptostrobus,Platanus,Quercus,Ulmus,Salix etc.)and give no idea of any xerophytic or early Mediterranean element (perhaps except Cupressus).A similar picture we find in the new Messinian seed-flora of the Stirone river (Fidenza),where we find for example"Toddalia", a special humid plant from SE-Asia today. A look on the abundant prae- or post-Messinian floras(especially with fruits and seeds) show the same picture and thus the salinity crisis from the palaeobotanical point of view was no"crisis" or catastrophe in the real sense.
Now the question arises how to explain many geological phenomena in the Mediterranean with a warm-temperate (subtropical),humid climate,which is confirmed by the fossil laurel-, evergreen and mixed-mesophytic-forests from the upper Oligocene to the lower Pleistocene (Santerniano).
There are some ideas about a "shift" from the Neogene Cfa-climate (sensu KÖPPEN) to a Cw-climate,which means a coming up of a winterdryness. We find plants in our fossil floras which occur nowadays in the winterdry Chinese Cw-climate and thus we can dare to compare our fossil climate with the Recent one - the same aspect is found in W-Germany. In such a climate the dessiccation in the wintertime (up to 3 months) is higher than the precipitation and allows to build up gypsum- and salt-deposits etc.
These macrofloras,showing us the autochtonous vegetation in the Mediterranean, are quite distinct from the microfloras,which seem to have a certain amount of xerophytic plants (Gramineae etc.),but from far away (allochthonous). This is due to windborn pollengrains or those transported by water.
In respect of these palynological records we have to reconstruct perhaps really "arid" conditions in Central-Asia or anywhere else,from where the pollengrains have come. There is also influence of the African continent,but this does not attack my research.
Some of the current literature is brought here and in the run of a project in Munich we try to solve all questions concerning Neogene fruit- and seed-floras,but also leaf-floras and especially the problem of the vegetation in Messinian times in the Mediterranean.

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V. Balkanese and Turkey

G-I5

Eratosthenes Seamount : a mid-ocean dip-stick recording the late Tertiary and Quaternary marine geological history of the Eastern Mediterranean

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The Eratosthenes Seamount is second to the Mediterranean Ridge as the most prominent physiographic feature in the eastern Mediterranean. The seamount is separated from adjacent structures such as the Nile Cone, the Levant Basin and Cyprus by a deep moat along its circumference. It is a simply folded, pre-Messinian structure, and as such bears sedimentary and structural evidence to the geological events that affected the eastern Mediterranean during the last 7 million years. We presume that due to its unique structural position and history, a thin but complete late Tertiary and Quaternary sedimentary sequence can be obtained from the Eratosthenes. This obtainable sequence would probably record the marine depositional environments of the eastern Mediterranean during the desiccation and the subsequent rejuvenation of the sea in the Mio-Pliocene transition period and during the various glacial period and the associated deposition of sapropels. The Eratosthenes Seamount would also bear evidence for the tectonic collision events along the Cyprean Arc and their dating. The collision between Eratosthenes Seamount and Cyprus preceded the tectonic collision along the Hellenic Arc. Since the Eratosthenes collision was not affected by subsequent halokinetic processes, details of the Afro-European tectonic collision could be encountered and interpreted. Boreholes of the Ocean Drilling Program on the Eratosthenes seamount and its environment would illuminate the major geological problems of the eastern Mediterranean, namely,

- Plate tectonic regime in the eastern Mediterranean
- Early stages of convergence and collision processes
- Pre-Messinian sedimentary history and paleoceanography of the eastern Mediterranean
- Messinian and Plio-Quaternary sedimentology, geochemistry, paleoclimatology and paleoceanography

G-I6

The Mediterranean : a deep-sea archive for global changes in sea level

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Eustatic sea level fluctuations manifest themselves differently in different depostional environments. For example, late Miocene/early Pliocene fluctuations have been extensively documented in the Mediterranean by lithologic (and biostratigraphic) changes recorded in numerous land sections, as well as in deep sea cores from three drilling legs (DSDP Legs 13 & 42 and ODP Leg 107). These lithologic changes resulted from a drastic restriction of the inflow of sea water at the western Mediterranean's connection to the Atlantic Ocean.

Earlier in the Miocene, the Mediterranean had already lost its eastern connection to the Indian Ocean, which probably terminated global circum-equatorial tropical circulation. With this closure, the Mediterranean was now essentially located on the western side of a continent with a subsequent climate change towards increasing aridity. As the modern Mediterranean is an important source of dense water with its opening to the Atlantic, it is proposed that the onset of similar restricted oceanographic/climatic conditions in the Miocene had significant global effects. The exact correlation of paleoceanographic events in the Mediterranean with other records of Miocene sea level change, particularly those derived from oxygen isotope stratigraphy in the open oceans and sequence stratigraphy on the contintental margins, would allow for an evaluation of the causes and consequences of these proposed global effects. Therefore, future ocean drilling in the eastern Mediterranean is proposed to recover a complete Miocene to Oligocene sequence in order to evaluate the relationship between global sea level changes and Mediterranean paleoceanography.

Correlation of sea-level events, as recorded in the sedimentary record of different basins, often proves difficult when magneto- and biostratigraphies fail or are not applicable. Strontium isotope stratigraphy is potentially an excellent method for correlating the open ocean record with problematic sequences, such as those deposited in restricted marine basins. For example, strontium isotopes have been used successfully to correlate Pliocene/Pleistocene pelagic sediments from ODP cores and land sequences in the Mediterranean Sea with cored sediments from DSDP sites in the open ocean. [1,2] With these correlations, it was possible to evaluate the response of the restricted Mediterranean, as manifested by lithologic changes, to late Miocene/early Pliocene sea level fluctuations, which are recorded as variations in the oxygen isotope stratigraphy from the open ocean sites.[1] Although the theoretical stratigraphic resolution of the technique for the period 6-4 Ma is 0.23 m.y., the practical resolution was estimated to be 0.3-0.5 m.y. It is proposed that paleoceanographic events recorded in deep sea sediments of the eastern Mediterranean could be correlated with globally recorded Miocene sea level fluctuations with the aid of conventional magneto- and biostratigraphy, as well as strontium isotope stratigraphy. This proposed correlation could thus be used to evaluate the influence of major changes in ocean circulation patterns on climatically induced eustatic sea level changes.

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[2] McKenzie, J.A., Palmer, S.C. and Mueller, P.A., 1988. Strontium isotope stratigraphy of the Piocene-Pleistocene "deep-sea type section" at ODP Site 653, Proc. ODP, Sci. Results, 107: College Station, TX (Ocean Drilling Program), submitted.

Mineralogy of Quaternary sand-size sediments from the Sea of Crete : implication for provenance variability in active continental margins

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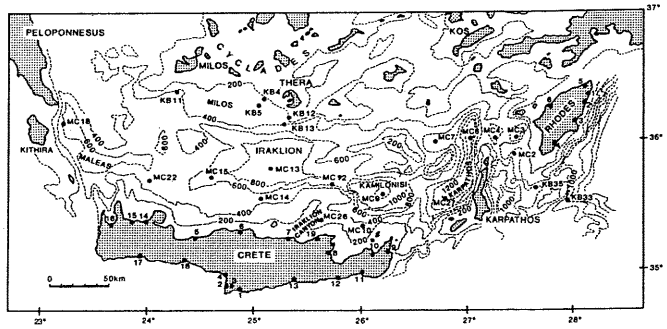
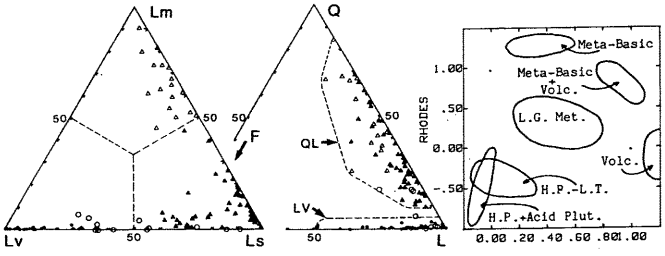
This study concerns 88 gravity core samples taken from 22 sampling points in the Sea of Crete (Bartole et al., 1983) and 25 samples collected along the coasts of Crete and Rhodes during the cruises R/V Noroit (1980) and R/V Bannock (1981). A mineralogical point-counting of both light and heavy minerals containing the sand-size fraction of these samples has been performed in order to infer the provenance of Quaternary turbidite sediments from the Sea of Crete.

Light mineral analysis shows that sands from the Sea of Crete can be subdivided into two different groups (Valloni and Mezzadri, 1984): (1) Lithovolcanic sands (LV), characterized by plagioclase and volcanic rock fragments (mostly wind-blown ash); and (2) Quartzolithic sands (QL) composed mainly of quartz and various types of metamorphic and sedimentary rock fragments (Saccani, 1987). LV sands are confined to the central and the northern part of the basin, closer to the volcanic arc of the Cyclades. QL sands occur in the southern part of the basin, closer to the Peloponnesus-Crete-Rhodes ridge (outer ridge). QL sands ca be further subdivided, on the basis of lithic grains, into two sub-groups: Lithometamorphic-dominated sands (Lm), in which metamorphic rock fragments are predominant; and Lithosedimentary-dominated sands (Ls), in which sedimentary rock fragments are prevalent. Lm and Ls sands occur in different portions of the basin depending on the composition of the closer source-area forming rocks.





Q-mode factor analysis of **heavy mineral** data shows that 5 heavy mineral associations occur in the Southern Aegean area:

(1) High pressure metamorphic assemblage (*Garnet - Epidote - Chloritoid - Glaucophane*) characterizing the western part of the basin behind the southern coasts of Peloponnesus (North Maleas basin). Provenance of these minerals is referred to the schists with Glaucophane outcropping in the Peloponnesus.

(2) High pressure metamorphic - acid igneous assemblage (*Green Hornblende - Apatite - Zircon - Sphene - Epidote - Glaucophane*) which is found in the branch of the basin behind the northwestern coasts of Crete (South Maleas basin). Provenance is inferred to be from the terrains of the phillite series outcropping in Northwestern Crete.

(3) Volcanic assemblage (*Hyperstene - Augite*) affecting the northern and central part of the basin (Milos, Iraklion, Kamilonisi and Karpathos basins). Provenance is from the volcanic arc of the Cyclades.

(4) Low grade metamorphic assemblage (*Epidote - Garnet -Amphiboles*) characterizing the sediments from Crete and from its northern slope and deriving from the metasedimentary terrains of Crete.

(5) Meta-basic assemblage (*Tremolite -Actinolite - Epidote - Spinel*) affecting the sediments from Rhodes, its slope and from the branch of the basin close to the Karpathos-Rhodes part of the outer ridge (Karpathos basin).

In conclusion, the two opposite margins of the Sea of Crete furnish to the basin quite distinct mineral assemblages. The different mineral associations descibed above are confined in individual sub-basins separated from each other by structural higs and plateaux (Bartole et al., 1983). Only in the eastern part of the basin volcanic-derived and metamorphic-derived sediments alternate vertically, depending on the prevalence of volcanic over tectonic processes.

An important issue which rises from these data is that, during Quatenary, compositionally differing sedimentary sequences developed within the same plate tectonic setting. Moreover, Recicled-Orogen-derived sands with stable mineral associations abundantly occur in a volcanic plate tectonic setting. Thus, this study is a great help in understanding sedimentation processes in modern and ancient sedimentary basins, especially along active continental margins.

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The prePliocene carbonate deposits at Leg 107 ODP - site 652 (Central Tyrrhenian Sea) : sedimentary and deagenetic frameworks

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The prePliocene sediments recovered at ODP site 652 (central Tyrrhenian) consist of a barren 533 m-thick calcareous -dolomitic mudstones and siltstones sequence intercalated with thin layers of nodular gypsum/anhydrite ,that have been interpreted to be lacustrine deposits of Messinian age Upwards , the series passes into a 40 cm-thick transitional interval of varicolored clays and marls and then into Pliocene hemipelagic oozes . Petrography , bulk mineralogy and oxygen and carbon isotopes of the carbonate phases are used to characterize the sedimentary and diagenetic conditions in relation to the geodynamic context .

The prePliocene sequence may be subdivided in two zones based on the mineralogy and stable isotope composition of the carbonate phases :

In the upper zone (192 m -410 m), calcite is dominant and commonly associated with an assemblage of near-stoichiometric and Fe-rich dolomites . The ∂ values of calcite are rather constant (-4.5 ±0.5 for ^{18}O and -1.0±0.5 for ^{13}C) indicating deposition from a large and well-mixed reservoir of continental waters . The associated near-stroichiometric dolomite is enriched both in ^{18}O and ^{13}C with respect to calcite as expected for cogenetic minerals ; this dolomite formed from the same water as the calcite is thus considered as early diagenetic .

In the lower zone (410 m to the bottom), dolomite becomes dominant relative to calcite and is the only carbonate phase in several intervals . The composition of these dolomites ranges from near stoichiometry to Fe-rich. Calcite present in the lower zone registers a maximum 2°/₀₀ decrease of $\partial^{18}O$ values while $\partial^{13}C$ values are unchanged ; the $\partial^{18}O$ variation is interpreted as the effect of burial diagenesis at a normal geothermal gradient of 3°C/100 m; therefore , the present-day thermal flow was induced after deposition of the late Messinian sequence .The Fe-rich dolomite exhibits low $\partial^{18}O$ values (-6.94 to -2.17) and negative $\partial^{13}C$ values (-2.64 to -0.58) which indicate respectively hotter and more restricted conditions during a late diagenetic event . The $\partial^{18}O$ values show a rather regular upwards decreasing trend by 4.8°/₀₀ at maximum ; this has to be the result of alteration from a geothermal gradient of 9°C/100 m (or more in the case of modified ^{18}O-rich pore waters) , which is obviously post Messinian and related to the thermal subsidence of the basin . Furthermore , the $\partial^{18}O$ evolution with depth of the Fe-rich dolomites indicates that the flow of dolomitization fluids became hotter when ascending progressively through the sediments .

G-I9

Characteristics of Adriatic Platform and its Northeastern part

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Disintegration of the carbonate platform in area of present Dinarides commenced in Paleogene–Middle Eocene. Flysch deposits sedimented in wider parts of its area. They indicated to more intensive uplifting of the relief. These tectonic movements presented the commence of the neotectonic period. The genesis of Dinaric Structures was pursued through a few phases during Upper Paleogene, Neogene and Quaternary. Simultaneously Adriatic basin was formed. Neotectonic movements were scrutinized by determination of lithofacial relationships, sedimentary conditions and paleostructural reconstruction. Constitutive result of that research is following, the present Adriatic platform is only one part of earlier carbonate platform. Uplifting of Dinarides was consequence of their displacement and underthrusting below Dinarides. Concomitant tectonic movements were not uniformed and as consequence of that, the disintegration of its parts was continued through further period.

During last years the new data about tectonic movements were achieved by studying of geological structure by deep seismic sounding, geophysical prospecting and earthquake events. Key deep interfaces are following: basement of carbonate complex, levels of earthquake foci and Moho discontinuity.

Results of researching indicate 3 relatively separated parts of Adriatic platform: northern, middle and southern. They have different intensity of displacement, rotation and underthrusting below Dinarides. On the basis of disposable data the mechanism of tectonic movements was supposed. Deep geological structure compared with adequate data on the surface. The most active tectonic zones – belts were separated and classificated.

G-I10

Proposal of three deep drilling points in the oceanic crust of Tyrrhenian Sea

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Magmatic manifestations are a very important tracer for the understanding of the opening processes in marginal basins. The present proposals of deep drilling sites regard the areas floored by oceanic crust of Tyrrhenian sea, even though these areas are not the sole to exhibit interesting features for the investigation.

Present knowledge of direct type on nature and evolution of Tyrrhenian oceanic crust is based on recovery and analyses of samples of products of different age. The deep igneous portions of the oceanic basement might represent the initial manifestations of spreading in the Tyrrhenian bathyal plains, while the large number of volcanic reliefs and seamounts there, might represent the intermediate and/or the final manifestattions of oceanic accretion.

This oceanic crust has been drilled in three deep drilling sites located in the deep basin of Vavilov and in one located in the basin bordering the large volcanic seamount of Marsili. The drillings have shown that the initial phases of the spreading processes rejuvenated moving from west to east, i.e. the Marsili basin is atleast 2 Ma younger than the Vavilov basin.

The deepest, true part of the oceanic igneous basement has been drilled in one point of the Vavilov basin (373A) and in one of the Marsili basin (650). Two different groups of age values of the basalts from site 373A have been discussed: 7.3 (late Miocene) and 4.1 Ma (early Pliocene). It seems reasonable that only one of the two ages is the true age. Maybe the older one. The reasons of the discrepancy are to be searched in the presence of alteration in analyzed basalts, complicating the radiometric determinations, and in the poor recovery of the sediments overlying the drilled lava pile which renders the biostratigraphic dating difficult. In this case, particular care should be taken, as it has been in former investigations, in the determination of the microfaunal assemblages present in carbonate veins crossing the basalt rocks.

In the Vavilov basin, a drilling point is suggested in correspondance with the position of a positive magnetic "high" (AGIP map of the anomalies of residual magnetic field) to the SW of Vavilov volcano (with maximum intensity up to 45 nTl) and E-W elongated.

The area of this magnetic anomaly is partially covered by Messinian evaporitic deposits which are thinning to the NE. The point should be sited at a selected pinch out of the Messinian layers, so that there could be the advantage of obtaining, alone from the rock types drilled, an indication of the minimum age of the oceanic crust.

It has to be expected that MORB type tholeiites of late Miocene age are dated with large uncertainties, because of low K and young age, and it has to be reminded that probably, only the K/Ar methods can be used.

An other drilling point in the Vavilov basin is suggested in the area of the N-S trending positive magnetic anomaly (with intensity up to 65 nTl) paralleling the Vavilov volcano to the west. This site has the advantage of investigating wether this anomaly and 373A anomaly, roughly paralleling the volcano, are coeval or not.

In the Marsili basin a drill point is suggested on the centre of a positive magnetic anomaly (with intensity up to 60 nTl) sited to the ESE of Marsili volcano. The aim is to check wether it belongs to the Olduvai paleomagnetic event, like the anomaly of site 650, or not. It is important to answer this question because it provides evidence in favor or against the view point of Marsili volcano as axis of spreading.

Aside from the age, the drilled igneous samples would represent very valuable material for petrochemical and geochemical analyses. These data should be evaluated together with those obtained from the products of the seamounts.

These proposals are the result of evaluations carried out with A. A. SCHREIDER of IOAN on R/V Vityaz and in Moscow during a visit of the writer there and an exchange between the Academy of Sciences of USSR and Italian CNR.

G-I11

Plio-Pleistocene Paleoenvironmental changes recorded in the Tyrrhenian basin

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Stable isotope analysis of two species (or groups) of planktonic foraminifers : Globigerinoides ruber (and G. obliquus or G. obliquus extremus) and Globigerina bulloides (and G. falconensis or G. obesa , or G. calabra) from DSDP Hole 653A and Sites 652 , 654 and 650 in the Tyrrhenian basin, records the Plio-Pleistocene glacial history of the Northern Hemisphere . Events of ^{18}O enrichment occurred at 3.1 , 2.4-2.2 ,1.6 and 0.8 Ma. Changes in the $\partial^{18}O$ variability occurred at the same dates , but the most important changes are recorded in the Late Pleisrocene time , near 0.8 and 0.45 Ma .The overall increase in mean $\partial^{18}O$ values is 1.7 ‰ for G. bulloides and 1.5‰ for G. ruber . Half increase results from the inception of dryness on the Mediterranean basin . The interval between 3.1 and 2.2 Ma appears as the more significant for the evolution of the Mediterranean water budget and may have corresponded to the onset of a permanent Mediterranean outflow. From 2.4 Ma onwards, the Mediterranean acted as an amplifier of the global climatic signals . ^{13}C global events are well recorded at 3.2-3.1 Ma, 2.4-2.2 Ma ,1.7-1.5 Ma and in the Late Pleistocene glacial-interglacial. oscillations . In the Late Pliocene-Early Pleistocene (2.2 -1.65 Ma , however , $\partial^{13}C$ values of the ΣCO_2 display a long positive excursion , in opposition with the global trend , which is clearly related to the local hydrology and climate evolution . At l ast, a significant modification either in the water masses structure or in the pattern of exchanges with adjacent basins , occurred in the mid-Pleistocene : in the Early Pleistocene the pycnocline may have been more pronounced than in the Late Pleistocene and the present day in the Tyrrhenian Sea .

G

G-II1

Le détroit de Gibraltar et la mer d'Alboran : évidence micropaléontologique et sédimentaire de la fertilisation d'eaux de surface

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Il y a 17 ans que nous avons relevé une remarquable concentration de Foraminifères planctoniques dans les sédiments hémi-pelagitiques et eupélagitiques de le plateau et de le talus continentales du NW. de la Mer d'Alboran (Mediterranée occidentale) (Mateu 1971), que la parition des recents etudes sur la fertilité de la zone (Minas et al. 1984) nous a permis de mettre en relation avec la couche ascendante d'eau atlantique, riche en elements nutritifs. et le mélange vertical dans le tourbillon anticyclonique de la Mer d'Alboran (Cano lucayo 1968).

Tenent compte des espèces planctoniques dominantes (Orbulina universa, Globorotalia inflata, Globigerina bulloides y Globorotalia truncatulinoides) il es posible d'affirmer ce qui suit:

1. Il s'agit d'un phénomène de production planctonique et d'accumulation sédimentaire qui trouve ses origines dans le temps postérieurs à la derrière glatiation (18.000 a. B.P.) puisque Neogloboquadrina pachyderma a perdu sa representation wurmienne dans cette zone là.

2. Les eaux atlantiques injectées dans le NW. d'Alboran contiennent des foraminifères planctoniques subartiques (G.bulloides) de la zone transitionelle nord-atlantique (G.inflata)et de la province subtropicale atlantique (O.universa, et G.truncatuloides) . Toutes ces espèces, généralement de relative basse salinité, on doit les mettre en rapport avec le "Canary current assemblage" (Mateu 1979) qui longeant le littoral ibérique poursuit sa route vers la marge continentale marocaine, filtrant vers la Méditerranée des formes nord-atlantiques.

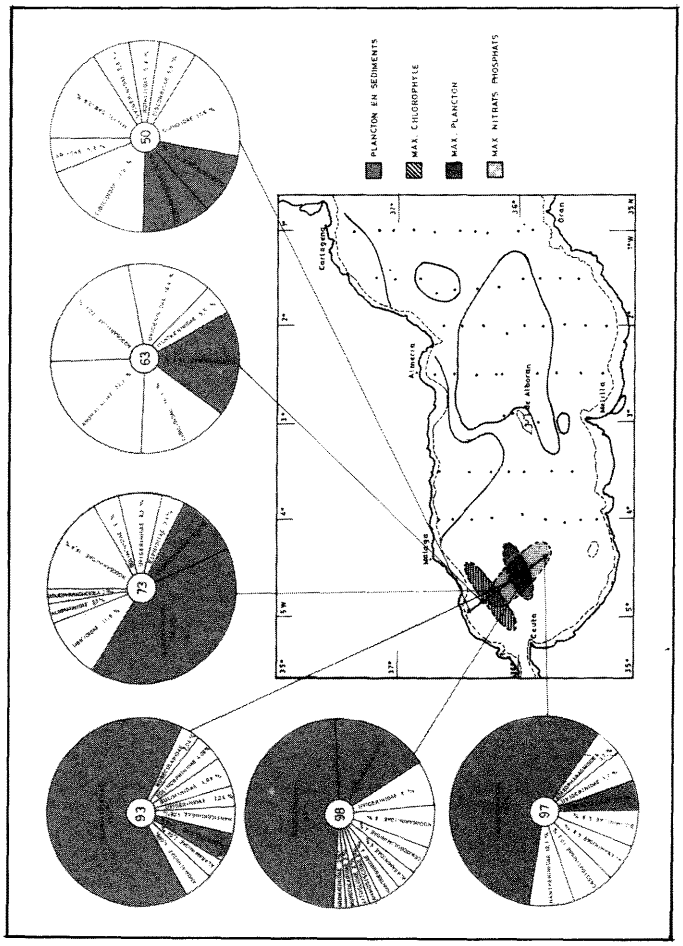

Fig. 1. Detroit de Gibraltar et Mer d'Alboran: Repartition de la Chrophylle et les nitrats et phosphats dan le couche epi-mesopelagique (Minas et al. 1984) comparées avec l'accumulation des foraminifères planctoniques dans les sediments de la zone.

3. Il existe une remarquable coincidence entre les niveaux epi-mesopelagiques contenant un maximun d'éléments nutritifs, et les plus élevés indices plancton/benthos observés dans les sediments de la zone.
Précisément l'abondance et le caractère mésopélagique de G. inflata, avec son gradient de densités, la situent dans le montant d'eau dont le mélange vertical hivernal conditionne la fertilisation ci-dessus mentionée.

G-II2

Crustal thickening and thinning in double-convergence conditions : the tectonic evolution of the Alboran crustal domain

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In the Alboran Basin, Neogene and Quaternary sedimentary sequences of variable thickness overlay a continental basement, 25-12 km thick.

Most of this basement belongs to the Alboran Domain, a preMiocene crustal segment made-up by a polyphase nappe-pile of Alpine age, the nappe-pile consisting of the main internal complexes of the Betic-Rifian orogen.

The Alboran Domain overthrusted westwards on both Southiberian and Maghribian crustal domains in the Miocene, through the Gibraltar crustal Thrust. The estimate relative displacement of the Alboran Domain is consistent with the coeval North Atlantic spreading. A North-South convergence between Iberia and Africa happened at the same time.

During the later stages of this "double convergence" process, extensional displacement ocurred, which strongly thinned the Alboran continental wedge before the Tortonian. Large-scale folds and subsequent transcurrent and extensional post-Tortonian faults determined the physiography of the Alboran Sea and the Bay of Cadiz.

G-II3

Submarine valleys in the continental margin of Murcia (Spain, Western Mediterranean) : an area where Aristeus antennatus is captured

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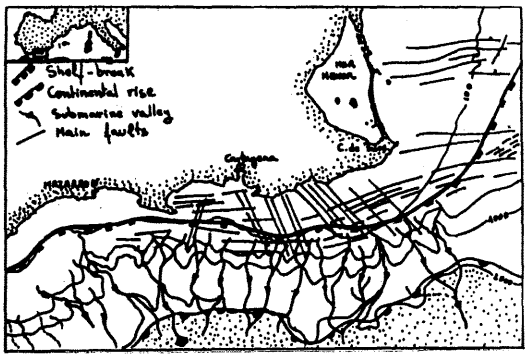
From the analysis of a seismic-reflection profiles and sediment samples, it has been possible to study the distribution of the sedimentary textures, as well as the morphology of the shelf and the continental slope.

The geological structure of the margin have a control role in the sedimentary distribution and its morphology. The shelf-break is close to the shore, and it's very abrupt.



In the continental slope are placed a group of submarine valleys. They have a sedimentary origin, but only some of them are located in the direction of the main faults.

The sediments forming the margin are mainly argillaceous, and have a PlioQuaternary age.

In this area, there is a hight fishering activity in *Aristeus Antennatus*.

Actually, we are studing some especies with a fishering interest. In this paper we present the relation existence between total biomass and the nature and morphology of the sea floor.

G

Mazarron escarpment : an inestable slope composed by Plioquaternaries Sedimentary Units (Murcia, Spain)

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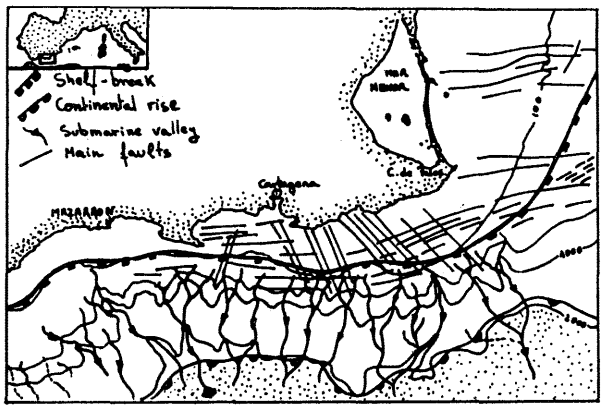
The Mazarron escarpment itself, constitutes the geological border between continental shelf-slope and the abyssal plain in the eastern Alboran basin, being part of the iberian margin in the province of Murcia. From a broader perspective it is considered as the extension to the SW of the Emile Baudot Escarpment.

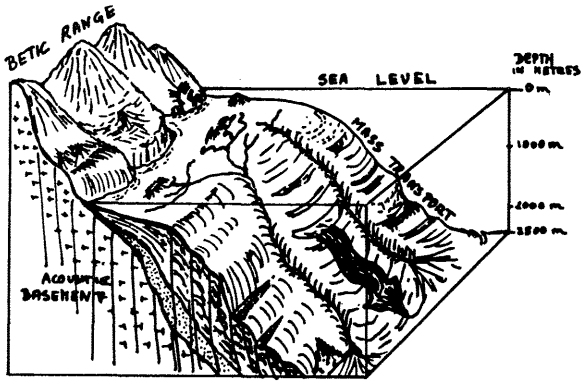
It still corresponds to the limit southward of the threshold linking the Betic Range and the Balearic Promotory.

The surveyed area in the continental margin of Spain, is located arround Mazarron place, in a depth between 0 and 2500 metres.

This margin belong to a passive type and is extremely steep along the Mazarron and Emile Baudot escarpment. The sedimentary cover, mainly Plioquaternary in age, is fully variable in thickness. It's covering a high tectonized substratum (Betic Range) that outcrops close to "Cabo de Palos".



From the sedimentary point of view, can be included in a abrupt-type, characterized by a narrow shelf with some irregularities produced by the proximity of the basement to the bottom, where the sedimentary factor has not exceed the tectonic one. The morphology of the slope is dominated by elongated reliefs (convex downslope) as a "tongue-shaped" sedimentary bodies. Those units are independiced one to the other, and are separated by submarine valleys -eventually deep-, wrich ocasionally are coincident with faults in a NW-SE direction (or close to it).



The sediments forming the margin are mainly argillaceous with calcareous beds, deposited in prograding series, getting thicker with the solpe. Those sediments are extremelly unstables and soft, and its plasticity help the slumping.
On base of seismic-reflection profiles (Sparker 7500 joules and 1000 joules), has been possible to stablish a structural-tectonic outline of the area. The margin is afected by numerous faults in a E-W to NNE-SSW and NW-SE directions.
Succesive evolution stages of the continental margin along the Neogene period, have produced the replayment of the anciant faults, due to alternation in the distensive regime and the compresive one. In consequence, the mass transport is triggered by the neotectonic activity.

According to some tectonic evolution theorys about passive margins, it's easy to explain the present morphology of the margin in the area, where the deposition is produced under a distensive regime followed of a compresive one.

Red Algae sediments in the Balearic Shelf

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The Balearic Shelf is an open marine shelf that ranges in width from 9 km in the north of Menorca to 55 km aroud Cabrera Is. Water temperatures at 5 m depth fluctuate from 12oC in winter to 27oC in summer. The absence of great terrigenous influx and the nutrient depleted waters make this shelf very clear to the light.

Sedimentation is mainly of biogenic origin (93%) and the lithoclasts (7%) are locally concentrated in littoral areas near the mouths of the rushing streams. Biogenic composition is formed by red algae (50%), molluscans (15%), foramminifers (6%) and briozoan (5%) fragments.

Productive communities like Posidonia oceanica and maërl are the main responsible for the biogenic composition. Second order productive communities are platform coralligenous, coralligenous on hard rock, photophilic algae, Vidalia volubilis, Cymodocea nodosa, Caulerpa prolifera. Productive communities and biogenic facies are closely related and so is their spacial distribution.

One of the most characteristic facies of the Balearic Shelf is originated by maërl communities. Principal components of the algal gravel facies are red algae fragments (60%) but bivalves, gasteropods, briozoan, foraminifera and crustacea fragments are also present. Textural parameters qualify this sediments as grainstones although locally rudstones are present.

Algal gravel facies are usually present at depths greather than 40 m and even reach 90 m deep. This range agrees with maërl community depths. Some carbonate productive species from maërl have been recognized in the sediment and some others have not.

Species that form the basal stage of maërl are among others: Phymatolithon calcareum, Lithothamnion corallioides, Lithothamnion valens, Peyssonnelia ros-marina, Lithothamium crispatum, Lithothamnium fruticulosum, Mesophyllum lichenoides, Lithophyllum expansum.

From those we have recognized in the sediment fragments of: Phymatolithon calcareum, Lithotamnium corallioides, Lithotamnium valens, Peyssonnelia rosa-marina, Lithotamnium fruticulosum, Lithophyllum expansum, Mesophyllum lichenoides.

An explanation for this disagreement can be found in the biological structure of some carbonate crystall arrangements which are not present in the unrecognized species.

Species distribution in sediments seem to be fortuituous though a depth influence is suitable. Algal gravel facies form growth patches over the sea bed where small mounds with bafflestone textures are found. These mounds are built up by the branching growth of red algae.

From the several areas that have been studied in the Balearic Shelf (Pollença Bay, Campos-Cabrera zone, and South Menorca shelf) the first two are dominated by corallinaceous species while the South Menorca Shelf is characterized by a great presence of peyssonneliaceae, especially in the deepest zones.

Apart from this distribution pathern mainly related with depth we have found other red algae sediments related with other processes.

Posidonia oceanica meadows are also rich in algal gravel sediments as well as some places from the infralittoral environment. These localities are placed on irregular coastlines, rather exposed to the wave action and with very shallow water. The red algae that have been found in these areas are characterized by branching rodolites (more than 16 cm in diameter) that are usually atached to a hard substratum or placed in mobil sands that fill morphological traps.

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G-II6

A seismic experiment in the Gulf of Valencia

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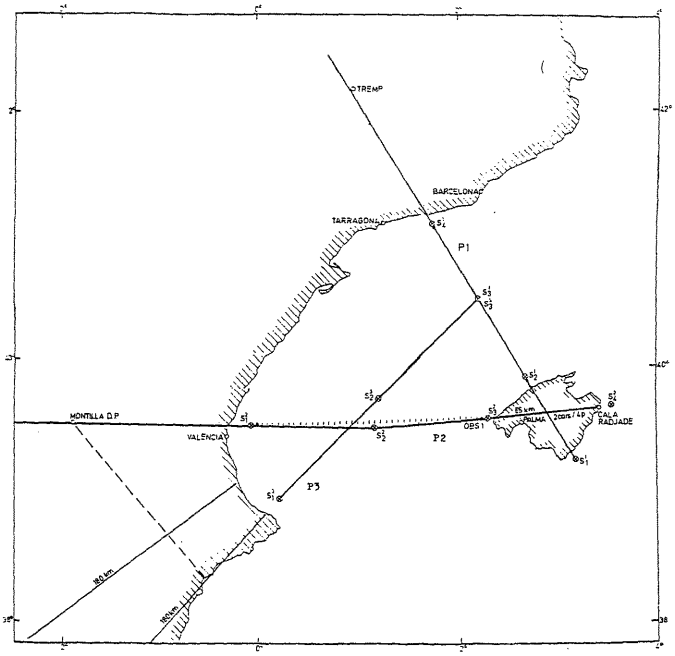
Within the frame of cooperation on marine sciences between the Universities of Hamburg and Barcelona a seismic experiment was performed in August 1988 in the Gulf of Valencia. The seismic energy was generated by small and large shots placed at 1000 m spacing along two lines. The onshore-offshore observations were performed by 110 three component, mobile and automatic operating stations of the LOBS-Type and 30 OBS-stations that were deployed at sea. Both seismic lines exceed 200 km in length and were oriented parallel to the Valencia



Trough, from Mallorca to Valencia and perparticular to it, from Mallorca to Barcelona. The length of the lines and the optimized shots at sea permitted efficient propagation of the seismic energy over large epicentral distances and thus deep penetration in the crust and upper mantle. The aims of this experiment are:

- to obtain the nature and thickness of the crust in the trough,
- to obtain the thickness and seismic structure of the sedimentary sequence in the Trough,
- to study the development of the passive margins and obtain their geometry and relation to the Trough,
- to deliniate deep structures and understand the processes that have caused the rifting of the Valencia Trough and finally,
- to establish the amount of oceanisation of the Trough if stretching was severe enough to disrupt the continental crust.

First results will be presented and discussed.

G-II7

Niveaux marins et climats quaternaires du Banc des Blauquières (sud-est de la France)

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Le Banc des Blauquières constitue le plateau continental du Sud de La Ciotat. Les relevés sismiques (3,5 KHz) mettent en évidence une succession de réflecteurs individualisant trois unités lithologiques échantillonnées par carottages à une profondeur de 130m (fig.1). Les trois carottes forment une série stratigraphique würmienne discontinue ; on observe successivement du bas vers le haut :

- un sable à algues calcaires (*Lithothamnium sp.*)(carotte CD30).
- une surface d'érosion.
- une vase sableuse avec 70% de fraction fine (carotte CD29).
- un réflecteur marquant une discontinuité.
- un sable vaseux avec 20% de fraction fine (carotte CD28).

Ces trois unités sont érodées par la surface du fond actuel. Le Foraminifère *Paromalina coronata*, présent au sommet de la série (CD28), indique l'absence de sédiments Actuel et Post-Glaciaire.

L'analyse factorielle des correspondances réalisée sur l'ensemble des comptages des Foraminifères (fig.2) montre un effet Guttman entre les axes I et II. L'axe I représente la granulométrie de la fraction fine et la température, et l'axe II la granulométrie des bioclastes. Les Foraminifères sont classés en cinq groupes :

- espèces infralittorales INF (de 0 à -50m environ).
- " circalittorales CIR (de -50 à -150m).
- " de vases profondes VB (>-150m).
- " à large répartition bathymétrique LRB.
- " pélagiques PEL.

Le nuage de point s'organise en diagramme triangulaire suivant la granulométrie et les biocénoses avec : un pôle infralittoral sableux (CD30), un pôle circalittoral sableux (détritique côtier) (CD28) et un pôle circalittoral vaseux (détritique du large) (CD29).

Pour diminuer l'influence de la granulométrie, une analyse factorielle des correspondances est réalisée sur ces cinq groupes (fig.3). L'axe I (80% d'inertie) correspond à la bathymétrie, les scores (abscisses) sur cet axe sont considérés comme représentatifs de la paléobathymétrie, ils sont ramenés à une échelle de profondeur basée sur l'étagement des biocénoses. A titre d'hypothèse de travail on peut proposer la répartition suivante :

- CD30 à limite supérieure du circalittoral soit vers -50m.
- CD29 dans le circalittoral inférieur (détritique du large), soit vers -130m (profondeur de prélèvement de la carotte).
- CD28 dans le circalittoral supérieur (détritique côtier) vers -80m.

Ces données permettent de déterminer les niveaux marins pour chaque carotte en fonction de la profondeur de prélèvement.

Les Foraminifères pélagiques permettent d'estimer les variations climatiques soit : un climat "tempéré froid" pour la carotte CD30 et un climat "froid" pour les carottes CD28 et CD29 (fig.4).

Pour comparer les courbes du niveau de la mer et du climat, les unités sont homogénéisées : l'Actuel est pris comme origine et le maximum de régression du Würm à 18000 ABP , d'environ -100m, correspond au climat le plus froid auquel on attribue également la valeur 100 (fig.4).

La théorie glacio-eustatique de Daly suppose une parfaite corrélation entre climats et niveaux marins, c'est-à-dire qu'un niveau régressif correspond à un climat froid. Les résultats des carottes sont en contradiction avec cette théorie ; en effet, le niveau régressif (CD30) correspond à un climat chaud et inversement (CD29 et CD28). L'important décalage entre les deux courbes peut avoir plusieurs origines :

- si cet écart correspond à une réalité, les carottes CD29 et CD28 montrent une tendance transgressive liée à un climat froid, cela indiquerait une persistance des faunes pélagiques due à l'inertie thermique des masses d'eaux. En suivant ce raisonnement la carotte CD30 serait en période régressive.
- si ce décalage est dû à la méthodologie employée, il pose le problème de la représentativité des espèces vis-à-vis des paléoenvironnements (TAVIANI, 1987). D'une part, les biocénoses ont une large répartition spatiale alors que l'échantillon d'une carotte est très ponctuel, par exemple *Hoeglundina elegans* est l'espèce rencontrée la plus profonde or, elle se trouve dans le niveau le plus haut (CD29 274) de la carotte CD29. Les limites des biocénoses sont extrapolées dans les paléoenvironnements sans tenir compte de leurs variations qui sont fonction des conditions du milieu et non de la bathymétrie. D'autre part, la méthode de détermination des climats par les Foraminifères pélagiques est employée avec succès dans les sédiments profonds intégrant toute la colonne d'eau, alors qu'en milieu littoral on ne trouve que les espèces épipélagiques qui sont les plus "chaudes". Par ailleurs, l'absence de sédiments Actuel ou Post-Glaciaire n'a pas permis de recaler les deux courbes de manière précise le long de cette série discontinue.

Ces deux méthodes donnent des résultats intéressants mais doivent être utilisées avec prudence pour déterminer les paléoenvironnements quaternaires en l'absence de datation absolue.

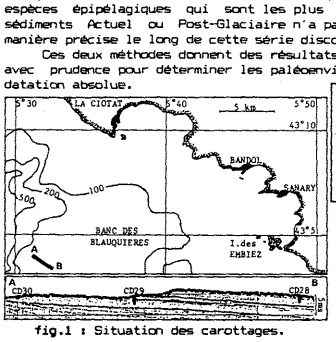

fig.1 : Situation des carottages.

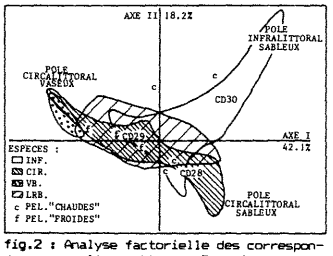

fig.2 : Analyse factorielle des correspondances sur l'ensemble des Foraminifères.

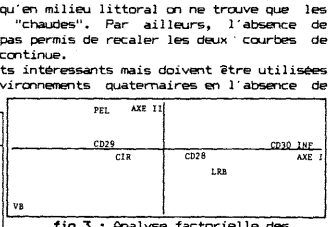

fig.3 : Analyse factorielle des correspondances sur les cinq groupes de Foraminifères.

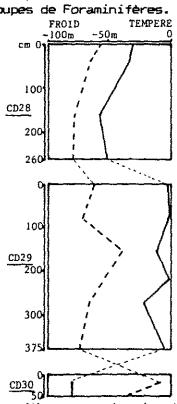

fig.4 : Niveaux marins (——) et climats (- - -) estimés dans les carottes.

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G-III1

Etude préliminaire de réalisation d'un système-expert en sédimentologie marine : un modèle de prototype sur la mer Méditerranée

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SUMMARY : Sedimentological, mineralogical, geotechnical, geochemical ...etc. analysis have been considered to obtain the facies, the physiography, the climatology and the condition of deposition of the deep sea sediments. These facies and physiographies represent the knowledge base of this system which can be modified or developed with the applications.

LE MODELE PROPOSE : Ce modèle est constitué de faciès sédimentologiques et de séquences physiographiques, formant la base de connaissances. Les analyses physico-chimiques(données) formant,elles, la base de faits.

LA BASE DE CONNAISSANCES: Dans une première étape,le système nous confirme l'identification du faciès; celui-ci est pélagique,hémipélagique, contouritique ou turbiditique(Bouma, 1962; Mutti et Ricci Lucchi,1972; Maldonado et Stanley,1978; Nelson et al.,1978; Piper,1978; Mear,1984) et même le faciès côtier de haute énergie (houles et tempêtes). Puis le système devra être capable de descendre dans l'arbre de décision des faciès en précisant le type de sédimentation (i. e. : pour un faciès la sédimentation peut être turbiditique silteuse, vaseuse ou biogène : Stow et al., 1984a). De plus la séquence peut être tronquée en haut ou en bas(Stow et al.,1984b) ou bien les deux à la fois. Dans une deuxième étape,le système interprète la physiographie, c'est-à- dire la nature du fond marin pour déterminer si l'on se trouve en Méditérranée Orientale(Maldonado et Stanley, 1978) avec ses séquences sédimentaires, sur un plateau continental, sur une pente continentale, dans un bassin profond où les sédiments ne présentent plus de structures sédimentaires("unifites": Stanley,1981)comme c'est le cas de la partie ouest de la mer d'Alboran, du bassin de Gozo dans la fosse de Corse en Méditérranée occidentale et des fosses Hélléniques en Méditérranée orientale, ou bien si l'on se trouve près d'un régime deltaïque(chenal ou levée d'éventail supérieur, lobe du suprafan d'éventail moyen, bordure d'éventail ou plaine abyssale). On considère les modèles proposés par Mutti et Rucci Lucchi,1972,1975; Normark,1978; Walker,1978.

LA BASE DE FAITS: Cette base est formée de l'ensemble des données qu'on peut obtenir sur un sédiment(en sédimentologie,minéralogie,géochimie,géotechnique,géochimie isotopique et paléontologie). Elle doit intégrer les caractères qualitatifs produits par l'observation visuelle : couleur et présence des structures sédimentaires. La première question posée par le système est la couleur à choisir parmi une palette prédéfinie(beige, gris, gris-vert, oxydé, gris à tâches noires, noir... ect). La deuxième question concerne la structure sédimentaire ou figures de sédimentation pouvant être identifiées (laminations entrecroisées ou horizontales, stratifications entrecroisées ou horizontales, débris flow... etc). Puis le système continuera de poser ses questions de la même manière, le plus précisément possible, en proposant toutes les possibilités de réponses; il suffit de choisir le cas le plus proche de l'observation à traiter; dans le cas des données manquantes, on passe à la question suivante en ignorant la question. Le système traite les données au fur et à mesure qu'on les rentre et les garde dans une mémoire qu'on appelle "la mémoire de travail"; à la fin de la rentrée des données, on passe à la phase d'exécution où le moteur d'inférence commande la mise en oeuvre des actions définies par les règles.
Pour quelques données(géotechniques, géochimiques et paléontologiques), il serait préférable d'utiliser un moteur d'inférence interactif, c'est-à- dire utilisable sur des interprétations en cours d'analyse; le système doit alors être capable de poser des questions complémentaires s'il manque des données ou de demander des précisions à partir desquelles il suggérera des interprétations qui n'existent pas dans ses buts. Ces interprétations"complémentaires" peuvent être très utiles pour mieux comprendre le milieu analysé.
Quelques données brutes doivent être traitées avant d'entrer dans le système. Il faut donc traiter ces données avant de les intégrer à la base des faits en appelant des programmes spécifiques. Par exemple on appellera un programme qui calcule l'indice d'évolution "n" à partir de la courbe granulométrique cumulative; les valeurs de "n" sont les seules "comprises" par le système, c'est-à- dire prises en compte dans l'activation des règles qui ont l'indice d'évolution dans leurs antécédents. Comme autre exemple, on appellera un programme qui calcule l'écart type des teneurs chimiques à partir desquelles le système confirme l'état de sédimentation(homogène ou hétérogène).

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G-III2

Sédimentation pollinique dans des dépôts récents devant l'embouchure du Grand Rhône

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La distribution du matériel déposé dans la zone d'épanchement du Grand Rhône a été étudiée dans le cadre du programme ECOMED (Bizon et Burollet, 1984). Il est apparu que certains traceurs sédimentaires tels les métaux se présentent dans les sédiments superficiels selon des répartitions cartographiques différentes. On note par exemple que les endroits où les concentrations en nickel ou en Cr sont relativement élevées ne sont pas les mêmes que ceux où les concentrations en Pb ou en Zn sont élevées. Dans le but de préciser les causes de cette diversité, d'autres paramètres ont été considérés, en particulier la fréquence relative de divers pollens. En effet, l'analyse pollinique des sédiments récents prélevés devant l'embouchure du Rhône jusqu'à 20km de la côte (isobathe - 100m) fournit des précisions sur l'influence des apports fluviatiles et des courants marins dans le transport et la sédimentation (Triat-Laval, 1984).
Deux exemples, choisis dans les diagrammes polliniques réalisés, illustrent le transport pollinique de Picea et de Phillyrea (fig.1 et 2).

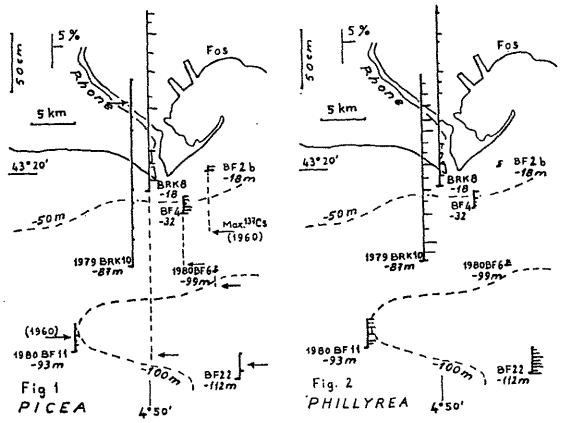

Fig.1 et 2. Distributions verticales de Picea et de Phillyrea, exprimées en pourcentage par rapport au total des pollens comptés.
Le niveau où le radio-élément 137 Cs est le plus abondant est indiqué. Les sédiments qui ont été contaminés par les apports relativement importants des années 1961-63 sont, du fait de la bioturbation, ceux des années 1959 ou 1960-61, approximativement (v. Badie et al., 1983, 1985).
Le trait plein vertical représente la portion (supérieure) des carottes qui a fait l'objet de l'étude palynologique. En tireté, complément vers le bas où le 137 Cs a encore été dosé (à l'aide d'un spectromètre Ge/Li du CEA-Toulon).

Le premier taxon, Picea, est abondant dans les forêts de la moyenne et haute vallée du Rhône et absent ou rare à basse altitude, tandis que Phillyrea, arbuste méditerranéen, prospère dans les forêts de chêne vert et les garrigues des basses collines provençales, les coustières de Crau et en Camargue jusqu'au voisinage du littoral.
PICEA. Dans les peuplements denses du Vercors, le pollen est faiblement représenté (Triat-Laval, 1971). En milieu marin, ce pollen bi-ailé est présent dans les diagrammes polliniques avec des fréquences qui atteignent 5% au débouché du Rhône et se réduisent ensuite notablement (fig.1). Ce modèle de distribution met en évidence le rôle des apports fluviatiles et montre que les grains de pollen ont le comportement général des particules détritiques qui subissent un long transport fluviatile mais sédimentent rapidement près de l'embouchure du Rhône.
PHILLYREA. Dans les peuplements provençaux, ce pollen sphéroïdal est faiblement représenté. En milieu marin, le pollen est présent dans tous les diagrammes polliniques avec des fréquences faibles à l'embouchure mais pouvant atteindre 5% à 30km au sud du delta (fig.2).

Ces deux exemples illustrent, d'une part l'importance du transport fluviatile à longue distance, d'autre part l'incidence sur la distribution du matériel pollinique des courants marins tels qu'ils ont été précédemment reconnus dans cette zone par Pauc (1971), Aloisi et al. (1982), Added et al. (1984). Il se confirme que des très faibles variations de densité ou de forme des matériels en suspension déversés par le Rhône déterminent des différences dans la répartition cartographique de ces matériels (pollens, argiles, micas,...).

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G-III3

Black-shale facies as indicator of global tectonics

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In the northern Apennines along the *Maiolica Formation - Fucoidi Marls* boundary (Aptian) a significant change in the sedimentary and tectonic regimes occurs. This change is accompanied by marked signs of slope activation (slumps and debrites).

From an older predominant limestone sequence one passes to an overlying set of marly-calcareous formations with some vivid colours (*Fucoidi Marls* and *Scaglia*). The change consists in the fact that from "pelagic" cherty limestones one goes towards more terrigenous and rhythmic sedimentation, triggered by the very beginning of tectonic movement, which is inferred to be a combination of basin subsidence and lateral compressional forces.

Near the base of this younger marly-calcareous sequence, here considered early syndiastrophic, episodic bituminous shales occur, viz. in the upper part of the *Maiolica*, at the base of the *Fucoidi Marls* (the 2 m-thick "*Selli Level*" of Early Aptian) and in the Albian portion of the *Fucoidi Marls*. Their appearance indicates the start of a filling epoch preceding the orogenic compression paroxysm. In other words, they mark the onset of a regional (geosynclinal) subsidence under marine conditions, replacing the older rift phase, characterized by megabrecciation, rift subsidence and graben-like and half-graben depressions.

The beginning, around the Aptian, of the Apennine basinal downwarping is synchronous with important modifications on a global scale. In particular, it corresponds to a widespread phase of rapid regional subsidence and transgression of the majority of passive continental margins and to the collapse of the "back-arc" region in the Alps (the so-called "Eo-Alpine lithospheric subduction" with the very-high-pressure metamorphism). Evidence is also accumulating to indicate a concomitant marked Aptian-Albian phase of rapid subsidence on different separated cratonic basins.

It is believed that these roughly synchronous subsidence histories are worldwide symptoms of a fundamental change in the regional stress field. This global acceleration of basin subsidence is postulated as occurring in response to the inception of compressional stresses of the lithosphere, due to a pulse of polar flattening. Thus, north-south lithospheric contraction and shortening produced the "swell-and-swale" geometry of alternating geanticlinal ridges and geosynclinal troughs. The latter, in the initial phase, are characterized by black-shale deposition.

G-III4

Les sédiments bio-accumulés des mattes de l'herbier à Posidonies. Essai de modélisation

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De nombreuses séquences de dépôt sont liées à un processus markovien c'est à dire à un ensemble naturel comportant des éléments aléatoires et des effets prévisibles déterministes. Par ailleurs, s'applicant à des séries cycliques ou non, l'analyse de Markov peut être utilisée comme un instrument prévisionnel.

La présente application concerne l'évolution des mattes de l'herbier à Posidonies (étage infralittoral de la Méditerranée), montrant des phénomènes oscillants d'accrétion et d'érosion. Le matériel piégé par les rhizomes de Posidonies est un sable bio-clastique comportant une fraction terrigène (25 à 50%). La teneur en carbonates peut dépasser 60% tandis que la partie interne de la matte demeure réduite (COT de 3 à 10%). Ce sédiment bio-accumulé à une vitesse rapide demeure hétérométrique et perméable, riche en eau, CO_2, SH_2 et CH_4. La matte fonctionne comme un "accumulateur" dont le "volant" sédimentaire assure l'intégrité du profil littoral.

La procédure employée comprend les étapes suivantes:

1 : définition des états absorbants limitant le système.

2 : définition des états intermédiaires assurant le fonctionnement du système.

3 : les données d'observation sur les mattes actuelles constituent les "compteurs" du modèle. Elles permettent d'établir la matrice des transitions (passages) des états exprimés en probabilités. Cette dernière constitue la base de départ ou période 1.

4 : ***l'analyse de Markov permet de définir au cours du temps (séquence des périodes successives) l'évolution probable du système, c'est à dire du sédiment bio-accumulé dans les mattes. Au bout de n périodes, on peut aboutir à deux types de possibilités:***

I : état d'équilibre et obtention d'une matrice exposant les occurrences probables des composants du système,

II : équilibre non atteint et obtention d'un régime stationnaire devenant constant en fonction du temps écoulé.

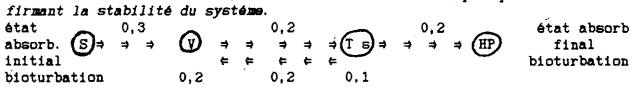
La séquence des essais a porté sur les situations suivantes :

1 : SEDIMENTATION REGULIERE DE LA MATTE ABOUTISSANT A UN HERBIER EN EQUILIBRE :

* les états absorbants définis sont S=surface du sédiment libre initial (soumise à la bioturbation): état de départ, -et HP=matte d'un herbier stable ou état final.

* les états intermédiaires sont V=vitesse de croissance des rhizomes de Posidonies: 5 à 52 mm/A (Boudouresque et Jeudy de Grissac, 1983) et Ts=taux de sédimentation: 0,2 à 10 mm/A.

Le modèle atteint rapidement un état d'équilibre à la période 12 avec les probabilités de 0,610 pour S et de 0,389 pour HP. Dès la période 3, les états V et Ts, interdépendants (lépidochronologie, modalités d'enfouissement et de croissance verticale), - montrent des transitions presque nulles confirmant la stabilité du système.

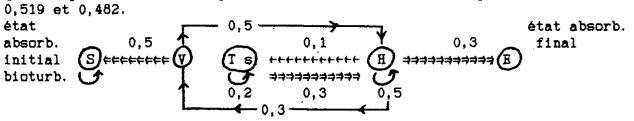


Les découvertes archéologiques, relevés cartographiques et l'analyse du remplissage des épaves confirment les hypothèses à T=10 A ou 25 A. Ainsi, lorsque les conditions sont favorables, les bio-accumulations évoluent rapidement.

2 : MILIEUX EXPOSES; MATTES EN COURS D'EROSION SOUS-MARINE :

Les nouveaux états absorbants sont S (e.initial) et E=érosion totale des herbiers à Posidonies (e.final), - ce qui correspond à un changement de type de fond ou à un nouveau cycle.

Les états intermédiaires actifs sont V, Ts plus H: flux verticaux et horizontaux (U max=courant orbitaire maximal au niveau du fond, U*=vitesse critique tangentielle amenant le déplacement des particules). Ces valeurs sont liées aux paramétres de la houle incidente par une régression multiple dépendant elle-même des impacts météorologiques et microclimatiques. Les contraintes du système augmentent au fur et à mesure que s'accroît le nombre des états intermédiaires. De ce fait, l'état d'équilibre n'est atteint qu'à la période 24 où les probabilités de S et E sont respectivement de 0,519 et 0,482.

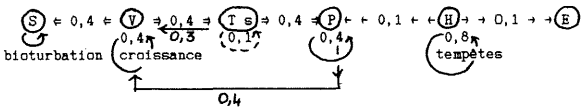


Le modèle aboutit à un état stable implicant la destruction du sédiment bio-accumulé tandis que se développent de petits cycles liés aux modalités hydrauliques et lépidochronologiques. Aux îles d'Hyères et au Brusc, les observations pratiquées depuis trois décennies (épaves, fouilles-témoins et repéres) confirment une hypothèse à T = 10 A.

3 : Des systémes complexes se développent lorsqu'interviennent des conditions d'abri exceptionnelles accompagnées de phénoménes de pollution.

Les états absorbants S et E sont conservés. Les états intermédiaires habituels sont augmentés de P=degré de pollution (échelle à 5 "pas") agissant sur la vitesse de croissance des rhizomes, lui-même "piloté" par les facteurs hydrauliques (flux turbides). L'augmentation des contraintes aboutit à un régime stationnaire sans obtention d'équilibre jusqu'à la période 25. La probabilité de S atteint 0,877 alors que la matte peut être détruite rapidement sans une forte érosion. Dès la période 18, les probabilités de transitions s'avérent pratiquement nulles pour les autres états.

On notera enfin l'existence de petits cycles liés à la croissance des rhizomes, aux impacts de la pollution ou à des tempêtes à fortes probabilités lorsqu'on considére une plus longue série chronologique.



Contribution à l'étude tectonique de la mer Ligure

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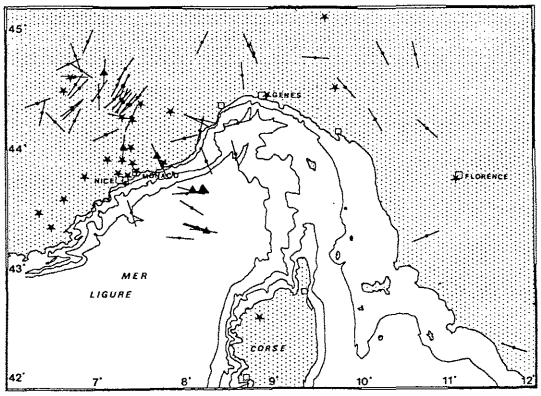
La multiplication des stations sismologiques et la généralisation des enregistrements magnétiques permettent d'obtenir des résultats beaucoup plus précis sur la sismicité d'une région et par conséquent des renseignements complémentaires sur la tectonique.

Des sismogrammes synthétiques correspondant à des évènements de la mer Ligure et du sud des Alpes Occidentales ont été calculés par la méthode des nombres d'ondes discrets. Nous montrons qu'à partir d'une assez bonne connaissance de la structure de croute régionale, il est possible d'obtenir une meilleure précision de la profondeur du séïsme que par les méthodes de localisations. Ainsi,au centre du bassin,les foyers des évènements étudiés seraient soit dans le manteau soit à la base de la croute alors qu'au pied du talus, ils seraient en haut de la croute et nettement superficiels à la côte.



Axes de contrainte répertoriés en mer Ligure et dans les régions avoisinantes.

Axes de Pression.
Sations sismologiques.
Séismes modélisés.

Nos nouveaux calculs de mécanismes au foyer complétant ceux décrits dans la littérature montrent une réorientation des contraintes entre le domaine océanique et la marge continentale. Un net régime de compression est observé dans le domaine le plus profond du bassin,où les axes de Pression sont orientés N 80-100;les décrochements respectivement dextres et sénestres observés sur la marge et sur la côte présentent des axes de Pression N 160-180;ils sont interprétés comme l'expression d'un régime compressif global issu d'un racourcissement local N-S.

Si nous cherchons à inclure ces différents états de contrainte régionaux dans un ensemble plus vaste, nous constatons que la poussée qui s'exerce au niveau des Alpes occidentales peut se décomposer en mouvements secondaires propres à chaque région. Le blocage de la plaque Apulo-Adriatique vers l'ouest contre les massifs cristallins externes suggère la création d'un système de rotation complexe issu de cette poussée.

Le régime compressif mis en évidence en mer ligure, ainsi que la concentration de la sismicité seraient dûs à la situation particulière de cette région, bloquée entre la zone d'influence du poinçonnement alpin et le système de chevauchement crustal stable existant dans la région orientale du golfe de Gênes-île d'Elbe (suture Apenninique) .

Structural pattern of the Tuscan-Latial continental shelf (Tyrrhenian Sea)

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The shallow crustal structure and stratigraphy of the southern Tuscany - northern Latium shelf, comprised between Elba island and Anzio, have been outlined on the basis of an old regional multifold seismic reflection survey. The calibration of the Matilde-1 offshore drilling (Agip, 1977) and the correlation with onshore wells and outcroppings (C.N.R., 1982), supported by data from the literature, made it possible the distinction of three main seismo-stratigraphic units along with their principal features.

The upper unit characterized by continuous, generally undisturbed reflectors, is constituted by the post-orogenic sedimentary cover of upper Neogene-Quaternary age. This unit unconformably rests on an intermediate, or when absent, a basal unit, both constituted by the tectonized geologic units of the Northern andCentral Apennines. The intermediate unit corresponds to the Ligurids and Sicilids allochthonous complexes, while the basal unit may be attributed to the following geologic units: the Tuscan Nappe and/or the Tuscan Autochthon in the shelf sector north of the Tiber river mouth; the Umbro-Sabine units south of the same mouth.

The tectonized substratum of the post-orogenic cover is characterized by numerous elongated, chiefly NW-SE trending depocenters, filled by sediments up to 1700 ms of double time. These narrow basins alternate with areas of structural highs, which in most cases have been interpreted as compressive features. NW-SE trends predominate, but E-W and N-S grains are also present, the former beneath the Latial shelf, the latter beneath the Tuscan one.

Many strike-slip faults, mostly of NE-SW (antiapenninic) trend, seem to cut the tectonized units, related to the differential tangential movements occurred during the compressive phases. Some of them are the prosecutions of onshore transcurrent lineaments described in the literature, such as the Grosseto-Val Marecchia line (auct.), or likely constitute their minor branches. Others are new lineaments separating zones of different structural characters. Among these, two seem connected to sharp variations of the magnetic basement depth (Cassano et al., 1986), so they could represent the shallow expression of deep-seated features. The faults with transcurrent characters are particularly frequent in the Tuscan portion of the shelf where they complicate the structural pattern and give rise to correlation problems.

At least two main diastrophic phases are recognizable from the seismic sections: a former phase, attributable to the early Miocene, is responsible for the last gravitational transport of the allochthonous complexes; a second phase, of compressional type and attributable to the middle-upper Miocene, strongly affected both the allochthonous sheets and their substratum, causing the upbuilding of many prominent features. A semiautochthonous sequence of local extension, comprised between the tectonized units and the post-orogenic cover, account for minor late orogenic compressive pulsations.

The post-orogenic sedimentation filled up depressions mainly inherited from the previous diastrophic phases, so that little to no movement affects the neoautochthonous sediments. An exception is given by a N-S trending deep basin placed in the Elba - Argentario sector, whose origin is mostly due to an E-W stretching of the crust which probably took place in the Messinian.

Two cycles compose the post-orogenic sequence: the lower one, made up of parallel reflectors, is referable to the transgression that affected the western Tuscany and Latium during the lower Pliocene (Ambrosetti et al.,1978); the upper cycle, somewhere characterized by a remarkable progradational configuration, is linked to the middle Pliocene emersion of the same areas, which led to the construction of the present continental shelf.

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G-III7

Anomalous Pleistocene oceanographic conditions on the Eastern Tyrrhenian Margin reflected by faunistic and isotopic records

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Quantitative and qualitative studies of the benthic and planctic Foraminifera, of the Pteropoda, of the fluctuations in the Oxygen and Carbon isotope composition in two taxa (Globigerina bulloides and Uvigerina spp.) and ^{14}C dating, carried out in a 390 cm long core from the eastern Tyrrenian continental slope, at 660 m of depth, allow to define the sedimentary sequence of the last 26000 years and to postulate a past complex hydrographic regime in the area.

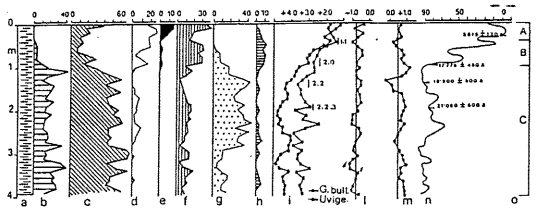
A drastic change in the assemblages of planctic Foraminifera is shown in the core at 100 cm from the top.In the lower part boreal faunas, such as N.pachyderma, G.bulloides, G.quinqueloba and G.scitula, are nearly the only species present and only between 140 and 260 cm G.ex gr. ruber, together with G. dutertrei, occurs.

In the upper part the above mentioned species decline and are replaced by varying percentages of tropical and sub-tropical forms such as G.ruber, G.trilobus, G.sacculifer, G.gomitulus, G.inflata, G.truncatulinoides, O.universa, Globigerinella and Hastigerina, G.calida and G.digitata.

Benthic Foraminifera show a clear variation at 290 cm from the top. Below this depth the assemblage is well diversified and Sphaeroidina bulloides and Uvigerina mediterranea are very frequent, whereas between 290 and 130 cm the assemblage is dominated by Bolivina and Brizalina; from 130 cm up to 40 cm the most peculiar character is the high frequence of Gyroidinoides altiformis,and finally the upper part of the core is characterized by the highest percentages of Uvigerina mediterranea.

A,B,C, zones of BUCCHERI & TORELLI 1981 are present in the Pteropoda associations: in particular the C zone has been recognized below 100 cm, the B zone between 100 and 40 cm, and the A zone from 40 cm up the top. The results of radiocarbon dating are as follows:

31 - 33 cm	5815 ± 120	y.B.P.
98 - 100 cm	17775 ± 450	y.B.P.
138 - 140 cm	19900 ± 500	y.B.P.
198 - 200 cm	21060 ± 600	y.B.P.



a, litology; Planctic Foraminifera: b, G. scitula; c, G. quinqueloba; d, G. ex gr. ruber; e, G. truncatulinoides - Benthic Foraminifera: f, U. mediterranea; g. Bolivina and Brizalina; h, Gyroidinoides altiformis - i, $\delta^{18}O$ G. bulloides and Uvigerina spp.; l, $\delta^{13}C$ G. bulloides; m, $\delta^{13}C$ Uvigerina spp.- n, Paleoclimatic curve - o, Pteropods.

Isotopic stages of Emiliani 1955, based on analysis of the oxygen composition in G. bulloides and Uvigerina spp., were also defined in the core. Isotopic stage 1, showing the well known Mediterranean characteristic has been detected from the top down to 100 cm, while below this depth it is problematic to recognize the peaks of isotopic stage 2.

Some negative peaks can in fact be interpreted as representative of stage 4; this should imply the lack of stage 3.

The $\delta^{13}C$ profile of Uvigerina spp. (bottom waters) parallels that of G. bulloides (surface waters) only in the deglaciation; while during last glacial the surface and bottom waters show different oxygenation. Moreover the $\delta^{13}C$ of the deep water has characteristics that resemble those of an open ocean rather than of the Mediterranean.

Because neither lithology nor microfaunistic analysis point out a hiatus and the study of carbonates excludes that the isotopic signal may be modified by terrigenous supplies, the explanation must be found in a particular oceanographic state of the area during the last glacial stage. We can therefore suppose that the weak positive pulse recorded by planctic Foraminifera, by Pteropods and by $\delta^{18}O$ curve coincide with a melting phase of Appenninic glaciers that trought to the sea fresh water enriched in light isotopes.

Because of the low sea level and consequent reduced seaway between Tyrrenian and Ligurian seas, this water remained entrapped in the area for a period long enough to cause the anomalous variation in the isotopic signal and to reduce vertical excanges between bottom and surface waters.

Isotopic $\delta^{13}C$ curve of Uvigerina spp. and the high frequencies of Bolivina and Brizalina record the low oxygen content, while primary productivity variations can be responsabile for the anomalous trend of the $\delta^{13}C$ in the lower part of the core.

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G-III8

Underwater survey of Panarea volcanic complex (Aeolian Islands)

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Panarea has been considered in literature as belonging to a volcanic complex more ancient than the Aeolian islands (South Tyrrenian Sea) because the end of its activity death about 500,000 years.

New geophysical, volcanological, structural and radiometric data provide a morphological-structural reconstruction of the underwater part of Panarea volcanic complex and a model for the evolution of the whole complex.

The island of Panarea represents a small portion of a much larger submarine edifice with the overall shape of truncated cone with an eastern protusion. The base of the cone is about 1,500 m below sealevel, and has a diameter of about 23 km and an area of 460 sq km. Several lobes affect the steep eastern slopes of the cone.

Three stages characterize the evolution of the Panarea volcanic complex:

1) Development of a regular central volcano in the western sector of the complex. The island of Panarea represents the top of this volcano.

2) Eastward shifting of volcanic activity, producing d evelopment of the lobed eastern sector of the complex

3) Extensive caldera collapse of the central part of the complex and replacement, within the collapsed area, of domes and lava bodies of different affinities, some of wich are basaltic.

NE-SW-oriented structures seem to have had a fundamental role during the development of the panarea volcanic complex. These structures have been active until recent times, the datation of Basiluzzo reef with K-Ar method shows that it is younger than 10,000 years.

Some structures have regional significance because the evolution of Stromboli has been controlled by NE-SW-trending structures. Panarea and Stromboli also have similar magnetic anomaly trend, geochimical affinities, and temporal relationships of volcanism.

Others factors show that volcanic activity is still present.

Underwater researches between Basiluzzo, Dattilo and Lisca Nera reefs, at N-E of Panarea, led to the discovery of submersed structures at 15 metres depth, that probably manufactured, perhaps identifiables with Roman hand-made contemporaneous to known presence on land (about 2000 years old).

The subsiding of 15 m. in 2000 years is very considerable and, not beeing bradisysm phenomenon in this area, is to ascribe to tectonic events related to a volcanic activity and probably to caldera evolution, when even Roman wharf gives evidence because it is submersed at 3 m. depth in the island of Basiluzzo.

We found many of submarine emissions in large zones near Panarea. The gas analysis of these fumarole samples verified the presence of magma in the substrate. This result is further evidence of activity in the volcanic complex.

Macro et micro évolution du littoral proche de la lagune de Ghar El Melh (Tunisie septentrionale)

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Using geologic(Pimienta 1959,Jauzein 1971),geographic(Paskoff1985)and halieutic(Romdhane 1985),we have retraced the evolution of the North-East Tunisian coast,we have separated three level of this evolution: Tunis gulf, Ghar El Melh LAgoon and the communication Lagoon-sea.

A la base des travaux de Geologie(Pimienta 1959,Jauzein 1971) de geographie(Paskoff 1985) et d'halieutique(Romdhane 1985),nous avons retracé l'evolution du littoral Nord Est de la Tunisie,à trois niveaux differents: le Golfe de Tunis,la Lagune de Ghar El Melh et les communications mer-lagune.

G

L'evolution ancienne et recente dans le golfe de Tunis est lié aux apports solides charriés par le Medjerdah,oued à regime torrentiel dont le debit varie entre 1,2 et 1200 m^3/s,ses eaux erodent un bassin versant de 23500 Km^2.,avec une charge moyenne de 30 g/l;l'avancement du delta de cet oued à fini par conquerir plus que 300 Km^2 de surface gagnée sur la mer.

La formation de la lagune de Ghar El Melh et son envasement sont aussi relatifs à ce phenomène,cet oued se jettais dans la lagune meme au cours des deplacements de son lit.

Les passes ou graus qui assurent la relation mer-lagune,avec principalement le recrutement biologique,sont aussi sujet à des modifications continues liées aux crues exeptionnelles,tel qu'en 1973 et surtout aux mouvements des eaux marines,tempetes et transit littoral.

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Les mécanismes de la sédimentation dans le golfe de Tunis (Tunisie)

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A travers l'étude sédimentologique des dépôts superficiels du Golfe de Tunis, les mécanismes de la sédimentation sont analysés.

La répartition des faciès sédimentaires et plus particulièrement le faciès argileux (Fig.1) fait apparaître des zones d'envasement précoce. Celles-ci, sont développées principalement devant l'Oued Medjerdah qui constitue la principale source d'apport de matériel détritique et accessoirement devant l'Oued Méliane exprimant les réactions d'échange entre le flux continental (solide et liquide) et le milieu marin.

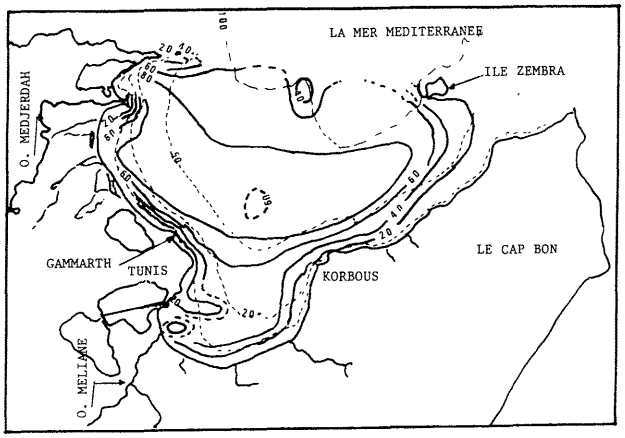

FIG. 1.- CARTE DE REPARTITION DE LA FRACTION ARGILEUSE DANS LE GOLFE DE TUNIS.

Le mécanisme de la floculation provoqué par l'intéraction entre les eaux douces et les eaux marines est bien marqué surtout face au delta de la Medjerdah. En effet, l'analyse du carbone organique total (COT) et notamment l'étude minéralogique des argiles des dépôts superficiels du Golfe, ont montré l'individualisation d'un prodelta dont le mécanisme de la formation a été bien étudié par J.C.ALOISI et al...(1975). Ce prodelta est bien caractérisé par une concentration relativement élevée en COT (2,2%) et un enrichissement en smectite (60 à 70 %).

En outre, à proximité de l'embouchure de l'Oued Medjerdah, bien que les dépôts soient essentiellement argileux (80 à 90 % de fractions ≤ 2 µm), les courbes granulométriques semi-logarithmiques sont variées. On note surtout la présence des courbes du type logarithmique traduisant un mode de dépôt par excès de charge. Cependant, dans le reste du Golfe, hormis les zones côtières ou domine le faciès sableux, les courbes granulométriques sont du type hyperbolique ce qui dénote que les particules qui échappent à la sédimentation précoce au niveau du prodelta de la Medjerdah sont déposées ailleurs par décantation.

Dans le petit Golfe, le transport pluviatil est assuré par un réseau hydrographique rudimentaire devenu encore moins important en raison du déficit sédimentaire et aquatique provoqué par la construction du barrage de Bir M'Chergua sur l'Oued Méliane (1973). Par ailleurs, le long de la côte sud du Golfe, il existe deux dérivés littorales dont la principale va de l'Est (Korbous) vers l'Ouest (La Goulette). Cette dernière charie une quantité appréciable de matériel sableux (A.KOUKI,1984) provenant éventuellement des formations oligocènes du Cap Bon. A ce stock d'éléments grossiers viendrait s'ajouter une autre fraction de matériel sédimentaire, soit, au droit des courants littoraux NS qui longe la côte Ouest du Golfe (MANSOURI-MENAOUAR,R.1979) et provenant de l'O.Medjerdah soit issus des différents Oueds qui se jettent dans de petit golfe (O.Soltane, O.Méliane, O. Bézirk El Bey, etc...) au moment des cures.

Ainsi, la diversité des sources d'apport en matériel détritique (sables, silt et argile),et la présence des courants littoraux N-S ou W-E relativement fort ont entrainé vraisemblablement une variabilité dans le mode de dépôt et plus particulièrement l'individualisation d'un faciès mixte (argilo-solto-sableux) bien caractéristique de ce secteur.

ALOISI (J.C.), MONACO (A.) et PAUC (H.),1975.- Mécanisme de la formation des prodeltas dans le Golfe de Lion.Exemple de l'embouchure de l'Aude (Languedoc).Bull. Inst. Bassin Aquitaine, n° 18, pp. 3-12.

MANSOURI-MENAOUAR (R.), 1979.- Contribution à l'étude de la sédimentation littorale historique et actuelle au voisinage du delta de la Medjerdah. (Etude du Lac de Ghar-EL-Melh et de la Sebkha de l'Ariana). Thèse 3è cycle, Bordeaux I, 175 p.

KOUKI (A.), 1984.- Contribution à l'étude de la dynamique sédimentaire dans le petit Golfe de Tunis. Thèse 3è cycle, Nantes, 168 p.

G-III11

The transition of the Sardinia Channel to the Tyrrhenian Sea

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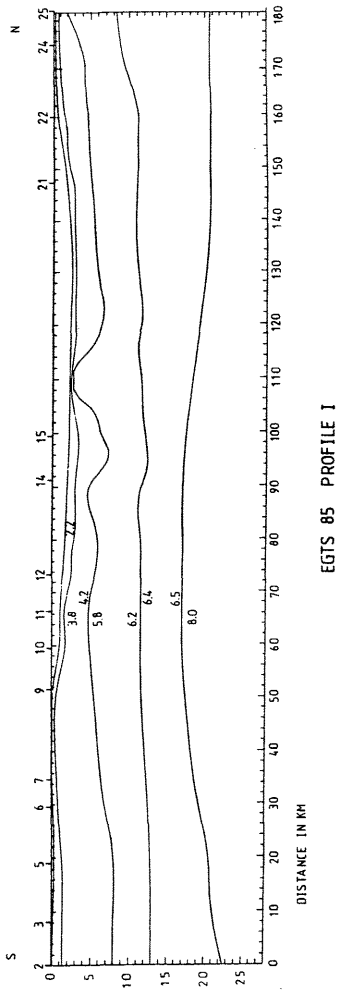
Seismic and gravity studies along the European Geotraverse, southern segment (EGTS) revield detailed models of the thickness and geometry as well as the nature of the crust and sediments at the Sardinia Channel, Tunisia and the Pelagian Sea. Particularly the seismic observations between Tunisia and Sardinia shawed that the seismic energy generated by the shots fired at optimized deth, propagate from south to north in a very efficient way but not vice-versa. This phenomenon, together with the geometry of the Moho and that of the basement could be explained by the distribution and orientation of a system of faults that limit crustal segments, their orientation and tilt. These structures, also controlled by gravity modelling, could be at best explained by tectonisation due to shearing and rotation of the lithological unites in a NNE direction. The crustal stretching along the Sardinia Channel is therefore a process that has nothing to do with rifting, since also the P_n velocities are normal, but is produced mainly by shearing, observed along Algeria and Tunisia and responsible for many distractive earthquakes along the north african shear zone. This process, together with observations on the development of the volcanic activity and style of deformation of the Tyrrhenian Sea, which was initiated at the west and gradually progressed eastwards to Calabria, permit the conclusion that the opening of the Tyrrhenis and the development of the Calabrian Arc are the direct consequence of the shearing and deformation system observed along the western part of north Africa.

Figure: Model of the Sardinia Channel



G-III12

Marine geology of the Gulf of Trieste (Northern Adriatic). A. Sedimentological properties

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The Gulf of Trieste is the northernmost part of the Adriatic Sea isolated from the res of the Northern Adriatic by a shoal located on the line Grado-Savudrija peninsula (Fig. 1). The Gulf occupies about 500 km^2 and lies at the contact between Istrian carbonate platform and Karst, and the Friuli plain on the west. The Gulf of Trieste is a shallow, nearly level marine basin about 20 - 25 m deep with rather steep shores. The bays of Piran, Koper and Muggia in the SE part of the Gulf are the wide submerged valleys of the small rivers Dragonja, Rižana and Rosandra, respectively. Thre detrital material in the sediments originates from the hinterland (transport by rivers and erosion of the Paleogene flysch). In this paper we present sedimentological data on the central and SE part (Yugoslav) of the Gulf, supplemented by the results on the northern part (Italian) of the Gulf published by various authors (Venzo and Stefanini, 1967, Brambati and Venzo, 1967).

The distribution of suspended sediment in the Gulf of Trieste, represented by Secchi disk transparency, shows the highest contents around the river Isonzo delta, and the lowest in the central and especially at the SW entrance of the Gulf, due to the inflow of the water from the central Adriatic with low suspended matter contents. The E and SE part of the Gulf is characterised by somewhat higher content of suspended sediment. The total concentration of suspended matter in the surface of the central and SE part of the Gulf varries mostly in the range 1.5 - 2.0 mg l^{-1}, of which about 60 % is of minerogenic origin.

According to grain-size distribution and mineral composition the sediment of the Gulf of Trieste could be subdivided into six zones (Fig. 2):

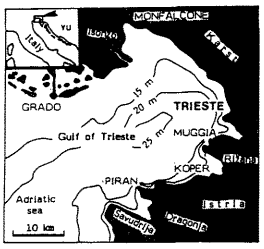

Fig. 1: Bathimetry of the Gulf of Trieste

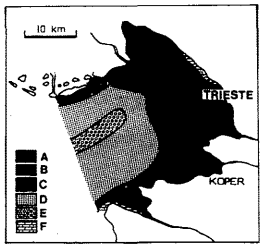

Fig. 2: Grain size distibution of the sediment (our analyses compiled by data of Brambati & Venzo 1967 and Ranke 1976).

A-Sediment close to the coast composed of silt and sandy silt containing a max. of 15 % clay and up to 40 % of a fraction $\geq$ 63 /um, the carbonate content 15-70 % and the median 30-70 /um.

B-Sediment of the interior of the small bays is a dart grey clayey silt containing up to 40 % of clay and 25-40 % of carbonates with a median of 3-6 /um. The biogenic component is composed of foraminifers, ostracods, shells and mollusks; pyrite incrustations of foraminifers.

C-Sediment of the transition zones is composed by grey silt with up to 25 % of clay and a median 5-20 /um, rich in organic skeletons, the carbonate content 40-50 %.

D-Sediment of the open part of the Gulf consists of pure silty sand and sand with up to 10 % of clayey fraction and 50-80 % of carbonates. The mean grain size ranges between 0.2-1 mm. The predominant component are biogenic fragments.

E-Sediment of the central part of the Gulf; medium to coarse sand, carbonate rich (70-90 % of biogenic skeletons), median 100-250 /um.

F-Sediment along the carbonate coast of Savudrija peninsula is composed by silty sand containing up to 80 % of carbonate, formed by erosion of Cretaceous limestone and biogenic production.

In the southern part of the Gulf some seamounds, composed of rhodolites, and hardground appear. The sedimentation rates, measured by radiocarbon and pollen analyses, revealed that the rate is lower than 1 mm y^{-1} in the central part of the Gulf, while it increases towards the inner part of the bays to about 3-5 mm y^{-1}.

Marine geology of the Gulf of Trieste (Northern Adriatic). B. Geochemical properties

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In parallel with sedimentological investigations of the Gulf of Trieste, reported in the previous paper (A), we investigated the geochemical properties of the surficial sediment in terms of organic C, total N and P, inorganic P contents, ^{13}C depletion of sedimentary organic matter and heavy metal content (Fe, Hg, Pb, Cd, Cr, Cu, Zn, Ni and Mn). Sediment samples were collected mostly in the central and SE part (Yugoslav) of the Gulf. The data obtained were integrated into a general pucture of the distribution of these sedimentary geochemical properties using data from the northern (Italian) part of the Gulf of Trieste published by various authors (Macchi, 1968; Stefanini, 1969; Donazzolo et al., 1984). The geochemical analyses were performed using an elemental C-H-N analyzer, colorimetry for P, mass spectrometry for $\delta^{13}C$ values and AAS for heavy metals.

Organic C contents in the surficial sediment of the Gulf ranges mostly between 0.5 - 1.5 %, total N between 0.1 - 0.15 % and total P between 200 - 400 ppm. The spatial distribution of organic C and total N and P shows higher contents ($\geq$1 % org. C, $\geq$0.1 % tot. N, $>$300 ppm tot. P) in the Bays of Piran, Koper, Muggia and Panzano and near the river Isonzo delta in conformation with the textural type of the sediment - clayey silt (prevalently type B and C). The lowest contents ($\leq$0.5 % org. C, $\leq$0.08 % tot. N, $<$200 ppm tot. P) are localized in the central part and especially at the Gulf entrance and conform to sediment types consisting of silty sand and sand (type E). Total and inorganic P higher than 400 and 300 ppm, respectively, are restricted to the Bay of Koper. Inorganic N and P comprises about 20 and 70 % of the total N and P, respectively. C:N ratios found were mostly lower than 10 (by weight) and $C:P_{org.}$ ratios mostly in the range 100 - 200 (by weight). Considering the prevalently C:N ratios $<$ 10 and $\delta^{13}C$ values of sedimentary organic matter in the range -19.9 do -23.0 °/oo, we concluded that this matter is principally autochtonous marine, the majority (about 60 %) of it originating from POM sedimentation in the sea water column.

Heavy metal analyses revealed in the central and SE part of the Gulf of Trieste rather low contents. Exceptions are Cu and Ni contents being mostly $>$ 50 ppm. The spatial distribution of heavy metals analysed shows a gradual increase in all heavy metal contents from the Gulf entrance towards the shore. For Hg an additional gradient is observable - a substantial increase (approx. 20-fold) in contents towards the river Isonzo delta, due to the high Hg content in the river. High contents of all heavy metals, except Hg, coincide well with the textural type of the sediment, the clayey silt and silt (types B and C) containing higher values. This horizontal distribution coincides with the organic C distribution, indicating that the heavy metals are bonded to some degree to organic matter.

Comparison of organic C, total N and P and heavy metal contents in the surficial sediments of the Gulf of Trieste with those determined in the borehole V-6 in the salt marsh of Sečovlje in the Bay of Piran, which serves as a paleoenvironmental background, revealed increasing contents of Hg, Zn and total P. Measuring these elements would be probably sufficient to assess the long-term effects of eutrophication and environmental pollution on marine sediments in the Gulf of Trieste.

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Premiers résultats sur les Foraminifères d'une carotte de la mer Adriatique

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La carotte a été prélevée lors de la campagne ETNA 1982 (Centre des Faibles Radioactivités CNRS-CEA) par 1077 m de profondeur dans la dépression sud-Adriatique (fig. 1). Elle comporte de nombreuses passées de cendres volcaniques qui ont été étudiées et datées et une courbe des variations de l'oxygène 18 a été établie. L'intervalle de temps concerné va de la fin du stade 5 au début du stade 1 (Paterne 1985).

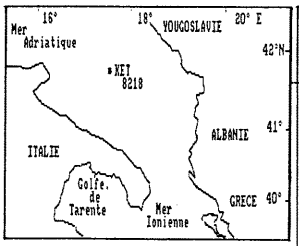

Figure 1: Localisation de la carotte.

Figure 2: Evolution des assemblages de foraminifères (d'après BLANC-VERNET, sous presse).

: foraminifères benthiques rares ou absents
: microfaune benthique peu diversifiée

Les variations de fréquences des foraminifères planctoniques chauds et froids permettent de tracer une courbe climatique estimée, qui est en bonne correspondance avec la courbe isotopique et de reconnaître cinq types d'assemblages successifs (Blanc-Vernet, à paraitre). On doit remarquer une faible représentation des espèces typiquement chaudes (divers Globigerinoides, Hastigerinella siphonifera, Orbulina universa, accompagnées lors des périodes d'amélioration climatique par de très forts pourcentages de Globigerina bulloides. Si l'on considère que les indicateurs chauds précités sont également des espèces qui ne tolèrent pas les faibles salinités (Bé et Tolderlund, 1971; Thunnell, 1978; Loubere, 1981), leur rareté en période chaude pourrait indiquer une certaine dessalure des eaux de surface suivant un mécanisme connu actuellement en Adriatique pendant l'été (Zore-Armanda, 1968).

Le peuplement benthique présente au cours du temps des modifications qualitatives importantes. La figure 2 montre la correspondance entre les principales coupures faunistiques des assemblages planctoniques et benthiques et la courbe climatique. On remarque que certains échantillons contiennent des microfaunes très pauvres en espèces comme en individus (assemblages à Heterolepa-Bolivina-Cassidulina). Ces épisodes défavorables à la vie benthique sont observés aussi bien en période froide que lors de réchauffements. A titre d'hypothèse on peut supposer que ces mauvaises conditions de vie sur le fond sont liées aux incursions en Adriatique de l'eau intermédiaire d'origine méditerranéenne provoquant, dans cette zone, une tendance à la stratification des masses d'eau. Toutefois aucun véritable sapropel n'a été observé.

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G-III15

On the origin and geological type of the Tuzla salt deposit in Yugoslavia. 2. Trace element geochemistry of lithotype indicator minerals

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Since the pioneer studies of Van't Hoff (1912), evaporitic salt deposits of marine origin - particularly their mineral parageneses - have been the subject of much detailed investigation. The commercial importance of these deposits and the complex geochemical relationships of their formation have warranted extensive surveys with regard to the genetic implications of their geologic and geodynamic setting (Braitsch, 1971).

The rock salt deposit of the Tuzla basin in the central part of Yugoslavia comprises the central salt body of the Tušanj area and the recently discovered salt stock lense of the nearby Tetima area. The essentially stratified salt-dome type deposit is of middle Miocene age and is hosted by a sedimentary series which consists primarily of banded marls with anhydrite. The whole salt formation forms part of the Majevica range horst, which was a prominent feature of an archipelago in the Miocene sea. However, there is yet no unambiguous evidence as to the geological origin of the deposit (Kniewald et al., 1986). There are three possible formation models:

1. the mixing-zone model (which is of an estuarine or shallow lagoon type, implying temporary contact with the open ocean)
2. the hypersaline lake/lagoon model
3. the marine evaporitic deposition model

As dolomitic limestones are found closely associated with the salt beds, the mixing-zone model could account for dolomitization under non-evaporative, evaporative or seepage reflux conditions.

The principal minerals of the salt deposit are halite (rock salt), thenardite and anhydrite, the $a(H_2O)$ indicator pair being thenardite and mirabilite. The other classic indicator couple gaylussite-pirssonite is however missing from the stratigraphic column. The assemblage comprises also several comparatively rare minerals - nahcolite, probertite, bradleyite and northupite.

Earlier investigations on the feasibility of northupite as a marine lithotype indicator have shown that this mineral is unsuitable for the purpose, probably due to its strong adsorptive properties as well as diagenetic transformations which have been observed on megascopic northupite crystals from the salt deposit (Kniewald et al., 1986). Halite was shown to be a considerably better indicator, but variations in the trace element contents biased rigorous correlation procedures. Thus, subsequent determinations of trace elements in samples of halite and assemblage minerals was performed and the results are given in Table 1.

Table 1. Trace element concentrations (ppm) in halite and assemblage minerals, obtained by inductively coupled Ar-plasma atomic emission spectrometry (ICP-AES). Seawater values are given as mol kg^{-1} (Bruland, 1983)

	Fe	Zn	Ni	Cu	Pb	Ca	Sr
Thenardite	0.75	1.00	0.32	0.16			0.016
Nahcolite	10.00	2.00	3.00			80.00	0.57
Halite 1	10.00	75.00		30.00	25.00		
Halite 2	10.00	80.00		20.00	25.00		
Halite + Thenardite	0.75	1.14	0.23	2.43			
Seawater	$1x10^{-9}$	$6x10^{-9}$	$8x10^{-9}$	$4x10^{-9}$	$1x10^{-13}$	$1x10^{-2}$	$9x10^{-5}$

Again, results for northupite and thenardite display no pronounced correlation with average trace metal levels in open ocean waters. Values for halite and nahcolite are somewhat representative of an enrichment factor of the order of magnitude of $0.5\text{-}2.0x10^3$. This could be taken as argumentation for the marine type or mixing-zone model with respect to the formation of the Tuzla salt deposit. Nahcolite, essentially $NaHCO_3$, is probably a convenient indicator mineral species, and its trace element content and distribution will be a matter of further research.

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G-IV1

Geophysical Investigation of Saros Bay and Its Implications

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On the basis of deep multi-channel seismics, shallow 40 cubic-inch airgun data and sonobuoy refraction studies, the structural and sedimentary sequence of the Saros Bay, and the area between the Gelibolu Peninsula and the island of Gökçeada have been elaborated including the results of available gravity and magnetic data in the area. The study area is situated at the northeastern corner of Aegean Sea (Figure 1). It is well known fact that the Aegean Sea comprises a set of back-arc basins (the Northern Aegean Basin including the Saros Bay), a volcanic arc and an inter-arc basin (the north Cretan basin) over the structural framework which is relatively young, and superimposed on older structures of an orogenic belt of Alpidic origin which can be traced from the Dinarides and Hellenides in the west, into the the Taurides and Anatolides in the east (İzdar,1975 ,Biju-duval et al,1979,and Şengör and Yılmaz,1980).

The Saros Bay area is not exactly in the isostatic equilibrium showing -50 mgal free-air anomaly minimum with +20 mgal (north) and +50 mgal (south) levels on the adjacent areas. Bouguer gravity anomalies indicate a positive anomaly zone extending in the northeast direction from Limni, Gökçeada and the Gelibolu peninsula on the south side of the Saros Bay which has a negative anomaly zone. No regular magnetic anomalies are exist in the Saros area(the Northern Aegean in general) besides the several lineations related to tensional tectonics and magmatic intrusions. The Ganos fault joins the North Aegean Basin to the Marmara Sea which appears as the prolongation of the North Anatolian strike-slip fault changing in this area into extensional strike-slip movement for the creation of these basins.

Five main structural features have been described from the Bouguer gravity anomalies and seismic studies as: (i)Dardanelles Graben (ii)Gelibolu Horst (iii)Saros Graben (iv)Semadirek High, and (v)Enez Graben. Semadirek High and the Gelibolu Horst are pre-Miocene anticlinal structures. Enez and Saros grabens have been developed in the synclines between the anticlinal areas. Dardanelles Graben is over an anticlinal structure. Three sedimentary sequences were described by Saner(1985) in the area separated by erosional surfaces of (i)Upper Cretaceous-Lower Eocene sequence, (ii)Middle Eocene-Oligocene sequence, and (iii)Mio-Pliocene-Quaternary sequence.

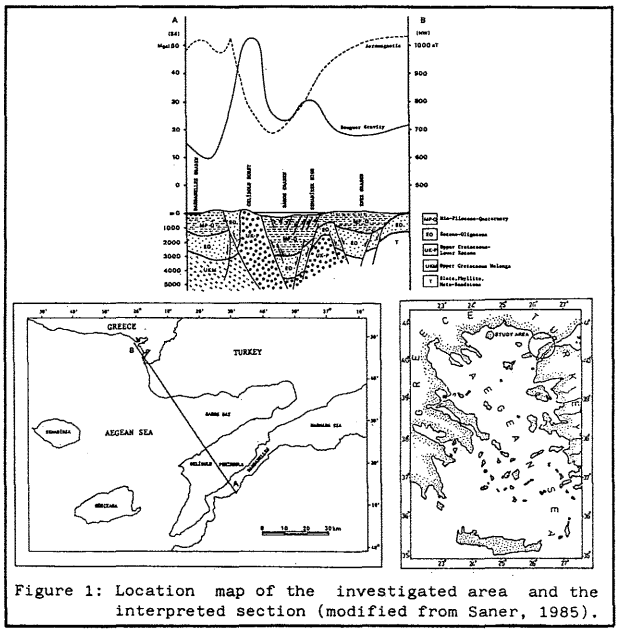

Figure 1: Location map of the investigated area and the interpreted section (modified from Saner, 1985).

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Texture and composition of the bottom sediments of Pagasitikos Gulf and Trikeri Strait, Thessaly (Greece)

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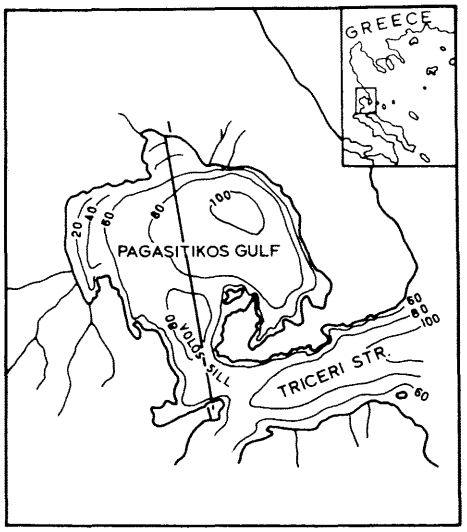
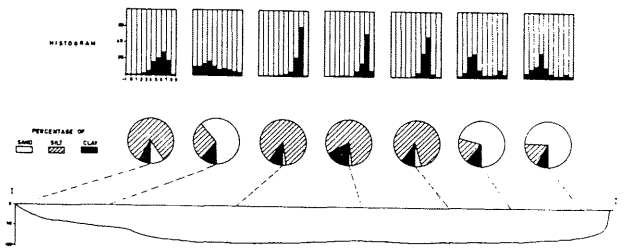
At an earlier note (1) the general setting and preliminary results of a marine geological research at Pagasitikos gulf and eastern Oreon strait (Trikeri strait) were given. In this paper a detailed study of the composition and texture of the sea floor sediments is presented.

The greatest part of the 100m. deep gulf is covered by silt (terms according to Sheppard) with a mean size from 6,0 to 7,30, the presence of which was noted even in the near shore areas. The units of sand, silty sand and sandy silt occur only locally, mainly at the northern and southern parts. Silt predominates also in the greater area of Trikeri strait (depth from 80 to over 100m.), with a coarser character (mean size 5,8 to 6,30), while sand occurs in narrow strips along the northern and southern coasts. The shallower Volos sill (depth around 75 to 80 cm.) which connects the gulf and the strait on the contrary is covered by medium and fine sand and only at its eastern sides fine grained sediments are present.





The coarse fraction of the sediments consists of terrigenous, biogenic and authigenic components, the most important of which show the following distribution: From the terrigenous components, quartz is abudant (up to 60%) at the nearshore areas of the gulf and the strait, but diminishes rappidly at the central parts. Rock fragments shows similar distribution with quartz, with higher percentages at the northern coasts, while mica is concentrated in significant amounts (over 20%) only at the eastern deeper parts of the gulf and the northern part of the strait respectively. From biogenic constituents, the benthonic forams show high percentage (over 20%) at the central sectors while the shell fragments exhibit an uneven concentration with high percentages at nearshore sandy areas with low sediment input (Volos sill, northern coasts of Trikeri Strait), as well as at the central parts. Finally glauconite (authigenic), is present mainly at the sill and the northwestern parts of the gulf, associated usually with high sand percentage.

From the above it is evident that both Pagasitikos Gulf and Trikeri strait are today sites of fine grained sedimentation. The sediments are redistributed by current action as shown by the benthonic foram and mica concentration. Little, however, sediment transport occurs between the gulf and the strait, mainly along the eastern part of Volos sill. Preliminary work on cores combined with data from seismic profiles indicates that the above sedimentation pattern has prevailed in the gulf throughout the holocene period, with sedimentation rates not exceeding 0,5m per kyr. At the Volos sill however, as well as the northwestern parts of the gulf the sediments reflect a different environment of deposition, related apparently to earlier periods.

Following the classification by Mc. Manus, the sediments of Pagasitikos gulf and Trikeri strait can be characterized as neoteric, amphoteric and occasionally palimsest, while the ones at the Volos sill are mainly relict and palimsest.

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Seismic stratigraphy and structure of Pagasitikos and Maliakos Gulf and the surrounding areas, Aegean Sea, Greece

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In this paper, preliminary results from the study of the seismic stratigraphy and structure of the following areas is presented :Pagasitikos gulf (max.depth 100m), Trikeri strait (m.d. 90m), Oreon strait (m.d.70m), Maliakos gulf (m.d. 25m.),Knimida strait (m.d.95m), western end of North Aegean Trough and western part of the Sporadhes Basin (fig.1).

For this research shallow (3,5 KHz, Uniboom) and medium (1 kj sparker)penetration seismic systems were used.

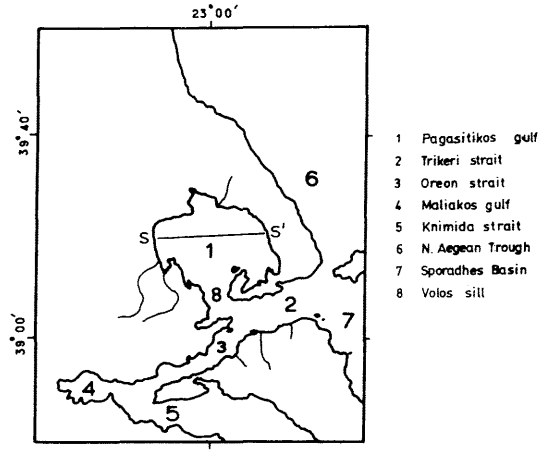

Fig. 1

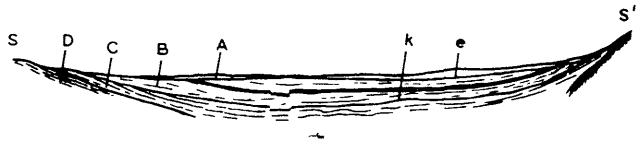

Fig. 2

In the greater Pagasitikos gulf, three seismic units were recognised, separated by two uncomformities (fig. II) while in some places (northern part of the gulf) a forth unit and a third deeper uncomformity appeared, which is not always clearly distinguished. Starting from top to bottom, unit A is a transparent sequence with greatest thickness in the central and the east part of the gulf (up to 16m.). Unit B is also transparent with many thin, undisturbed, parallel reflectors (max.thickness 50m.). In this sequence a thin layer with strong reflectivity was observed, which extends in the whole area. Unit C is less transparent than B, while the internal reflectors are thicker, continuous, parallel to each other and slightly folded. The bottom of this unit was not always possible to be determined due to limited penetration of the seismic systems used. Unit D, as mentioned before, appears only at the northern part of the gulf and has different characteristics from the others, such as strong reflectivity with obscured prolonged reflectors.

In the shallow sectors of the other areas, the uppermost unconformity was also observed separating unit A from the underlying sequences, which are not always recognised.

In the deeper sector (sea depth above 120m) such as the N. Aegean Trough and the Sporadhes Basin the seismic stratigraphy is different. There, a uniform sedimentary sequence is observed which was apparently deposited in normal marine environment. The total thickness of this cover was not possible to be estimated at the North Aegean Trough. At Sporadhes Basin its thickness is up to 150m., and is in angular unconformity with the underlying sequence which consists of harder formations. In some parts of the basin, where the sea floor is steep, mass movement processes were noted, transporting sediments to deeper areas.

Based on land observations, the above horizons are tentatively correlated to Holocene marine sediments (Unit A), Plio-Pleistocene sediments (Units B & C) and undivided Neogene formations or pre-neogene beds (Unit D).

In the research area, two systems of normal faults were observed. An older one, which strikes NNW-SSE, and which is responsible for the shapping of the steep Pelion coasts, Pagasitikos basin, Volos sill and Sporadhes Basin and a younger one, which strikes ENE-WSW, and which is responsible for the formation of Trikeri, Oreon and Knimida straits and for todays Pagasitikos-Maliakos shape. It is suggested that the second fault system was active during Middle-Upper Pleistocene. Apart from the above tectonic lines, the sediments are affected by many synsedimentary faults.

G-IV4

Distribution of sediments in Maliakos Gulf and the surrounding areas

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The submarine geological studies of Maliakos gulf and the the surroundings areas are part of a project the aim of which is the study of the Greek submarine region.During the research, sampling of sea-bottom sediments, coring and subbottom seismic profiling were carried out. The research also included Oreon and Knimida straits.

The Maliakos gulf has a maximum depth of 25 meters and its southeastern extension, Knimida strait, a depth up to 100m.

Oreon strait has a NE-SW orientation. In the northern part of the Oreon strait,a-long the coast the sea-bottom is steeper than the one in the southern part. In the remainder, it is almost flat.

South of Glifa, small prolonged basins are formed(fig.1,2,3) which are confined by the isobaths of 70m.

The subbottom seismic profiles of Maliakos Gulf, showed that a subsidence was taking place, in the southern part of the gulf up to Holocene.That depression was filled up by material derived from the North.The result of this subsidence was the formation of slumping folds and synsedimentary faults due to creeping.In the Knimida strait the subsidence was at a higher rate and the Holocene sediments were thicker.The Oreon strait is a tectonic symmetrical graben.

The microscopic analysis of the sea-bottom sediments has shown the followings :

Quartz : is representing values ranging 10-20% in the SW part of Maliakos Gulf close to the coast but in the larger part of the gulf the values are low.In the opening of the gulf the values are higher than 20%.

In the Oreon Strait, in both southern and northern parts the quartz values range from 5-10%. The same quartz distribution pattern occurs in Knimida strait.

Mica : is representing, in the southern coast of Maliakos gulf, values higher than 8% while in both the western and central parts of the gulf the values are lower than 4%. In the northern part of the Maliakos gulf opening the values are low, 0-2%.

In the Oreon strait, small mica concentrations(less than 2%)occur.

In the Knimida strait the mica values are relatively low.

Rock fragments: In both the western and northern parts of Maliakos, the values are high, that is higher than 40%. In both the central and southern parts the values are lower,ranging from 0-10%. High values of rock fragments occur in the Oreon strait. (20-40%).These values rary reverse proportionally to the distance from the coastline. In the southern coast of Knimida these values exceed 40% and they are decreasing towards the centre of the strait.

Heavy minerals: The heavy minerals concentration are less than 6%, in all areas except the Maliakog Gulf opening and the southern part of Knimida.

Glauconite: Occurrences are limited and its values do not exceed 4% except the northern Knimida coast and Oreon strait where they exceed 6%.

Fe-pyrite : Fe-pyrites occurrences are relatively restricted.In Maliakos Gulf the values are less than 1%.The same also situation occurs in the remainder of the studied area.

Shell fragments: In the Maliakos gulf their concentrations are high ranging from 10-40%. In both the Oreon and Knimida straits their values exceed 40% except the southern Knimida coast where are less than 10%.

Benthonic foraminiferae: In Maliakos Gulf their values range from 5-20% or higher.In both Oreon and Knimida straits their values are very low and range from 0-5%.

The seismic data and the sediment analyses showed that most of the above mentioned sediments were deposited after the last transgression of the Upper Pleistocene.

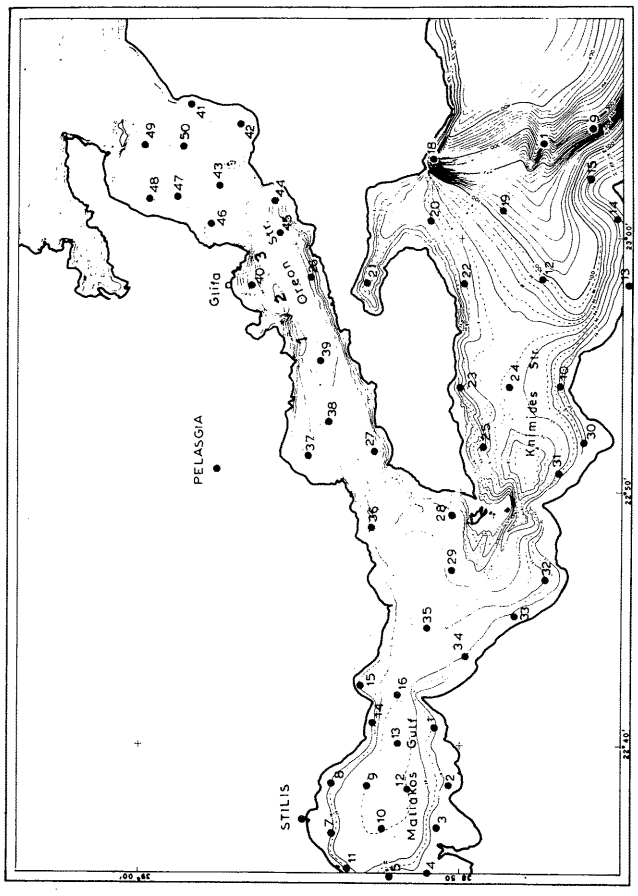


Fig. 1

G-IV5

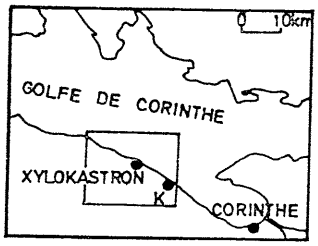
Bref aperçu sur la géologie du secteur SE du golfe de Corinthe

Anastasie KOUTSOUVELI

I.G.M.E., Messoghion 70, 11527 Athènes (Grèce)

Autour du Golfe de Corinthe s' observent des rivages effectués par la Néotectonique.

Une étude cartographique detaillée dans la partie Sud-Orientale du Golfe Corinthien a montré que les formations du Pliocène et Pléistocène ont masqué par endroits les calcaires du Cretacé de la zone allochtone du Pinde-Olonos et les calcaires éocènes de la zone autochtone du Gavrovo-Tripolitza (KOUTSOUVELI A-METTOS A. sous presse) qui affleure aussi dans cette région.



Situation de la région étudiée

Les formations de la série néogène et quaternaire sont des faciès marins, saumâtres et fluviolacustres.Les plus anciens dépôts de cette série affleurent vers l' Ouest, leur épaisseur atteigne 350 mètres, et se constituent des conglomerats intercalés à des bancs gréseux et marneux. Vers le haut ils passent lateralement à des marnes de grande épaisseur, dont les membres inférieurs sont des marnes blanchâtres lacustres à lentilles lignitifères et à intercalations gréseuses ou conglomératiques;tandis que les mémbres supérieurs se constituent des marnes blanchâtres à horizons sableux de faciès marin ou saumâtre. Vers l' Est l' épaisseur des formations du Pliocène supérieur se diminue et les formations du Pléistocène couvrent une grande étendue. Le Pléistocène marin affleure dans cette région sous forme de plusieurs terrasses qui sont crées par la fluctuation de la mer et les mouvements tectoniques (KERAUDREN (1970-72), KERAUDREN ET SOREL (1987), DUFAURE et al. (1975), DUFAURE et ZAMANIS (1979,1980), SEBRIER (1977), SCRODER B. (1975) qui ont affecté la région.

Ainsi plusieurs fractures de directions E-W, NW-SE et ESE-WNW s'observent dans cette région. Des accidents synsédimentaires montrent aussi l' existence d' une tectonique très intense au cours du Plio-Pléistocène. Cette tectonique, surtout extensive est responsable pour les nombreuses failles normales et la réactivation des failles préexistantes à des miroirs impréssionants sur les calcaires prénéogènes. L' analyse microtectonique a permis de reconnaître les trois axes principaux des contraintes et a mis en evidence le rôle fondamental d' une allongement de direction N-S à l' évolution de cette région.

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Stratigraphie au S.E. du golfe de Corinthe

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I.G.M.E., Messoghion 70, 11527 Athènes (Grèce)

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Neotectonic structure and evolution of the Western Saronikos Gulf

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Detailed continuous seismic reflection profiling data (~750km) from the western Saronikos Gulf resulted in the study of the neotectonic structure and the recent geodynamic evolution of the gulf. The research project was financed by the Earthquake Planning and Protection Organization and the fieldwork was carried out by the R/V AEGAION during 1986-1987 using a 40in³ air-gun, a 1-9Kj sparker and a 3,5 KHz profiling system.

Saronikos Gulf, extending between the peninsulas of Argolis to the west and Attica to the east, displays a complicate morphology. It can be distinguished in a western and an eastern part by a N-S island bridge (Methana, Angistri, Aegina, Salamina) with a very shallow plateau in between. This N-S zone separating western from eastern Saronikos Gulf comprises several volcanic outcrops of Plio-Quaternary age, representing the northwestern edge of the modern volcanic arc. The western Saronikos includes two basins, the WSW-ESE oriented Epidaurus basin in the South with more than 400m of depth and the E-W oriented Megara basin in the North which is relatively shallow (less than 250m).

The major active faults, as shown on fig.1, trend mainly to WSW-ESE and N-S. In Epidaurus basin the WNW-ESE marginal faults have about 350m of throw and create a rather symmetric tectonic graben. An important N-S fault zone with throw more than 400m occurs along the Peloponnesian coastline bordering both basins of Epidaurus and Megara to the west. The Megara basin is a tectonic graben formed by W-E to WNW-ESE marginal faults having a throw of 400-500m. An alternation of horsts and grabens is observed along a N-S profile of western Saronikos, between the Epidaurus and Megara basins. This structure has been created by the WNW-ESE faults with throws between 200 and 300m.

The maximum thickness of Plio-Quaternary sediments was found in the centre of the shallow Megara basin (more than 500m) whereas in the deeper Epidaurus basin it was found 250-500m. Extensive areas of Saronikos Gulf including plateaus of the N-S bridge island zone in the east, as well as of the E-W horsts between Megara and Epidaurus basins are covered by less than 50m of sediments.

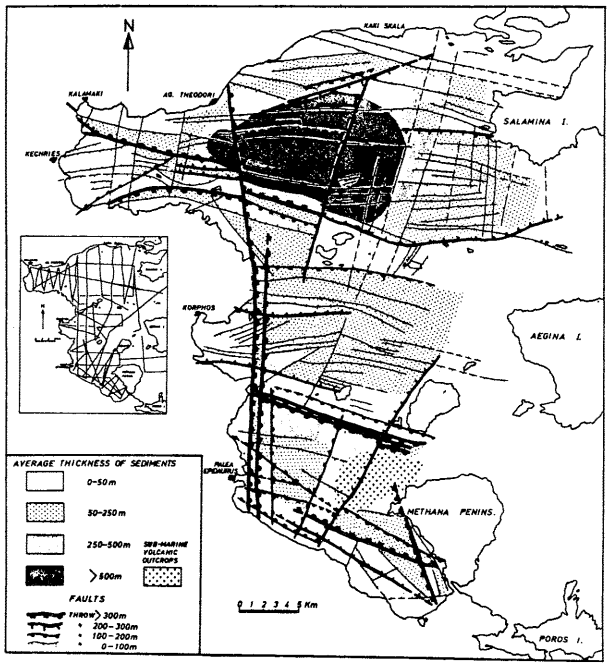

Fig.1. Neotectonic sketch map of western Saronikos Gulf.

In conclusion, the structure of the western Saronikos Gulf is very complicated including different neotectonic styles with: (i) major faults boundering horsts and grabens representing the marginal faults of the basins, (ii) minor faults affecting the sediments within the grabens and (iii) slightly affected plateaus in the eastern part of western Saronikos Gulf where the modern volcanics occur.

G-IV8

Athens Sea outfall : geological data collection and evaluation

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** Ministry of Environment, Planning and Public Works, Athens (Greece)

From the greater Attiki district, where more than 3 million people live, an estimated 600.000 m^3 of domestic wastes and industrial effluents are discharged per day at the shallow water Keratsini bay, off Piraeus. Additional industrial and domestic wastes are discharged at Elefsis bay as well as along the Attiki coastline. As a results, the area at Keratsini bay and surroundings is heavily polluted , with fatal effects on the fauna and flora as well as on the aesthetic and amenity aspects in the greater area. In order to solve this problem, a sewage treatment and fluid, disposal plan was designed, involving building of a siphon for transferring the sewage from Keratsini to the nearby Psittalia island. At the island a treatment of the wastes will take place, while the remaining fluids will be discharged south of Psittalia by diffuser pipes laid down on the sea floor (Fig. 1).

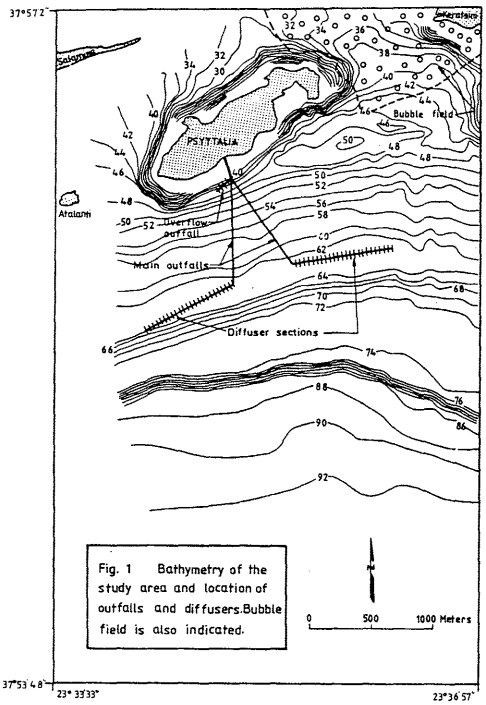
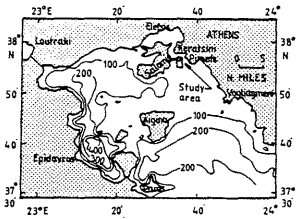
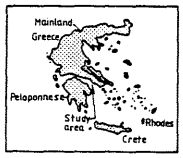


Fig. 1 Bathymetry of the study area and location of outfalls and diffusers. Bubble field is also indicated.





For the examination of the sea floor, where the siphon and pipe emplacement will take place, a detailed seismic and sedimentological research was carried out in the greater area. The seismic profiling was effected by the use of a 3,5 KHz and a Uniboom seismic system. The data showed that the sea floor morphology is smooth, except near the coastline and between the 74 to 86m, contours, where a steep gradient is observed. Also a N-S channel is formed between Keratsini and Psittalia island. The area is covered by a thin layer with transparent character and thickness up to 2m., which was correlated to the unconsolidated surface sediments. At deeper sectors two seismic units were discerned (B and C) having discontinuous and brocken seismic character and correlated with the Quaternary and the Triassic formations which crop out at the island. A different picture was obtained at the Keratsini-Psittalia channel where the seawage deposition has produced an extensive bubble field were the 3,5 KHz and Sparker-seismic systems were unoperational. At this area the Uniboom profiles indicated the presence on the floor of a layer with a thickness up to 6m., which was attributed to sewage deposition (Fig. 1).

Based on the seismic evidence a gravity and vibro coring program was subsequently effected along the lines of the emplacement of the diffuser pipes. The sediment analyses showed that the sea floor at the nearshore areas is covered by poorly sorted coarse biogenic sands, the western part is covered by silty sand while at the eastern part sandy silt predominates. The study of the cores, on the other hand, showed that two horizons are present, a lower one consisted of sand and silty sand and an upper one consisted of sandy silt and silt. The lower unit increases in thickness toward the north indicating derivation from Psittalia island while the upper unit increases in thickness toward the east showing transportation of fine grained material from the sewage area off Keratsini. At the bottom of six cores fragments of hard psammite and biogenic limestone were relieved which belong to the quaternary formation (unit B mentioned above). Thus the thickness of the unconsolidated sedimentary cover at the studied area, south of Psittalia, ranges from 10 to 167 cm.

All above show that rather minor technical work will be needed for the emplacement of the diffuser pipes.

G-IV9

Tectonisation and sedimentation processes in the Cretan Sea

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Anagnostou, Ch.[2] ; Götz, L.-G.[1] and Siolas, A.[2]

In 1986 geological-geophysical studies were undertaken in the Cretan Sea with the research vessel SONNE (cruise SO 41).

The sedimentary record of recent and subrecent processes of sedimentation, as well as a mapping of tectonic lineaments, confirm the continuing subsidence and stretching of the coastal basins.

The Cretan Trough lies within two W-E trending fault systems. Intensive blockfaulting dissected the trough into numerous horsts and grabens (Fig. 1). Strong strechting of the continental crust in this region produced this tectonic structure. The Cretan Sea block was not only formed by vertical tectonic movements, but also through lateral slip-slide faulting. These lateral displacement were produced by different faces of drift- and rotation movements occuring between the African and Agais plates.

The study area revealed the presence of an oval shaped, flat basin in the area, which lies at depth of 1800 m. This place is recognized as the stress-release point between NW-SE and NE-SW trending lateral displacements. Subsidence is specially higher in this district.

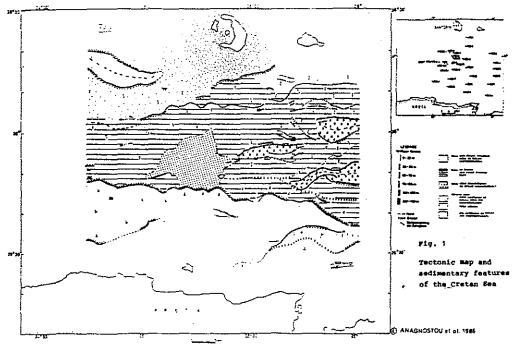

Fig. 1
Tectonic map and sedimentary features of the Cretan Sea

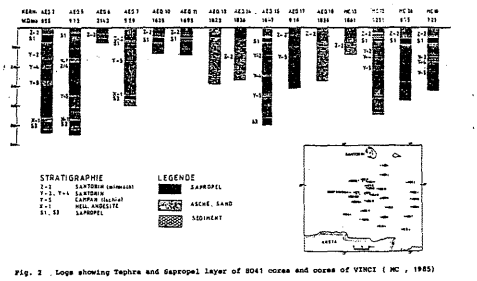

Fig. 2 . Logs showing Tephra and Sapropel layer of SO41 cores and cores of VINCI (MC , 1985)

In compiled potential field maps of the Cretan Trough, gravimetric and magnetic anomalies correlate with weak zones and tectonic structures.

In the deep sea sediments of the Cretan Sea, several Tephra- and Sapropel layers form, which further document, very well the tectonic nature of the region and its associated volcanic activity. In the study area piston core samples were also collected. Geochemical analysis of the Tephra layers and a differentation based on their chemical background yielded ash-like layering-pattern. Based on this manner of layering and the behavior between K_2O, Rb, Zr and Y versus SiO_2 , their volcanic origin could be established. A correlation of these ashes with those of existing Tephra- and Sapropel-chronologies give the age of the ashes in our research area (Fig. 2). Most Tephra originated from the volcanic eruptions of the greek archepelago, their main source being the eruption of the Santorin about 3.500 years ago. Another prominent source is the Ischia-layer , wich can be traced back to the Eruption of the Campanian Region (Southern Italy) about 34.000 years ago. They form reliable sources for determining the rates of sedimentation in the Cretan Sea. The high rate of sedimentation accounts for the continuing subsidence. This subsidence (5.00 to 7.7 cm pro 1000 years) is clearly higher than that of other regions in the Agais and southern Crete.

G

Petrography and geochemistry of uppermost Pleistocene sediments in the outer Thermaikos Shelf : Project EURECOMARGE

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Smear slide petrography and geochemical analysis were carried out on a series of seven gravity cores recovered from the outer continental shelf of the Thermaikos Gulf in the northwest Aegean Sea (fig. 1). On the basis of the lithofacies associations observed in the cores they are divided into two broad categories: a)cores recovered from water depths of less than 175m are composed mostly of a uniform mud with in tercalations of silt and sand (cores 26, 36, 35,4 in fig.1). b) Cores recovered from water depths of more than 180m (cores 31,39,2) contain a cyclothematic lithofacies development centered around sapropelic horizons already reported by Anastasakis (1985) and well established from other deeper regions of the Eastern Mediterranean Sea.

Smear slide petrography has revealed important downcore variations in the compositional attributes of these predominantly fine-grained sediments. From the studied cores (fig.1) the only which apparently recovered the entire Holocene transgression is core 36. This core is getting coarser downwards and smear slides show a significant increase in the terrigenous minerals, most notably in the quartz, feldspar, muscovite, heavy and opaque minerals. From the biogenic components cal careous nannoplankton and foraminifera shells are the most abundant. Towards the base of this core there is a substantial increase in the shell fragment contents, including shells of nearshore environments. Core 26 is also getting coarser downwards, however this trend is not well defined .Generally speaking the fine grained layers (silts and muds) displaying some faint lamination contain increased amounts of terrigenous minerals composed mostly of quartz, feldspars and mica.However adjacent mud layers can contain variable amounts of terrigenous components.The dominating biogenic elements are calcareous nannoplankton and a few foraminifera shells which are getting more abundant downwards joined by an increased proportion of ostracods and gasteropods. Core 35 is composed entirely from current reworked and emplaced thin clastic sand, silt and laminated mud layers.The coarser sandy layers generally display enhanced proportions of quartz and most notably heavy mineral contents. Core 4 is entirely composed of homogeno us mud and only the middle portion of the core is displaying some lamination. This laminated portion is displaying an enhanced proportion of terrigenous minerals, most notably increased mica contents. The biogenic components display no significant variations along this core. Cores recovered from the east Thermaikos shelf(cores 31,39 and 2) con sistently display an increased proportion of terrigenous minerals dow nwards. This increase is getting more pronounced below the sapropelic layers joined by a concomitant decrease of the biogenic attributes. Core 39 contains also an enhanced proportion of stable heavy mineral grains.

The geochemical analysis were performed by means of X-ray fluorescence and the results recalculated carbonate free. In the cores recovered from the outer periphery of the Thermaikos shelf(cores 39 and 2) major element contents, most notably SiO_2 and K_2O, display a clear increase downwards. However this trend is not so obvious on the west shelf region where river derived sediment input during the lower Holocene had a more irregular pattern. Down-core minor element data show some variation between samples. In general, the sapropelic lithofacies is enriched in Ba,Ni and depleted in Mn, when compared to the other lithofacies. Cores containing heavy minerals display a substantial increase in Zr.

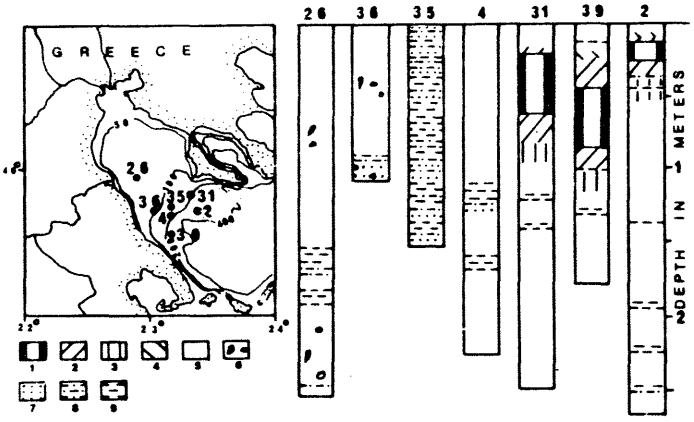

Fig.1:Coring stations and core logs studied in the Thermaikos outer continental shelf region.The basic lithofacies are:1 for sapropelic mud; 7,8,9 for turbiditic sand, silt and mud respectively.

The above cited results indicate that Upper Pleistocene sedimentation in the outer Thermaikos shelf has been influenced strongly by the latest marine regression-transgression. As a result, generally there is observed an enhanced proportion of terrigenous minerals downwards in the cores resulting mainly from the increased input of terrigenous material in the outer Thermaikos shelf region during the uppermost Pleistocene-low Holocene. This was the consequence of the direct fluvial sediment supply in the outer shelf region during the latest major low sea level stand. It is well established, through the study of high resolution seismic reflection records, that deltaic sequences are the main Holocene sedi ments in the Thermaikos plateau(Lykousis et al.,1986).

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Gravity and tectonics of the Southern Aegean Sea

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The southern Aegean and particularly the Cretan Sea were resurveyed recently by gravity, magnetic and seismic methods. The new data confirmed to a great extend the existing modelles and provided new information that can be used to refine the geological concepts for the development of the Cretan Sea.

In the past, the Back Arc spreading modell was used to explaine the evolution of this area. Another possibility for interpreting the observations could be provided by considering the deformation as a consequence of large scale shearing associated with the East Anatolian Fault System and the way that continental crust and lithosphere react under shearing forces. The Cretan Sea, seem under this aspect, can be understood as a'pull apart basin'. Geophysical evidence and gravity modelles will be presented and discussed under this aspect.

G-IV12

Seismic stratigraphy, microfossil dating and the environments of Akburun-Alaçati epineritic succession (Cesme, Turkey)

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On the southern shelf area of the Çeşme Peninsula, a shallow seismic study was carried out and 12 gravity cores (0.30 - 1.15 m.) collected. These marine surveys were conducted by R/V K. Piri Reis along the Akburun - Alaçatı regions (Fig. 1). The stratigraphic succession of the Çeşme Peninsula, which has a Mesozoic limestone basement, is mainly composed of Late Tertiary intermediate-acid volcanics and alternating limestone-marl and sandstone. The uppermost rock unit is represented mainly by tuffaceous sediment, and this is covered by sandy-muddy clastics. Twenty km of seismic reflection profiles and refraction surveys were carried out using 40 in^3 airgun with a single channel hydrophone-array and a sonobuoy system respectively. From these studies, the seismic velocities, thicknesses and dips of layers were determined. The geological cross-section of the area was also constructed from these results (Fig. 1). The observed stratigraphic sequence includes four lithological units (excluding the Mesozoic basement): (1) Volcanics; (2) Neogene limestone-marls; (3) Tuffaceous sediments and (4) Recent sandy-muddy clastics.

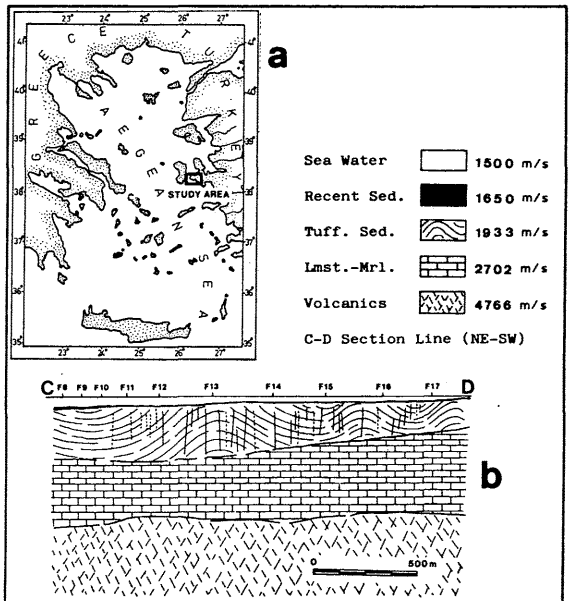

Fig. 1: (a) Location map and (b) Geological section of the study area deduced from the seismic studies.

Micropalaeontological study was mainly applied to the core samples from the Recent sediments and tuffaceous horizon as well as to the land outcrops of the limestone-marl-sandstone unit. The geological age of the tuffaceous horizon is Sarmatian from the association of Elphidium antonium (d'ORBIGNY) E. hauerium (d'ORBIGNY), E. reginum (d'ORBIGNY) and Ammonia beccarii (LINNE). The tuffaceous sediments are lagoonal products. The deposition of the uppermost clastics occurred during the post-glacial period (Holocene) in a shallow marine environment with variation in sea-level given by the following assemblage: Carinocythereis antiquata (BAIRD), Trachyleberis hystrix (REUSS), Xestoleberis communis (MULLER), Ammonia beccarii (LINNE), Cytheropteron alatum (SARS), Elphidium crispum (LINNE), Discorbis globularis d'ORBIGNY Callistocythere elegans (MULLER). Moreover, this unit contains only benthic foraminifers and ostracodes as microfossil association. Absence of planktonic foraminifers in this horizon might be explained by enhanced regional supply of fresh water during pluvial episodes of the Late Quaternary. In addition to this, diversity of the benthic foraminifers and ostracodes is probably linked to a tranquil sea-bottom, with high oxygen availability and abundant nutrients. The micropaleontological studies on the land samples of the limestone-marl unit, showed these also to be Sarmatian in age and deposited in lacustrine conditions, according to the following ostracodes: Candona (Typholocypris) illustris (SNEJDER), Candona nobilis (SNEJDER), Limnocythere sp.

The results obtained in the present study demonstrate the effects of two phases of shoreline oscillation: (i) A late Miocene episode probably related to the begining of Aegean tectonic extension; (ii) A late Quaternary cycle linked to late and post-glacial climatic changes.

G-IV13

La macrofaune marine des sédiments pliocènes et pléistocènes en Messenie Occidentale (Péloponnèse, Grèce)

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INTRODUCTION

La région étudiée se situe au SW du Peloponnèse (fig.1) où les formations pliocènes et pleistocènes se sont dispersées dans 4 petits bassins tectoniques (fig. 2 a,b,c,d).

Fig. 1

Ces formations qui reposent en discordance sur le substratum sont d'origine marine,lacustre et fluviolacustre; elles se constituent en général de marnes sableuses ou argileuses à intercalations gréseuses et de conglomerats.

Les plus anciens dépôts datent du Pliocène inf. (biozone à *Globorotalia margaritae)* , (Koutsouveli et al. 1985, Koutsouveli 1987), affleurent dans le bassin "d" (region de Falanthi), et leur étendue est très limitée,tandis que les sédiments du Pliocène supérieur (biozones à *Gl.crassaformis* et *Gl.inflata*)sont assez répandus (bassins a,b,c,d,). Le Pleistocène affleure dans les bassins "a" (région de Stenossia) à *Hyalinea balthica* (Koutsouveli et al. 1985, Koutsouveli 1987) et "b" à *Chlamys septemradiata* (Koutsouveli, 1987).

BIO-CHRONOSTRATIGRAPHIE ET INTERPRETATIONS PALEOECOLOGIQUES

D'après l' étude détaillée de la macrofaune constituée par 90 espèces de différents groupes (tabl. 1) nous avons constaté que durant le Pliocène inf. (z.à *Gl.margaritae*) la mer était assez profonde, tandis qu' au cours du Pliocène sup. il y avait une diminution de la mer, événement qui se confirme par la présence des Bivalves (Ostrea,Spondylus, Pectinidae e.t.c.),des Gastéropodes (Murex, Strobus,etc.) et d' autres groupes de fossiles . L'espèce *Chlamys septemradiata* caractéristique des sédiments du Pléistocène affleure dans le bassin "b".

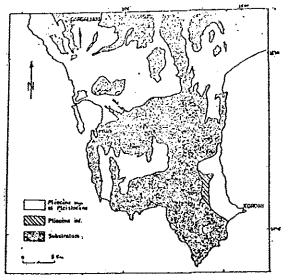

Fig. 2

On peut signaler que l'association des fossiles recueillis dans tous les bassins susmentionnés, a les caractères suivants :

1. Les Bivalves, en général , conservent les deux valves.
2. On observe des traces d'activité des Sponges et des Vermes sur des tests des fossiles.
3. On n'a pas observé des transport des fossiles.

Ces observations nous ont permis de considérer que les fossiles sont "in situ" et il s'agit d' une thanatocoenose.

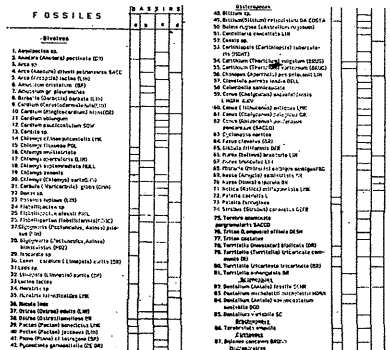

Tableau I

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Upper quaternary organic rich sequences in the outer periphery of the South Aegean Island Arc : new developments

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During the Tyro 87/2 mission a total of 24 piston and gravity cores (Fig. 1) were recovered from the outer periphery of the South Aegean island Arc.Knowledge gained in previous missions suggested that a more codensed and complete stratigraphic record is normally encountered on topographic highs (Anastasakis and Stanley, 1984).It is well established that only cores recovered from regions dominated by hemipelagic sedimentation, that is deposition of sediment by settling through the water column are likely to bear evidence for the complete range of oceanographic conditions affecting the hydrography of the basin (Anastasakis and Stanley ,1986).The Tyro 87/2 coring sites have been selected on a basis of a dense high resolution seismic reflection survey.

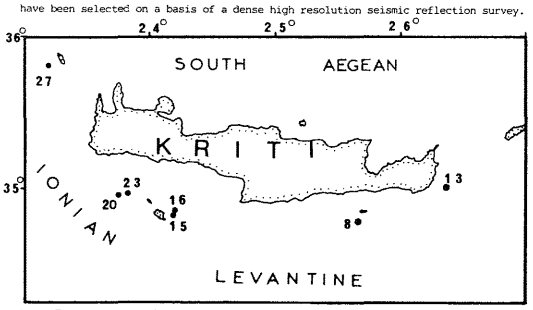

Fig.1. Tyro 87/2 station locations of the cores illustrated in Fig. 2.

Representative core logs from the four regions of the South Aegean island Arc studied in detail are given in Fig. 2.These cores recovered several sapropel-lic sequences displaying a well preserved development and bearing no evidence of reworked organic rich lithofacies..Individual sapropel and/or sapropelic layers are correlated in terms of their compositional , faunistic and isotopic characteristics.New developments in our knowledge of these organic rich Eastern Mediterranean sediments based on the study of these cores suggest: a)A new uppermost limit of S_1 deposition in water depths of less than 230m in the NW Levantine and Ionian Seas.This is based on the recovery of S_1 in cores retrieved from the Gavdos Rise (cores 15 and 16 in Fig. 2).

b)The recovery for the first time, of a complete succession of the five uppermost sapropels in minimal water depths of 300m (Four of them are contained in core 13, see Fig. 2) c)The revelance of similar compositional attributes in the sapropelic sequences S_1 S_2,S_3 which however are displaying differnt isotopic signals suggesting that differrent paleoceanographic scenarios can result in similar sapropel-lic sequence development.

d) The identification of marked differences in the development of the S_4 sequence, including a significant increase in the organic carbon contents reaching values up to 11% with a concomitant decrease in the carbonate contents and an increase in the siliceous test contents upwards.

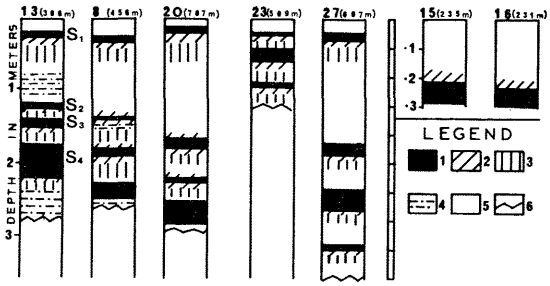

Fig. 2. Representative core logs of the Tyro 87/2 mission. The lithofaces associations in the legend are: 1) sapropel-lic 2) organic ooze 3) grey mud 4) sandy silt.

TABLE 1:

Core No and sample depth in cms	Organic C%	S%	Carbonates %	Core No and sample depth in cms	Organic C%	S%	Carbonates %
TYR-13: 0 - 3.5	0.34	0.14	60	TYR-13: 213 -215	9.5	2.1	48
13 - 15.5	0.99	0.34	58	218.5-220	6.1	1.95	47
18.5- 21	1.1	0.37	56.5	223 -225	1.75	1.5	62
26 - 28.5	0.29	0.24	69.5	234 -236	0.49	0.8	65
113.5-116	0.31	0.17	65.0	271 -273	0.49	0.7	61
118.5-120.5	1	0.39	65.5	TYR-15: 3 - 5	0.28	0.13	68
124.5-126.5	0.36	0.25	65.5	17.5- 20	0.35	0.2	69
137 -139.5	0.27	0.18	64	25.5- 28	0.89	0.85	69
142 -144	1.1	0.34	61	TYR-16: 2 - 4	0.27	0.14	69
145.5-148	1.8	0.48	62	10 - 12	0.29	0.2	67.5
152 -154	0.36	0.28	65	20.5- 22.5	0.38	0.24	65
165 -167	0.48	0.43	56	23 - 24.5	0.86	0.84	65
170.5-172.5	1.85	1.1	37	27 -29	0.92	0.59	64
191 -193	10.95	2.2	48				

It is becoming apparent that each individual sapropel or sapropelic horizon has its own distinctive history, including areal extend, time needed for its deposition and complex interplay of factors that triggered its deposition .Different paleoceanographic scenarios, as evidenced by isotopic signals, can result in a similar stratification and subsequent stagnation of the water column.Moreover some of the Eastern Mediterranean sapropels can result from stratification and subsequent stagnation of the water column accompanied also at some point by an enhanced productivity of the surface waters. These sapropel lithofacies are associated with the highest organic carbon values, normally exceeding 5%.

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The Dolomitic Breccias of Mainalon MT. (Central Peloponnesus). Origin and diagenesis

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ABSTRACT

The Tripolitza zone is tectonically underlain by the Manis metamorphic zone and overlain by the Pindic Arcadic cover and represents a continual platform carbonate sequence, from Triassic to Eocene.

The present study is focussed on the origin of the dolomitic breccias that are distributed along the Jurassic-Cretaceous dolomitic beds of the Tripolitza zone in the Mainalon Mt. and the surrounding areas.

This brecciation is not due to tectonic activity as it is limited to certain stratigraphic horizons and seems to have a local character with no continual lateral extension. On the contrary sedimentological studies revealed that these dolomitic breccias correspond to an evaporite solution-collapse breccia formation.

The breccia clasts are consisted of cloudy xenotopic, microcrystalline,slightly calcian and non-ferroan dolomite, resulting by penecontemporaneous dolomitization of a precursor calcium carbonate sediment, under Sabkha conditions. Dolomitization and following recrystallization has obliterated the primary textural characteri - stics of the sediments. Only in places cryptalgal laminites have been preserved.

The dolomitic clasts either float in a matrix of crushed dolomite or are ce - mented by isopachous dolomite fringes composed of clear coarse blocky dolomite crystals. The dolospar cement is considered a relative late diagenetic event because it has precipitated on cavities and/or cracks surfaces that developed after dolomitization, lithification and dissolution of evaporites by freshwater influx.

A late-stage syntaxial sparry calcite cement coats the remaining dolospar lined voids precipitated from meteoric fluids. Doubly-terminated megaquartz crystals frequently occlude the remaining voids. Due to the well-developed cementation,porosity of the rocks has been strongly reduced.

Evidence for vanished evaporites consist pseudomorphs after evaporite crystals and/or nodules, as well as the euhedral quartz crystals.

G-IV16

Geological structure of the Deep Eastern Mediterranean Sea (East of 25°E)

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The deformation fronts of the Cyprus Arc and of the Mediterranean Ridge, extending from the Turkey-Syria boundary to North Cyrenaïca are the southernmost superficial expression of the convergence between the Eurasian and the African plates. They separate the Eastern mediterranean deep basin into two different structural units

- A thrust belt, northward, with the presence of Cenozoïc sedimentary basins (Iskenderun, Adana, Cilicia, Antalya and Rhodes basins). These basins, filled by 4000 to 6000 m of Cenozoïc sediments, lie on a substratum composed of south vergent nappes emplaced between the late Cretaceous and the late Miocene.
- A fore land area, southward, where the thick Herodotus and Levantine sedimentary basins, relatively undeformed, lie on the passive and subsident african continental margin initiated during late Triassic or early Liassic time.

Due to the still active collision between the thrust belt and the Erathosthenes seamount, the Cyprus island was uplifted and nowadays represents the emerged part of the deformation front.

During the Messinian, with the isolation of the Mediterranean Sea, evaporitic deposits including a salt layer, sometimes more than 2000 m thick, were widely distributed into the Iskenderun, Cilicia, Antalya, Levantine and Herodotus basins. In these basins, the Messinian sedimentation was directly controled by basin topography.

The interpretation of multi-channel seismic profiles recorded East of the 25°E allowed to establish a synthetic structural map and regional geologic cross-sections. Front of nappes, thrusts, faulted and folded belts, evaporites and salt extension, diapiric zones, onshore geology as well as reactualized bathymetry and isopaches of the salt base - sea bottom interval, are figured on the map at the 1/2.500.000 scale.

G-IV17

A review of the gravity field of the Mediterranean Sea. Report from the Meteor-cruise n° 5/6

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During the last few years several sets of gravity data from the Mediterranean countries and sea were collected by the IfG and BGI and compiled into Bouguer Maps of the whole region. More than 200.000 point values from individual surveys, digitised maps and already computed grids were incorporated into this map, which was divided into 10 sheets and printed in 1:1.000.000 scale as overlay sheets to the GEPCO-bathymetric maps of the Mediterranean Sea.

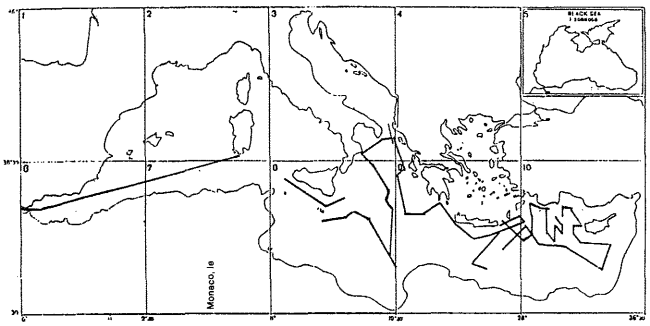

Figure 1.- Track chart Meteor-Cruise 5/6

In summer 1987 during the RV METEOR cruise No. 5/6 in the Mediterranean Sea several detailed gravity profiles were resurveyed. Our aim was to controll the old data and establish their accurencies. The KSS-30 gravity meter and the GPS and Loran C navigation systems permit very precise measurements compared to those performed 20 years ago.

The comparison between the above mentioned Bouguer maps and the direct gravity measurements of RV METEOR is shown for a line in the western Mediterranian from Gibraltar from to 2 degrees West (see Fig. 2). This comparison elucidates that the regional features of the old and the new data are in good agreement.

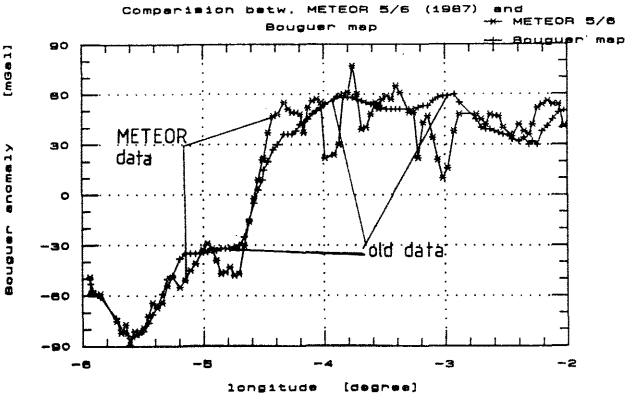

Figure 2.- Western line from Gibraltar to 2 degrees West.

In summary it was found that:

- The average values coincide for both data sets.
- High frequency anomalies, which are shown by the new data, could not be resolved by the old measurements.
- The steepness of gradients are smoothed in the old data and differ significantly from the new ones.

The old map permits a good regional overview over the gravity field in the Mediterranean but for detailed interpretations of geological and tectonic structures new measurements are recommended.

Structure and evolution of Antalya Basin deducted from geophysical data

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The objective of this study is about the structure of the Antalya Bay area as well as its relation with the Taurus belt in the northeast and west, and Cyprus in the southeast. After reviewing the available geophysical and geological data for the eastern Mediterranean in general, the analysis and interpretations of gravity, magnetic and seismic reflection data were attempted for the Antalya basin in proper.

There are still a lot of controversery about the structure and geological evolution of the eastern Mediterranean, its basins and the land surrounding it . There is an argument on the possibility of an early continental break-up, and the north of Africa-Arabia can be interpreted as the formation of a passive continental margin during the Late Triassic-Liassic. Evidence of rifted margins during this time has also inferred from different tectonic sequences (Antalya, Mammonia, and Hatay-Baassit nappes).

The eastern Mediterranean is divided into several subbasins. As in the other parts of the Mediterranean, the Messinean event which is characterized by thick sequence of evaporities, is observed almost all of these basins. Maximum salt layer has been found to be reaching up to 2000 m in the deep Antalya basin where this thickness is controlled by previous topography and the structural evolution of the Cyprus arc in the south.

The Antalya Bay area has a broad 100 mgal Bouguer gravity anomaly closure, appears to be a natural continuation of the Cyprus anomaly to the southeast). This anomaly is terminated abruptly against the authochtonous Beydağ range at the west of Antalya Bay. The eastern part of the Antalya Bay is free from magnetic anomalies. Main magnetic anomalies are located along the axis of the deepest part of the Antalya Bay running in the north-south direction. In this respect that the Antalya Bay area and the Antalya complex may be the extension of Troodos massif where the Bouguer gravity and magnetic anomalies continue under the sea. The Antalya complex thrusting against the Beydağ range, may be the over thrusted segments of the ophiolitic rocks at depth of the Antalya basin giving rise to these magnetic anomalies.

Seismic stratigraphic interpretation of deep penetration multichannel seismic data collected by the Turkish Geological Survey with the R/V Sismik I. using Bolt Airgun Array as a seismic source and 3600 m streamer, was attempted. One main reflecting horizon was distinguished as the base of Plio-Quaternary. Velocity data analysis indicated that the base of Plio-Quaternary can be correlable with the basement velocities possible of ophiolithic rocks. These basement rocks were indicated by weak and dispersed reflections without any special characteristics.

The ophiolities of Antalya, Cyprus and Hatay-Baassit could be pieces of obducted oceanic floor where the eastern Mediterranean deep basins were located on remnants of an old oceanic basin and on an attenuated continental crust. It is very difficult to reconstruot the successive paleographies of the basins in the region because the area has been tectonized continously since the Maestrichtian. In this context, the north of Florence, the Antalya deep basin constitutes a single basin which can be interpreted as interdeep (or fore-arc) basin without no well-defined volcanic arc.

High-resolution seismic reflection (Uniboom) profiles in and around the head of the Anamur Submarine Canyon, Turkey, NE-Mediterranean

Vedat EDIGER, Mustafa ERGIN and S.N. ALAVI

A detailed bathymetric survey, supported by the high resolution seismic reflection (Uniboom) profiles was carried out onboard the R/V Bilim in the Bay of Anamur (Southern Turkey) (Figure.1) in 1985.

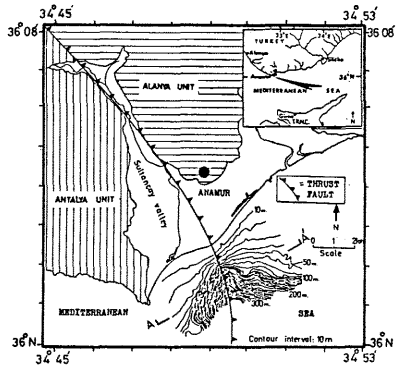


Figure.1. Location map of the study area showing the onshore thrust fault coinciding with the Anamur Canyon.

The main purpose of the study was to investigate the features of an onshore thrust fault of early Tertiary in age beneath the sea floor, if they were present. A total of 36 continuous seismic profiles were obtained both in N-S, and W-E direction. Data obtained in this study has shown that the continental shelf and the upper slope here is dissected by V-shaped submarine canyon head (Figure.2). The rim of the canyon occurs at about the 100 m countour line and its apex is only about 1 km away from the shoreline.

The canyon head shows a dentritic system of tributaries (Figure.3) suggesting its partial erosion during the post-glacial stage as the eustatic sea level fell some 100 m below its present level.

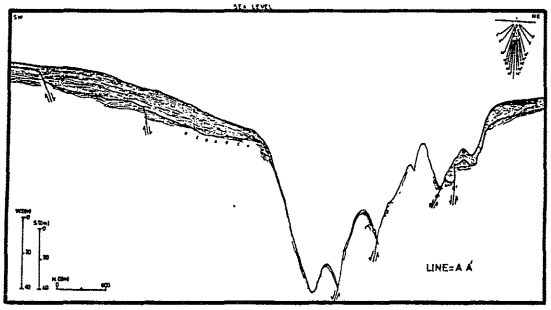


Figure.2. Sketch of a seismic profile along a survey line in the study area. Note the bedrock overlain by unconsolidated sediments.

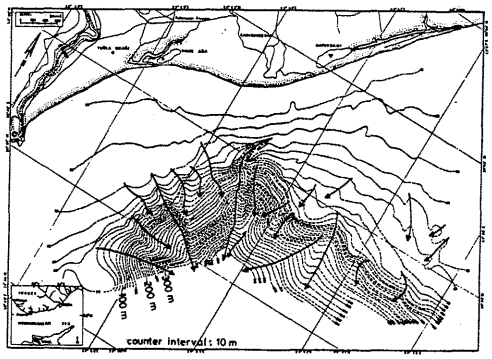


Figure.3. Distributaries and small valleys of the upper reaches of the canyon.

Occurrences of moderately sorted siliciclastic gravelly sand around the rim of the canyon also support this view. The unconsolidated sediment layers were often less than 1 m over most parts of the sides of the canyon. This is presumably due to slope instability on the walls of the canyon.

As the axis of the canyon head is found to be in alignment with a major thrust fault onshore, it is conjectured that the canyon may itself be the expression of tectonic movements. However, the processes of submarine or even aerial erosion in the past may also be partially responsible.

G-IV20

Facies distribution patterns inshore the Mersin Bay (Turkey) mapped with side-scan sonar

Mehmet Nuri BODUR and Mustafa ERGIN

Sampling of a total of 56 surface sediments as well as bathymetric and side-scan sonar surveys were carried out onboard the R/V "Lamas" inshore the Mersin Bay, Turkey (Fig. 1).

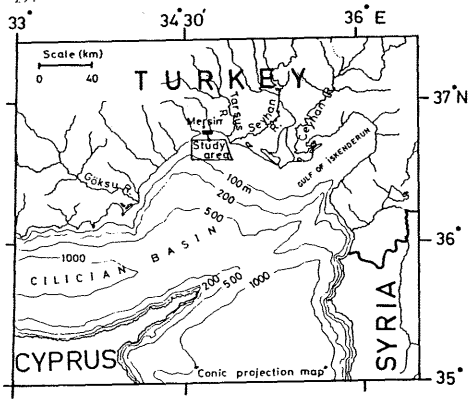


Figure 1. Study area, Mersin Bay, TURKEY.

The main purpose of the study was to investigate recent sedimentary processes and related deposits in areas with depths less than 15 m. Grain size and side-scan sonar data along 29 cruise lines showed irregularities on the sea floor (Fig. 2).

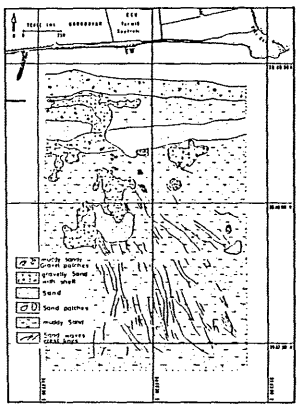
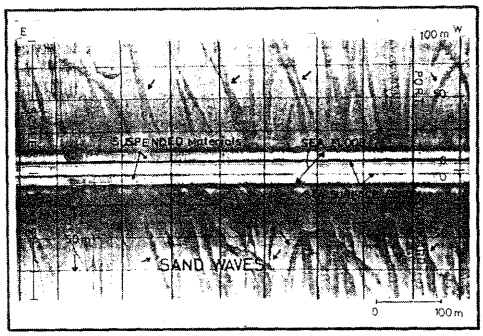


Figure 2. Distribution of sedimentary facies on the sea floor based largely on sonographs.

Surface sediments ranged usually from mud to sand and to gravel in size with varying percentages. The presence of the gravel fractions is related mostly with the occurrences of rock exposures and shell fragments. Gravelly and shelly sediments showed a spotty pattern due to acoustic shadows. Sandy areas appeared with a darker tone while muddy sediments were generally poor reflectors and appeared with light tones on sonographs. Rocky areas showed strong reflections and shadows.



(water depth = 10 m) inshore the Mersin Bay.

The most important features found in this area were a series of bifurcating sand waves (Fig. 3) up to 100 m and more in lengths.
These asymmetrical sand waves which are believed to be more local and transitory reflected prevelance of coastal near-bottom currents oriented in NW-SE direction.

G-IV21

Neogene grabens in the Aegean : regional or secondary extension ?

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New and older data reveal that local spreading is responsible for the formation of two major, representative Neogene grabens in the Aegean; consequently, these grabens do not testify to an extreme post-Miocene regional stretching of the lithosphere in this area, as has been previously suggested. More explicitely:

North Aegean Trough: (i) This graben is of Miocene origin, and consequently predates the postulated Plio-Quaternary extension. (ii) The uniform stretching model predicts that islands bordering this graben result from thermal uplift, dying away from its axis, but geomorphological data show exactly the other way around. (iii) Uplift of both shoulders of the graben is observed, and not uplift of only one of them, as the stretching model presumes (footwall uplift of the main fault). (iv) Fault plane solutions and seismic data showing strike slip deformation, bathymetry, showing deep elongated troughs, geometry of a master and of a secondary fault and folds oblique to the axis of the trough suggest that the latter is of transtensional origin.

Gulf of Corinth: Normal faulting dominates, but stratigraphic and geomorphological data, as well as the pattern of recent vertical motions reveal that this area resembles to two adjacent, homoaxial fold-type flexures, an anticlinoid to the south, and a synclinoid to the north, corresponding to the uplifted area of North Peloponnesus (1800 m of uplift in Quaternary) and to the depression of the gulf, respectively; the eastern end of these flexures is the Isthmus, deformed as by torsion. This suggests that the twin flexures are large folds, and that normal faulting reflects just secondary or gravity spreading. Efforts at explaining the observed morphology as due to a fault with a variable throw, and consequantly with variable footwall uplift, taking their max values in the middle of the fault (gulf) are not satisfactory, for they require seismic energy to be concentrated in the middle of the gulf, something completely contradictory to evidence. Besides that, the footwall theory predicts unrealistically large amounts of throw, or uplifts ten times larger than what is observed.

G

Paleoenvironments and Episodic Stagnation of the Eastern Mediterranean during the Brunhes Epoch

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Paleoenvironmental Reconstructions

Faunal composition and oxygen isotopic analyses of foraminiferal shells were utilized to reconstruct the paleoclimatic and paleohydrologic history of the Eastern Mediterranean during the last 500 K years. The main factors considered important in determining the composition of planktonic foraminifera and pteropods are temperature, salinity, food and oxygen.

Paleotemperature and paleosalinity reconstructions were made separately for surface and intermediate water. *Globigerina bulloides*, *Globigerinoides gomitulus*, *Globigerinoides ruber* and *Globigerinoides sacculifer* were employed for surface water, while *Globorotalia inflata*, *Globigerina pachyderma* and *Globorotalia scitula* were utilized for intermediate water paleoenvironmental interpretations. The reconstruction was done by mapping recent fauna in core "tops" deposited during the Holocene and their calibration against observed present-day temperatures and salinities in the water column. The broad data base, using published faunal distributions from the world ocean covers a wider range of temperatures and salinities and a combination of these factors, than those which are thought to have existed during glacial periods in the Mediterranean. The longest, nearly continuous record, spanning ~ 500 K years is contained in Lamont-Doherty Geological Observatory core RC9-181 (Herman, 1981). This core was less affected by tectonic activity than other cores, although in the upper 150 cms reworked upper Miocene coccoliths were observed. Within the time interval represented by RC9-181 six major cold-warm cycles, correlateable to Emiliani's isotopic stages 1-12 (Emiliani, 1970) were recognized. Calcareous nannoplankton biostratigraphic and biochronologic framework have been utilized for estimating rates of sedimentation and ages. Two important datum levels were recognized: the extinction of *Pseudoemiliania lacunosa* between 899 and 936 cms, suggesting an age of 0.44-0.46 m.y. for this level and the first appearance of *Emiliania huxleyi* 0.26-0.27 m.y.a., between 455 and 479 cm depth in core (Herman and Backman, 1986).

During glacial temperature minima, surface water temperatures were ~ 3°C lower in summer and ~ 3-4°C lower in winter (Herman, 1981). Stadial and interstadial salinities were variable, reaching highest values (at least 1o/oo higher than today) during the last glacial temperature minimum when climates were more arid than today (van der Hammen et al., 1971; Fairbridge, 1972; Flohn, 1973) sea level stood very low, the Nile discharge was greatly reduced and the connection between the Mediterranean and the Black Sea, which is a major supplier of low salinity water was severed (ibid.). Following global warming and subsequent massive deglaciation, sea level rose. When the sea stand reached the Bosporus sill (~ 36 m) the connection between the Mediterranean and the Black Sea was reestablished and the low salinity Black Sea water spilled over into the Mediterranean. A significant increase in precipitation and river runoff is also recorded during transitional climatic periods (Kullenberg, 1952; Fairbridge, 1972). These compounded effects, namely warming of the surface water, together with the flooding of the Eastern Mediterranean by large volumes of fresh and low salinity water produced a low density surface water layer which restricted thermohaline convection (Kullenberg, 1952). The result was stagnation of the sub-surface water and subsequent deposition of sapropels (ibid.). Some of the sapropels including the most recent one deposited between 11,000 and 7,000 years BP (ibid.) were laid down during such intervals of pronounced density stratification. Surface water salinities dropped to low values during the deposition of sapropels as evidenced by oxygen isotope data (e.g. Vergnaud-Grazzini and Herman-Rosenberg, 1969). Twelve sapropels, documenting different degrees of stagnation, occur in sediments representing the last 0.5 Ma.

Today sub-surface water forms in the Mediterranean and it probably did so in the past. We estimate that sub-surface temperature during glacial temperature minima were ~ 3-4°C lower than today and salinities were ~ 1o/oo higher as compared to present day values.

Acknowledgements.

I thank Lamont-Doherty Geological Observatory (LDGO) for making the R. Conrad and Vema cores available and the Core Curators for making the core samples available.

Support for the curating facilities of the LDGO Deep-Sea Sample Repository was provided by the NSF through Grant OCE85-00232 and the ONR through Grant N00014-84-C-0132. This investigation was supported by the donors of the Petroleum Research Fund administered by the American Chemical Society Grant 10939-AC2.

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The study of interstitial water of a core sample from the Nile Cone, Southern Mediterranean

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The aim of this research was to establish the environmental conditions controlling the sedimentation pattern over the Egyptian margin during the Late Pleistocene and Holocene. A gravity core sample of 238cm. length and 2670m. depth was collected from the Nile Cone region and at a distance of 250Km. north of Alexandria (Lat. 33 28 2 N , Long. 30 0 9 E). The interstitial water of this core was analysed for salinity, alkalinity, Cl, SO4, Ca, Mg, Na+K, NH4 and Si. Chemical analysis for interstitial water showed that it retains the original composition of the sea water, and according to Valyashko (1955) it could be classified as oceanic type(MgSO4 ;Alk<Ca). The geochemical interpretation of the data revealed that the anaerobic conditions are highly associated with the excess of organic matter in the sediment succession. Sulphate redution, as well as the decrease of SO4/Cl, NH4 and Si in a downward direction in the interstitial water (Fig.A)and the increase of Alk, Alk/Cl and Alk/SO4 in the same direction confirmed this conclution (Manheim and Chan, 1974, Nasr,1983, Gorsky et. al. 1986). From this study we could conclude that the factors controlling the diagensis of interstitial water of the Nile Cone area during the Late Pleistocene and Holocene time could be summerized in the following: 1) Sea level and climatic oscillations, 2) Rate of terrigenous sediment influx and fresh water discharge , 3) Diagensis of organic matter and clay minerals and 4) Infeltration of salts from the underlying Messinian evaporites.

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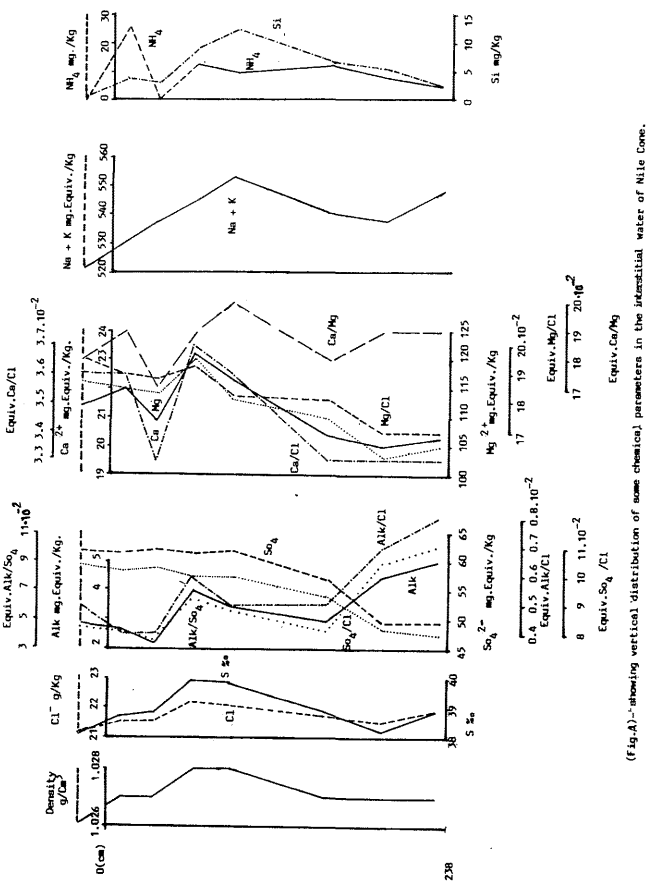

G-IV24

Interstitial water and authigenic minerals formations in bottom sediments, South of Crimea, Black Sea

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Detailed Study of interstitial water and lithology of the bottom sediments of Yelta region, south of Crimea have been carried out. The aim of this work was to recognize the interaction between different processes leading to metamorphism of interstitial water and separation and formation of authigenic minerals from this water during the Late Quaternary time. Eleven bottom core samples with length of about 3m. have been collected at Yelta region along two profiles from the nearshore to the offshore area(1820m.depth). Detailed lithological investigation for the sediments have been carried out. The interstitial water of these sediments was investigated for pH, Eh, salinity, alKalinity, Cl, SO4, Ca, Mg, Na, K, NH4, P, Fe, Mn, Zn, Cu and Ni. Lithological study for the sediment succession showed the presence of eight geological facies differed from each other according to texture, structure and chemical composition. The study of authigenic minerals revealed the occurrence of three types of sulphides(Fine-grained , coarse grained pyrite[FeS2]and greigite [Fe3S4]), two types of carbonates (fine-crystalline calcite and prismatic aragonite [CaCO3]), iorn oxides [Fe2O3.nH2O]. For the first time, barite [BaSO4] and vivianite [Fe3(PO4)2.8H2O] have been recorded in the bottom sediments of the Black Sea. Geochemical interpretation of the data may allow us to conclude that the main factors controlling the formation and diagensis of the interstitial water of the area under investigation could be summerized in the following: 1) Increase of salinity as a direct result of connection of Black Sea with the Mediterranean Sea 9000 yr B.P. (Emelyanov and Chumakov, 1962, Sayles et.al. 1973, Manheim and Schug, 1978). 2) Biological factor expressed in sulphate reduction and oxidation of organic matter. This factor led to accumulation of biogenic compounds such as NH4 and P in the interstitial water (Gorsky, 1980) and 3) Ion-exchange between the interstitial water and sediments. This factor led to direct metamorphism (Valyashko, 1981) and formation of a new type of interstitial water which is calcium chloride [CaCl2] instead of the oceanic type (MgSO4). Finally, good correlation have been established between different types of authigenic minerals at different horizons and chemical composition of the interstitial water at the same horizons.

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G-IV25

Geochemistry of short core sediments off Alexandria Region

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Since the early twenties of this century, the shelf sediments of the Egyptian coast, specially those of the Nile delta, have been the interest of several geological surveys. Texture, chemistry, minerology and microfauna were of prime importance for these investigations. Apart from the long core samples collected during the Swedich Deep-Sea Expedition (1947-48), R/V ALBATROSS and R/V VEMA in the late fiftees along the Egyptian coast, attention was only focused to the characteristics of the surficial sediments. The present study aimed to represent the levels of some metals in short core sediments in relation to their organic carbon and carbonate content.

During July 1986, short core samples (18-30 cm) were collected from three different sites located west and east of Alexandria region (figure 1). Station I represents the bottom of a highly oligotrophic water system (24 m depth) while station II is located at the mouth of Rosetta Nile branch (13 m). Station III was sampled at about 25 Km (24 m depth) offshore from station II to represent the corresponding stratification at offcoast locations. Collection of samples was carried out using a pheliger core. After collection, samples were kept freezed at -18°C. Organic carbon was determined according to El-Wakeel and Riley (1957) while the method described by Presley (1975) was used for determination of total carbonate content. Residual concentrations of Al, Fe, Mn, Cu and Ni were determined using AAS according to the method described by Tessler et al.(1979). The accuracy of the analytical methods were tested against Standard River Sediments 1645 from NBS and were found satisfactory (C.V. 2-5%).

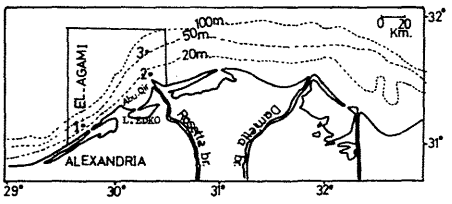

Figure 1. The study area and location of sampled stations.

Figure 2 represents the vertical profiles of organic carbon , total carbonate and studied elements in sediment core samples collected from the three selected stations. Generally, considerable variations appeared between the levels recorded for the inshore stations (El-Agami and Rosetta I). Higher carbonate levels i.e. 32-51% were observed at El-Agami station while carbonate concentrations in Rosetta inshore station do not exceed 11%. The average ratio of carbonate content for inshore:offshore samples in Rosetta region was 0.6:1 indicating the decrease of carbonate content sea-wards. El-Sammak (1987) recorded high carbonate levels in El-Agami area reaching >80% most of which are in the form of pseudo-oolit possibly derived by errosion of coastal formations and beaches while El-Wakeel and El-Sayed (1978) argued the low carbonate content of Nile sediments to the solubility of CaCO3 in Nile water. Newly deposited Nile sediments represented by the upper few centimeters of the core showed high carbonate content reaching 2-3 times those of middle and bottom layers. However, organic matter showed a reversed trend to that of carbonate (r=-0.65) with higher values for Nile sediments (average 1.37-1.74%) compared to 0.75% found

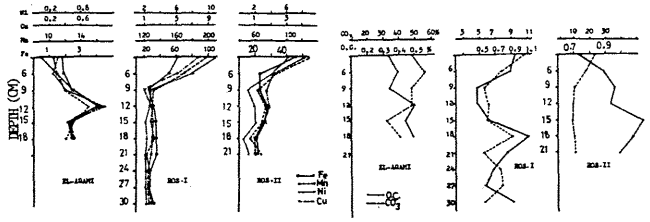

Figure 2. Vertical profiles of O.C.(%), CO3(%), Fe(mg/g), Mn, Cu&Ni(ug/g) in core samples. west of Alexandria region. The increase of organic matter(O.carbonX1.8) content with depth at station I coincided to a more or less extent with the decrease in carbonate content and the oligotrophic nature of the overlying waters. The enrichment of the top layer of Rosetta I core with organic matter could be explained by the increased rate of deposition of fine grain sediments high in organic content at the mouth of Rosetta Nile branch.

The enrichment of all studied elements was observed in the top layer of core samples(figure 2) collected from stations II and III as indicated by the high metal/Al ratio calculated for surface : total column (ex. $0.12X10^{-3}$: $0.07X10^{-3}$ & $0.69X10^{-3}$: $0.05X10^{-3}$ for Cu, respectively). This increase was followed by a sharp decrease then a nearly constant profile to the core bottom. The gradient of metals decrease with depth was maximum between 3-6cm for station II but between 0-3cm for station III due to different depositional regimes. In station I, higher levels of different studied elements were observed at bottom levels(below 9 cm) with maximum values always between 9-12cm(figure 2). The high carbonate content of station I may act as a diluent factor for these elements in sediments. Co-variation between different metals and the carbonate content showed always negative correlations(r= -0.75, -0.62, -0.31 & -0.39 for Fe, Mn, Cu & Ni, respectively). On the other hand, studied elements showed significant positive correlations with organic matter content specially Cu(r=0.66) reflecting their tendency to form organo-metallic complexes. Fe&Mn show a good positive correlation with each other(r=0.95) indicating their incorporation within the sediments. However, the efficiency of MnO2 particules to transport Ni ions from the overlying water to sediments was reflected on the high correlation observed between both elements (r= 0.752).

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Sea level rise in Alexandria during the Late Holocene : archaeological evidences

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The Mediterranean Sea as such is regarded as a natural historical museum in which the eventual history of various civilization is displayed. Most of the submerged ruins are Hellenistic quays, harbours, village, statues, shipwrecks and other artifacts.

Since its construction in 332 B.C, Alexandria became one of the main centres of Hellenistic civilization. The sea level has greatly changed in Alexandria than during the Ptolemis and Roman times (Breccia,1922). Alexandria was also subsided (2-3 m) during this period, this was observed in the necropolis along the coastal area. Direct evidences for the subsidence of the earth's crust accompanied by the rise of sea are the submerged Roman ruins in the Eastern and Western Harbours of Alexandria and in Abu Qir Bay (Jondet, 1916; Tousson, 1934; Morcos, 1985).

Several observations were made on the coastal stretch of Alexandria on emerged and submerged coastal structures, excavated pools & necropolis to derive the original sea level following the method of Flemming (1969).

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Table 1. Ancient sites in Alexandria, with age in millenia, relative displacemnt in m, average rate of displacement.

Name	Age (millenia)	Depth (m)	Depth/age (m/millenium)
Pharos (lighthouse)	2.3	2	0.86
Timonium	2.0	4	2.0
Antirrhodes	2.0	2	1.0
Cape Lochias	2.0	2	1.0
Hercules T.	2.2	4	1.8
Isis T.	2.0	3	1.5
St. Chyr Ch.	2.0	3	1.5

The ancient sites in Alexandria with approximate age in millenia and relative displacement in meters are shown in Table 1. A vertical movement on the coast of Alexandria is of 1-2 m/millenium downwards. Although, no concrete relation was found between age and depth of sites, a relative vertical displacement higher than the effect of the rise of sea level is obvious. Therefore, the eustatic factor is accompanied by a tectonic factor in Alexandria. Tectonic factor accompanied by the warping of the Nile Delta resulted the subsidence of the coastal area. Broadus et al (1986) found that the rate of subsidence of the Nile Delta is in the order of 5-6 m every few thousand years. As sea level rises the wedge of salt water that underlies the delta fresh ground water is forced further inland. This ground water seriously affect most of the coastal antiquity sites along Alexandria.

A prospective scenario assumes a 1 m rise in relative sea level over the next 100 year in the delta of Egypt; this can be thought of as a 50 cm rise in eustatic sea level combined with 50 cm increase in local subsidence (Hoffman et al., 1983). This rise would affect at least 15 % of Egypt's current gross domestic product (Broadus et al., 1986).

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Application of factor analysis to the geochemical data of Alexandria shelf sediments

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Introduction:

The shelf of Alexandria encompasses two depositional sedimentary environments (El-Sayed, 1979); this area has well-defined geochemical and mineralogical provinces (El-Sayed, 1981). This paper discusses the application of the Factor Analysis (F.A) to the geochemical data of 40 bottom sediment samples collected from the inner shelf of Alexandria (Fig. 1) and representing the different sediment constituents.

Methods:

Powdered samples were totally digested by a mixture of strong acids; quantitative chemical analysis was carried out in an AAS for the determination of major elements and some trace metals.

The raw geochemical data were classified objectively using F.A. The F.A starts by the construction of a correlation coefficient matrix, then the extraction of eigenvectors and eigenvalues. The final step is the varimax rotation technique to achieve a simple structure to the rotation of the factor matrix.

Results and discussion:

The average concentrations of the geochemical parameters are as follows: 19.46 % SiO_2, 11.76 % Al_2O_3, 31.03 % CaO, 5.72 % MgO, 1.12 % Fe_2O_3, 0.14 % TiO_2, 0.53 % NaO, 0.14 % K_2O, 0.05 % MnO, 66 ppm Cu and 52 ppm Ni.

The rotated factor matrix is shown in Table 1, while the plot of the first two factor is presented in Fig. 2. Results of the F.A reveal that three factors account for 70 % of the initial information. Factor 1 accounts for 33.7 % of the total variance and characterizes the association of Ca-Mg and Na and the inverse association of Fe-Mn. It is mostly a carbonate factor which define the skeletal and non-skeletal carbonates in the area and the chemical interaction between iron and manganese. Factor 2 accounts for 19 % of the total variance and describes an alumino-silicate association which strongly reflects the terrigenous and relict origin of most of the sediments. Factor 3 which accounts only for 17.4 % of the total variance defines a K-Fe-Mn association. This factor reflects the feldspar-clay mineral association which is largely contributed through terrigenous agencies.

The F.A provides a powerful approach to the interpretation of wild geochemical data in a rapid and explicit way; it also enable the identification of the different sources and association of elements in the inner shelf of Alexandria.

Fig.(1)

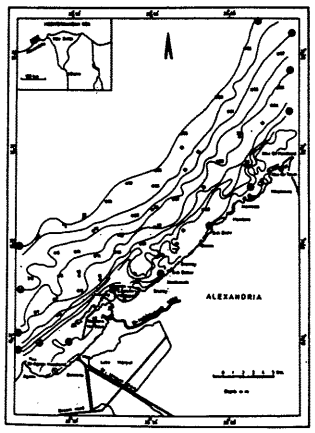
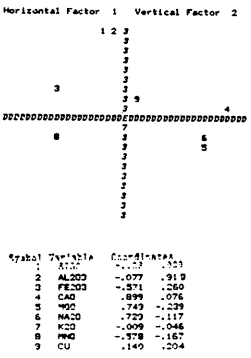


Table (1)

Rotated Factor Matrix:

	FACTOR 1	FACTOR 2	FACTOR 3
SIO2	-.12278	.90868	-.08192
AL2O3	-.07720	.91775	.24084
FE2O3	-.57140	.28934	.63831
CAO	.89674	-.07616	-.14955
MGO	.74901	-.23907	.01714
NA2O	.72950	-.11705	.31988
K2O	-.00902	-.04298	.91769
MNO	-.57845	-.16719	.50369
CU	.14041	.20418	.34925

Fig.(2)



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G-IV28

Nile Delta shoreline changes : aerial photographic study of a 28-year period

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ABSTRACT
Airphotographic analysis is used to detect erosional and accretionary changes, and to define coastal features along some stretches of the Nile Delta coast of Egypt. Two series of aerial photographs, taken in 1955 and 1983 were applied to three unstable coastal zones: the Rosetts and Damietta promontories, and the Burullus-Baltim sector. Comparison of the two successive photo surveys serve to monitor the impact of the Nile River control and the coastal dynamic regime. The study reveals that the outer margin of both Rosetta and Damietta promontories seem to be the most eroded areas. These promontories are retreating due to the cut off the sediment supply after damming the river. The estimated highest rate of erosion during the 28-year period is: 114, 9 and 31 meters per year, respectively, at Rosetta, Baltim and Damietta sectors. Remarkable accretionary patterns are also coupled with shoreline erosion, as has been noticed on the eastern side of the two promontories, and to the west of Burullus inlet. Moreover, photographic analysis helps to detect some salient coastal features such as the ancient coastal sand ridges east of the Rosetta and Damietta promontories, and a distinct spit southeast of the Damietta promontory.

DISCUSSION

A comparison of the set of 1955 and 1983 aerial photographs and maps constructed based on these indicates that during the 28 year study period, the outer margin of the Rosetta and Damietta promontories have been eroded (Fig.1 a&c). The highest erosion rates are 114 and 31 m per year, respectively. The Burullus-Baltim sector along the coastal zone of the delta ie erosional, with greatest rate of 9m per year (Fig. 1b). This investigation of airphotographic analysis is also coupled with earlier coastal dynamic factors (waves, littoral currents and tides) affecting the coast in this region published by others Manohar, 1976; Quelennec and Manohar, 1977; Khafagy and Manohar 1979; Fanos, 1986). The coastal processes affecting the two promontories appears to operate in a similar manners: much of the eroded materials from the tip of the Rosetta and Damietta promontories is transported easward by littoral drift and accreted on the the eastern parts of the promontories. Moreover, there has been formation of a spit on the same (eastern) side of the Damietta promontories. Also of note in the 1983 aerial photos is the shoaling of the entrance of Burullus inlet and the mouth of the Rosetta Nile branch a phenomenon which caused navigational problems particulary to fishing boats.

In summary, it can be ascertained that the observed erosional and accretionary patterns along the three investigated sectors resulted from the interaction of the prevailing coastal processes and decrease of sediment supply from the Nile River upon completation of the Aswan High Dam in 1964.

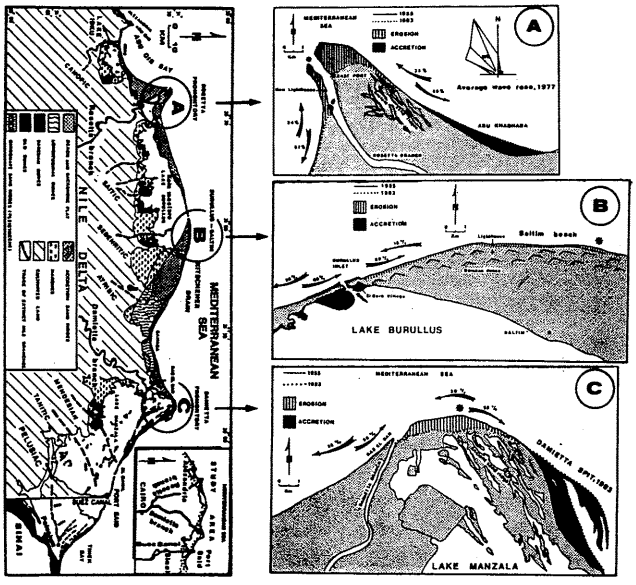

Figure 1. Shoreline changes at the three study areas during the 28-year period, from 1955 and 1983. Points (*) denote the highest rate of erosion, 114, 9, and 31 meters per year respectively at Rosetta, Baltim and Damietta sectors. Arrows indicate the directions of dominant littoral currents; the frequency is denoted by the percentages.

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G-IV29

The oblique oceanic spreading along the Dead Sea Rift

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Recent geological and geophysical investigations of the Dead Sea rift indicate that the rift was formed by oblique tectonic offsets, consisting of both normal and strike-slip components. Most geological and geophysical observations are apparently conformable with both offsets, such as the occurrence of normal and strike-slip faults along and within the rift, the sedimentological evidence of the subsidence rate of the rift floor, the occurrence of mesozoic basement underneath the rift-fill, the thinned crust and the anomalously low seismic velocity in the upper mantle underneath the rift, the southward increase in heat flow and the ENE-WSW trending in situ extensional stress in the rift and its western margin. The quantitative rates of horizontal and vertical displacements are not known, but updated geological and geophysical evidence suggests extensional opening of 15-20 km, lateral displacement of approximately 10, km and crustal thinning of 25-30 percent.

Some of the important geological evidence from the rift seems inconclusive, such as the solutions of earthquakes focal mechanisms, which are poorly constrained, or the lengths of the intra-rift basins, which are unrelated to the strike-slip displacement. Inconclusive also is the significance of the occurrence of contemporaneous, isofacial sedimentary sequences at the facing flanks of the rift, with the eastern occurrences located some 100 km north of their corresponding sites on the western flank. This finding could be attributed to the depositional NNE-SSW sedimentary facies trend that commonly prevailed in the region from the Triassic to the present.

Studies in the northern Red Sea and the Suez rift showed that the extensional tectonic regime of the northern Red Sea prevailed there continuously since the early Miocene. The Suez rift became tectonically inactive in the late Miocene, and the northern extension of the Red Sea spreading center jumped eastwards and formed the Dead Sea rift in the early Pliocene. An arcuate system of rifts in the northern Red Sea changes its trend northward from NNW-SSE to NNE-SSW, and continuously extends from the Red Sea into the Gulf of Elat. These rifts are interpreted as products of an extensional tectonic regime, and suggest that the axis of the northern Red Sea incipient spreading center extends into the Gulf of Elat. This interpretation is conformable with observations from the central Jordan valley and from the Sea of Galilee, that indicate the unlikelihood that large lateral offset occurred along the Dead Sea rift there.

The discussion concerning the tectonic origin of the Dead Sea rift is far from settled, but it seems that the available data are compatible with the model suggesting that the rift is an incipient spreading center extending from the Red Sea, the separation across this young spreading center is oblique, but the lateral offsets are secondary to the vertical displacements.

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Le rôle de l'héritage dans la formation des bassins et des marges océaniques. Les exemples du bassin Liguro-Provençal, de la mer Rouge et de la marge Armoricaine

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Le terme de "modèle", primitivement cantonné aux sciences expérimentales, s'est progressivement diffusé dans le langage géologique grâce à l'importance grandissante du rôle de la géophysique dans la compréhension des phénomènes géologiques. Cependant, l'usage généralisé de ce mot ne peut pas dire qu'il a la même signification pour chacun. Pour les géophysiciens, il n'est qu'un outil intellectuel indispensable pour ordonner les résultats d'une mesure. Pour beaucoup de géologues, il s'agirait d'une proposition beaucoup plus concrète, analogue, par exemple à la traduction à une échelle plus petite d'un lever de terrain détaillé.

Quelques exemples vont nous montrer comment les structures observables de quelques domaines marins peuvent s'écarter notablement d'une "structure" théorique déduite le plus simplement possible d'un modèle géophysique. Ceci nous amènera à mettre en évidence le rôle déterminant de l'héritage structural dans la réponse du domaine continental à la formation d'un domaine océanique.

La morphologie d'ensemble de la **Mer Rouge** et des reliefs qui l'encadrent constitue un cas tout à fait pédagogique pour illustrer une séparation commençante de blocs continentaux. On notera :
- la remarquable concordance du tracé des rivages orientaux et occidentaux ;
- la correspondance des bordures montagneuses littorales, de sorte que, comme l'a noté MC KENZIE, les courbes de niveau des 1000 m se correspondent ;
- le fait que, compte tenu de l'ouverture d'amplitude croissante du N au S, les fonds océaniques n'apparaissent que dans la moitié sud de la mer selon une étroite bande axiale.

Il n'est pas, jusqu'à l'existence du triangle des Afar et de la "Bielette danakile", qui ne renforcent l'impression d'un passage simple des faits à un modèle théorique, y compris avec une complication locale permettant d'affiner ledit modèle.

On comprend qu'une telle morphologie ait pu suggérer à certains auteurs que l'ensemble du fond de la Mer Rouge, du Golfe d'Aden et de l'essentiel du triangle des Afar ait pu être océanique. Les données géophysiques de forages et d'études directes conduisent à limiter l'étendue du domaine typiquement océanique. Celui-ci constitue le plancher d'une vallée axiale entre 15° et 20° N puis, au-delà vers le N, le caractère océanique n'apparaît plus que ponctuellement au sein de fosses, parfois à saumures, et dont la plus septentrionale est la fosse Jean Charcot (Shaban), sur le 26e parallèle. On peut penser qu'une telle disposition signifie que l'océanisation ne s'effectue par selon un processus continu à la manière d'une "fermeture éclair", mais d'une façon discontinue, par coalescence progressive de zones pionnières.

L'examen des caractères géologiques de ces fosses et de la vallée axiale qui les contient montre que ces structures apparaissent dans un contexte d'extension limitée, en tout cas facilement compensé. La formation des fosses semble résulter d'un défaut ponctuel de cette compensation lié au passage d'un accident transverse à l'axe de la vallée.

En ce qui concerne la vallée elle-même, ses limites, sa structure d'ensemble et sa constitution géologique sont assez bien connues. En accord avec la remarquable symétrie de la morphologie des bordures de la Mer on pourrait s'attendre à ce que cette vallée "axiale" se localise avec précision au niveau de l'axe de la Mer Rouge. En fait, le tracé s'en écarte notablement. L'examen des faits géologiques aboutit à une conclusion qui rejoint celle obtenue sur les fosses, c'est-à-dire que la localisation de la vallée est sous le contrôle d'accidents dont les directions sont différentes de celles qui régissent l'aspect d'ensemble de la Mer Rouge. Un simple examen des cartes des régions qui encadrent la Mer Rouge permet de retrouver ces mêmes familles de direction N-S, N45, N130.

Les processus de l'ouverture de la Mer Rouge et parmi eux, les phénomènes thermiques, ont donc bien contrôlé la disposition générale des reliefs crées lors de cet épisode. Cependant, ceci ne s'est pas exprimé par la formation de nouvelles structures propres au processus, mais par le réemploi de structures préexistantes. Ailleurs, tout s'est passé comme si ce réemploi avait modifié l'expression du phénomène profond, jusqu'à provoquer des écarts importants entre le tracé théorique de la vallée axiale et sa localisation réelle. Il a pu aussi induire la formation des fosses, introduisant ainsi des facteurs de discontinuité dans une océanisation que les masses mises en jeu imposent de supposer continue.

Dans le cas du **Bassin Liguro-Provençal**, une étude des niveaux supra-évaporitiques et du diapirisme qui les affectent a mis en évidence des familles de directions structurales qui ont guidé la montée des diapirs et contrôlé certains dispositifs sédimentaires. Schématiquement, certaines zones du pied de l'éventail profond du Rhône apparaissent structurées selon des directions N-S et E-W, tandis que d'autres, plus au Sud, sont structurées selon des directions NE-SW et NW-SE. Toutes les directions se retrouvent sur le continent, mais divers arguments conduisent à voir dans la deuxième famille une caractéristique du fond océanique local, correspondant aux directions de transformation et d'accrétion.

On voit donc que la formation d'un fond océanique lié à la dérive du bloc corso-sarde s'est ici accompli en suivant les guides de la fracturation continentale primitive. Comme celle-ci est le reflet du réseau rhegmatique régional, on doit admettre que celui-ci est le guide unique de la structuration continentale aussi bien qu'océanique.

Le **talus continental qui s'étend du Canyon du Cap Ferret à l'Eperon de Goban** borde au N le fond océanique du Golfe de Gascogne. C'est sur cette marge qu'ont été mis au point les modèles d'amincissement de la croûte continentale par constitution de blocs basculés et failles listriques. Ces accidents sont décrits comme ayant un pendage systématiquement océanique et des rejets croissants du continent vers l'océan. Une telle disposition expliquerait mécaniquement l'amincissement. En principe, les blocs basculés ont un allongement parallèle à la marge et sont de plus en plus "basculés" au fur et à mesure que l'on s'écarte du continent.

La direction générale du talus étant N120, on devrait s'attendre à trouver des blocs ayant cet allongement séparés par des failles listriques présentant cette même direction. Une famille d'accidents transversaux plus ou moins perpendiculaires devrait pouvoir également y être observée.

En pratique, une étude minutieuse des très nombreux profils sismiques disponibles sur cette zone, particulièrement entre la Terrasse de Mériadzek et l'Eperon de Goban ne permet pas de mettre en évidence ces directions "prévisibles". On y relève seulement deux familles très dominantes à N60 et N130 qui, selon les lieux, jouent l'une en faille normale et l'autre en décrochement. Vers Mériadzek, c'est la direction N130 qui est décrochante, au S de Goban, c'est l'autre famille. De plus, si les regards "océaniques" des failles normales sont les plus fréquents, ils sont loin d'être les seuls et certaines portions de profils présentent une simple succession de horst et de grabens. A une autre échelle, on notera que les points à sédimentation urgonienne s'alignent sur les zones ascendantes du continent voisin tandis qu'ailleurs, la sédimentation marneuse de même âge correspond aux régions à tendance négative.

Nous sommes donc ici très loin de ce que les modèles d'amincissement laissaient supposer. La structure d'ensemble est beaucoup plus le reflet de la remise en fonctionnement d'un dispositif hérité que de la création d'une nouvelle structure adaptée au contexte tectonique. Ceci se conçoit d'autant mieux qu'il s'agit d'une tectonique en distension mais oblige à se poser la question de la signification d'un "modèle" ainsi privé de toute possibilité d'expression.

Ces trois exemples illustrent le rôle de l'héritage continental dans la structuration des domaines océaniques. Cela doit rendre prudent dans le choix des faits destinés à constituer un modèle. Certains peuvent être directement l'expression des phénomènes que l'on se propose de décrire, d'autres n'en sont qu'un reflet lointain et infidèle. Ceci, dans l'hypothèse favorable ou des faits suffisants étayent le modèle. Dans d'autres cas, l'écart est tel qu'on doit se poser la question de la validité de celui-ci.

Asymmetric distribution of Crust in the Northern Red Sea. Evidence for shear controlled early oceanisation (Pull Apart Model)

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The crustal structure of the Northern Red Sea was established from the results of several geophysical campaigns: Seismic observations show on the western flank an abrupt change from continental to oceanic crust only 25 km offshore Egypt, while on the eastern flank thinned continental crust extends almost into the center of the Red Sea. This asymmetry is also expressed in the gravity field as the computations of two-dimensional gravity lines show.

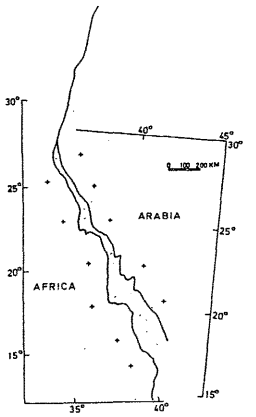


Figure 1. Pre-Red Sea-Rift.

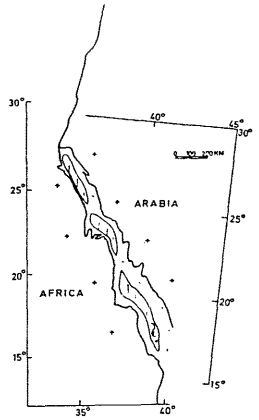
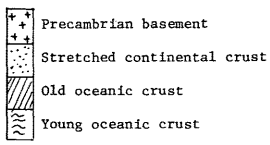


Figure 2. Creation of Pull-Apart Basins along the Western Red Sea Margin.



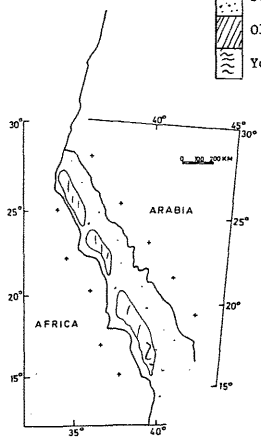


Figure 3. Stretching of continental Eastern Red Sea Margin.

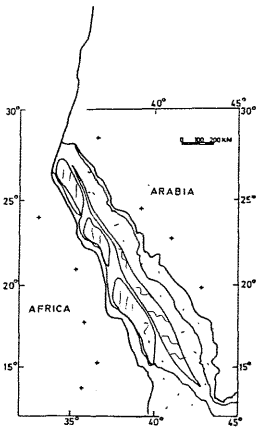


Figure 4. Sea floor spreading in the Axial Red Sea Trough.

The data implicate, that different tectonic processes were relevant during the Red Seas evolution:
- Continental stretching affected only the eastern margin of the northern Red Sea.
- Recent sea floor spreading in the axial trough was preceded by
- early oceanicsation in pull apart basins along the western Red Sea margin.

Those pull apart basins were generated by strike slip movement along major transcurrent fault, which obliquely cut an old zone of structural weakness, the pre Red Sea rift. Displacement of the fault along the rift facilitated subsequent oceanicsation of the pull apart basins.

G-V2

Seismic, Gravity and Magnetics Surveys in the Central Red Sea : their interpretation and implications for the structure and evolution of the Red Sea

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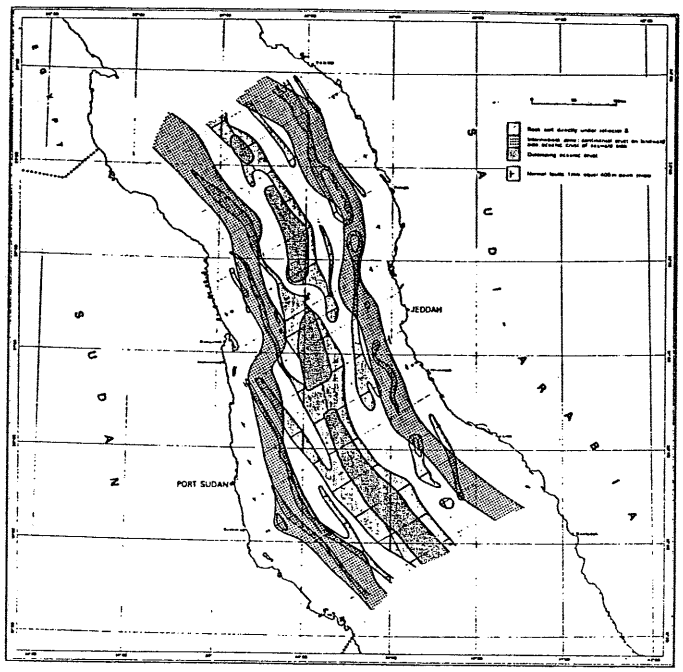
While there is unanimous agreement that the axial part of the Red Sea has witnessed seafloor spreading since the early Pliocene, opinions diverge considerably with regard to the situation in the main trough and shelves. New, high-precision data comprising palaeomagnetic, seismic, gravity, magnetic, and bathymetric measurements from the central and northern parts of the Red Sea have been examined to discriminate between the earlier proposed hypotheses, and to formulate an evolutionary model for the Red Sea. The results show that oceanic crust extends for at least 80 km (at 19°N) on each side of the spreading axis. Symmetrical seafloor spreading magnetic anomalies are recognized out to: anomaly 3A (6 m.y.B.P.) between 18°30' and 19°45'N; anomaly 2A between 19°45' and 20°N and near 21°N; anomaly 2 near 22°N and only anomaly 1 near 23°30'N. Although anomaly 3A is the oldest recognizable magnetic anomaly, the extent and configuration of the oceanic basement as determined from seismic measurements indicate that spreading has occured and continued without a hiatus since 10-12 m.y.B.P.



Seismic interpretation map: results from 21 coast-to-coast multichannel seismic reflection profiles showing boundaries of the different types of basement and belts of rocksalt. Crosses indicate intermediate crust which separates definite continental from definite oceanic crust. Outcropping oceanic crust is hatched, whereas belts of rock salt are stippled.

The definite continental crust is restricted to an approx.30 km wide stripe along the Red Sea coastlines. The area of "intermediate crust", seperating the well defined types of crust, is that of maximum sedimentary coverage, which was elucidated by wide angle reflection and refraction profiles in early 1988. Those results indicate that on the western flank off Sudan the nature of this intermediate crust is oceanic.

G-V3

Crustal structure of the Central and Southern Red Sea. New seismic data

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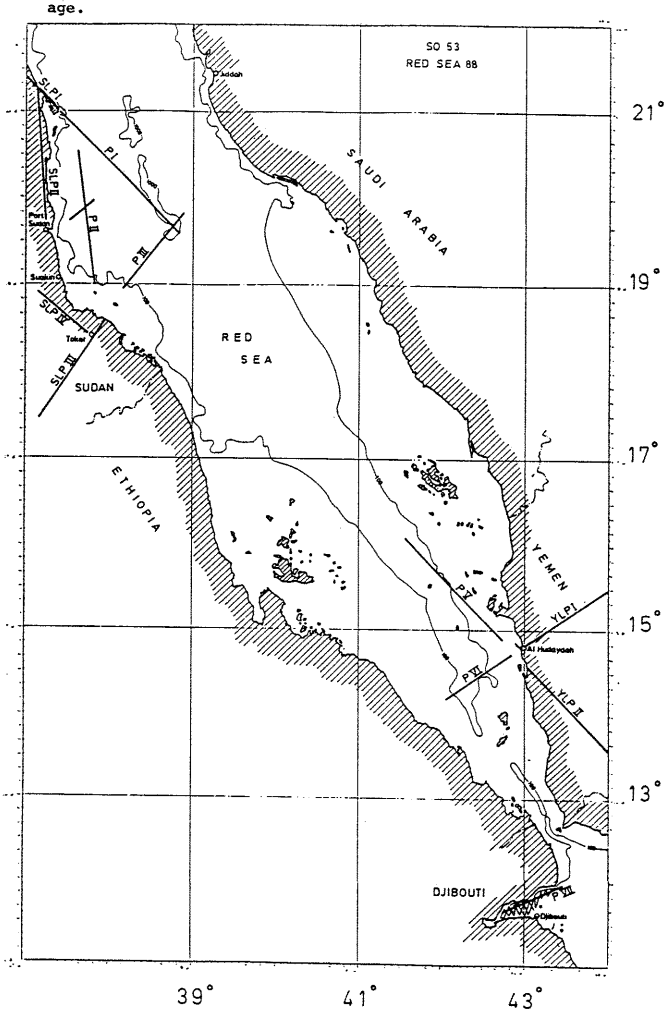
Crustal Structure of the Central and Southern Red Sea - new Seismic Data

In early 1988 an onshore/offshore geophysical experiment was carried out in the central and southern Red Sea. Main areas of interest were the western flank off Sudan and the eastern flank off the Y.A.R. In both areas seismic profiles crossed the entire structure from the newly formed oceanic crust in the axial trough into the old continental blocks of the African and Arabian Shield. Energy was generated using explosives and a large airgun array.
Evaluation of wide angle reflections and refractions permitted in both areas precise delineationg of ocean-continent transition. The results show that

- the axial Red Sea Trough is floored by young oceanic crust,
- the western flank offshore Sudan contains a major portion of older oceanic crust, overlain by thick sedimentary series. A significant part of these sediments lies below the mid-Miocene evaporites and is characterized by low p-wave velocity,
- the eastern flank offshore Yemen is made up of stretched continental crust and does not show sediments of pre-evaporite age.



A microseismic array of eleven units had been deployed in the Suakin Deep (axial trough offshore Sudan) covering an area of approx. 400 km^2. The evaluation revealed an astonishing high microearthquake activity of approx. 100 events per day. Localisation of hypocenters permitted exact delineation of active fault and fracture systems.

Similitudes entre les éléments structuraux majeurs aux limites Afrique-Méditerranée en Tunisie et Amérique du Sud-Caraïbe à l'est de Trinidad

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Les éléments structuraux majeurs caractéristiques de la Tunisie Atlasique, au N. de la plateforme saharienne, sont induits, pour l'essentiel, par le jeu de décrochements conjugués. Les études de terrain et/ou les analyses de profils sismiques conduites dans la région des Chotts, le paléo-archipel de Kasserine, le Sahel de Mahdia, les bordures du Golfe de Tunis, la presqu'île du Cap Bon et le Plateau Continental oriental, révèlent une même logique des déformations. Les plis en échelon fréquemment fléxurés, les chevauchements, diapirs, failles, fossés, sillons sur décrochements ... entrent dans un système cisaillant de décrochements majeurs dextres, grossièrement E - W , et senestres, sub-méridiens (1) (Fig.1).

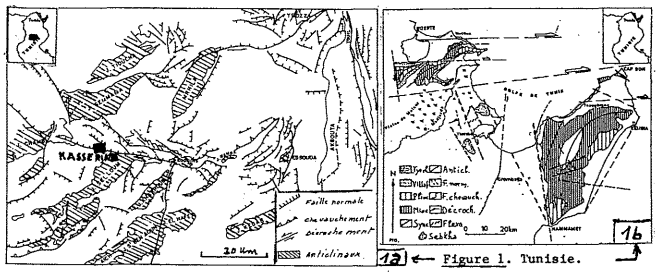
Les sections sismiques montrent que la plupart de ces éléments s'enracinent en s'amortissant dans des niveaux de disharmonie et de décollement, tout particulièrement dans les séquences triasiques. Plus récemment, les profils de sismique-réfraction "Campagne E.G.T.85" confirment que cette tectonique de couverture se développe sur une croûte continentale localement amincie.

Les modèles physiques conduisant à ce type de schémas de déformations de la couverture impliquent au niveau du socle le jeu des décrochements de même nature. Par ailleurs, l'intensité des cisaillements, en particulier dextres E - W, s'amplifie très notablement au Nord de la Tunisie.

De ce fait le"contact" Europe-Afrique, au niveau du secteur Sicile-Sardaigne-Tunisie, tend à apparaître comme une partie d'un couloir de décrochement dextre, latitudinal, large et complexe, en liaison avec l'Arc Calabrais à l'E. immédiat. Il doit être envisagé comme la résultante d'un différentiel des vitesses des continents dérivant tous les deux vers l'Est.

A l'E. de Trinidad, dans le prolongement du couloir de cisaillement E - W dextre de Paria-El Pilar, à la limite de la plateforme guyanaise et des Caraïbes, l'étude des profils sismiques et l'analyse morpho-structurale des cartes bathymétriques (2 et 3) amènent à proposer un schéma structural en de nombreux points comparable à celui de la Tunisie Atlasique ; ici encore existe un niveau de décollement, responsable par ailleurs de l'apparition du prisme d'accrétion de l'Arc des Antilles et un différentiel des vitesses de dérive vers l'Ouest peut être évoqué comme origine du phénomène structural général. (Fig.2).

Dans ces deux zones de même échelle et de même position géodynamique de deux domaines éloignés issus de la Thétys, le même type de réponse est enregistré.



12 ← Figure 1. Tunisie.

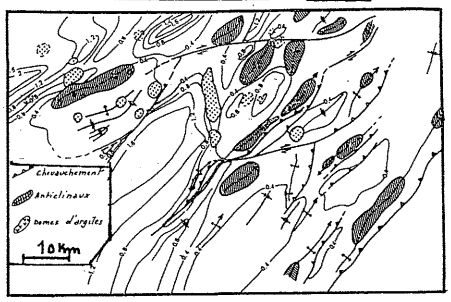


Figure 2. Antilles.

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Géodynamique des Caraïbes , Symposium, PARIS, 5-8 Février 1985, Edit. Technip, page 221-223.

Recent sea-floor spreading in the North Fiji Basin : first results of the French-Japanese Kaiyo 87 cruise

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The North Fiji Basin (NFB) was created by oceanic spreading at the back of the New-Hebrides arc in response or creating the clockwise rotation of this arc, beginning 8 to 10 My ago, from an initial position near the present location of the Vitiaz zone.Several models explained its formation (Chase, 1971 ; Gill and Gorton, 1973 ; Dubois et al., 1973 and 1977 ; Falvey, 1978 ; Malahoff et al., 1979; Kroenke,1984 ; Auzende et al., in press) which, even if it is still not fully understood in details, can be summarized as follows : (a) 10 to 8 My, reversal of the polarity of the subduction along the Vitiaz zone due to the collision of the Ontong Java plateau near the Salomon arc. (b) 8 to 3 My, start of the accretion along an axis initially roughly parallel to the Vitiaz zone ; clockwise rotation of the New-Hebrides arc (the spreading progressively turns from a N120 to a N150 direction) and counter clockwise rotation of the Fiji plateform (with a spreading centre north of the Fiji islands which turns progressively from N120 to N90). The Hunter zone is at this time functioning as a fracture zone only near its eastern end. (c) 3 to 0.7 My, spreading jump in the central NFB from N150 to a NS direction at the same time as the beginning of spreading in the Lau Basin. Possible cessation of the spreading north of the Fiji islands. (d) 0.7 My to present, local modification of the spreading in the central NFB between 15°S and 18°30'S, creation of a triple junction (ridge-ridge fracture zone) near 16°40'S with a southern branch oriented N15, a northern branch oriented N160 and the prolongation of the North Fiji Fracture Zone (FNFZ) toward the east oriented N60 in this area (Lafoy et al., 1987). (e) Recently, creation of a new spreading area roughly EW trending in the northern NFB along the South Pandora ridge.

We will present here the preliminary results of the Kaiyo 87 cruise.

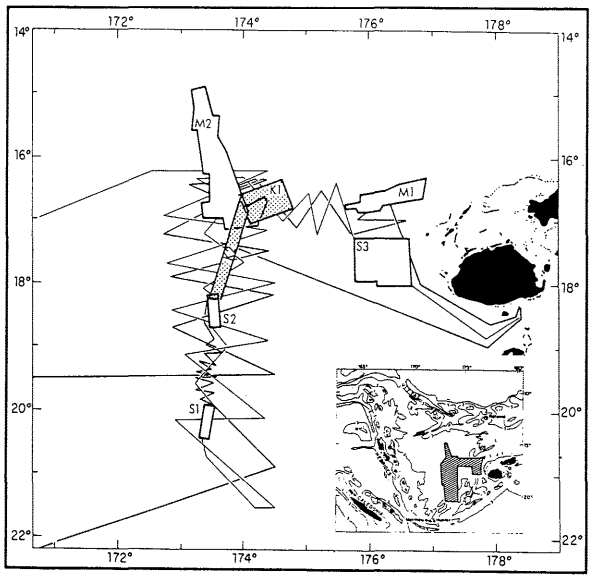

Figure 1. Location map of Seapso 3, Moana Wave ad Kaiyo 87 cruises. Thin lines : Seapso 3 profiles, heavy lines : Kaiyo 87 profiles, S1, S2 and S3 : Seapso 3 cruise complete coverage Seabeam boxes, K1 and K2 : Kaiyo 87 cruise complete coverage Seabeam boxes, M1 and M2 : Moana Wave Seamarc survey.

In December 1985, the Seapso 3 cruise of R.V. Jean-Charcot in the NFB allowed to precise the geometry of the NS spreading system (Auzende et al., 1988) and to present some hypothesis concerning the evolution of the entire NFB (Auzende et al., in press). After the Seapso 3 cruise, Japanese (STA : Science and Technology Agency) and French (IFREMER) decided to build a cooperative program (STARMER) to improve scientific knowledge of the rift system in the North Fiji Basin. The Kaiyo 87 cruise (November 28th 1987 to 2nd January 1988) was the first phase of this common project. It has been carried out on the semi-submersible catamaran R.V. Kaiyo fitted out by the JAMSTEC (Japan Marine Science and Technology Center) and equipped with a multibeam echosounder (Seabeam), single and multichannel seismic systems, a magnetometer, a deep towed side scan sonar, a deep towed TV photographs system, a CTD rosette for water sampling and dredges.

The main goal of the cruise was the detailed study of the spreading system in the axial part of the NFB and the study of the associated hydrothermal activity. For that, a large scale survey has been performed with nine Seabeam, magnetic and single channel seismic long profiles (100 miles) across the central part of the basin. Then two complete coverage Seabeam boxes have been surveyed : one around the triple junction of 16°40S (Lafoy et al., 1987 ; Auzende et al., in press), the second one along the axis between 18°10S and 16°30S. At last, rocks sampling, hydrocasts, and deep towed videos and photographs observations have been carried out all along the axis (fig. 3).

G-VII1

Maquette du Deep-Sea Fan du Rhône à l'échelle du 1/200.000 établie à partir des profils Sea-Beam

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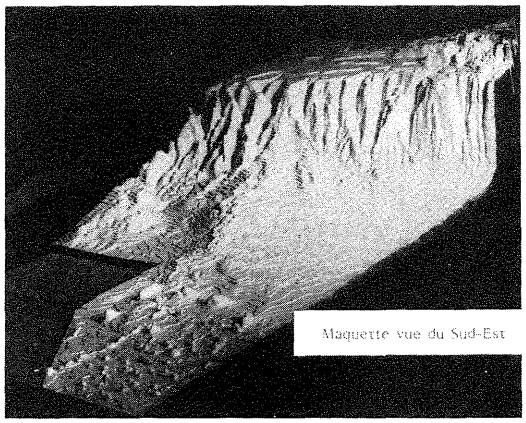
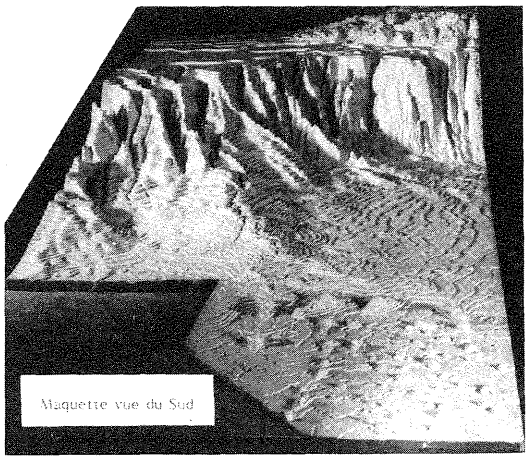
Une maquette du deep-sea fan du Rhône a été récemment réalisée à partir de la carte établie grâce aux profils bathymétriques provenant des campagnes Profans-Deltarho du N/O "Jean-Charcot".

Elle représente, très fidèlement grâce au sondeur multi-faisceaux sea-beam, la topographie sous-marine entre les profondeurs de -2580m et -200m. Les cotes supérieures, sous-marines (0, -200m) et continentales (0, +1000m) ont été reconstituées à partir des données préexistantes (sondeurs mono-faisceaux, cartes de l'Institut Géographique National). Les limites de cette maquette sont les suivantes : 41°00N-43°35'N; 04°10'E-06°00E.

Cette maquette a été construite à l'échelle du 1/200.000 par découpage, superposition et collage de feuilles polystyrène. L'épaisseur de ces feuilles varie de 5mm (correspondant à des dénivellations de 50m) dans les zones situées au-dessus de -2000m, à 2mm (soit 20m de dénivellation) dans les zones plus profondes, de manière à obtenir une meilleure précision dans les modelés peu accentués des parties profondes de l'éventail. L'exagération verticale résultante est de 20 fois. Les dimensions de la maquette sont les suivantes : 1,44m de long, 0,78m de large et 0,33m de haut. Son poids est d'environ 15 kg.



Nous présentons ici deux photos de cette maquette prise sous des angles différents (Sud et Sud-Est).



Tous les modelés morphologiques spectaculaires mis en évidence par la carte sea-beam apparaissent en trois dimensions avec un détail étonnant : méandres du chenal central, éventail naissant lié à des phénomènes de colmatage et d'abandon de chenaux, cicatrices curvilignes laissées par les glissements en masse, grabens générés par les failles de croissance liées aux couches salifères sous-jacentes, effets de barrage sédimentaire liés à l'alignement des dômes de sels etc. D'autres modelés, peu apparents sur les documents cartographiques sont ici tout à fait évidents comme la présence de cuvettes surcreusées au pied de certains canyons, illustrant l'énergie des processus d'érosion dans ces secteurs.

G-VII2

Blocs-diagrammes du Deep-Sea Fan du Rhône par cartographie automatique des données Sea-Beam

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Plusieurs blocs-diagrammes en couleur du deep-sea fan du Rhône ont été récemment réalisés grâce au traitement cartographique automatique des données sea-beam mis au point par le Bureau National des Données Océaniques. Ces données sea-beam proviennent des campagnes du N.O "Jean-Charcot" (Profans-Deltarho) au cours desquelles 281 profils bathymétriques parallèles d'une longueur de 40 à 60 kilomètres chacun et espacés de 500 à 2000m, représentant un trajet total de plus de 13.200 kilomètres, ont été levés.

La zone représentée est limitée par les parallèles 41°55'N et 43°00'N et les méridiens 04°10'E et 05°30'E.

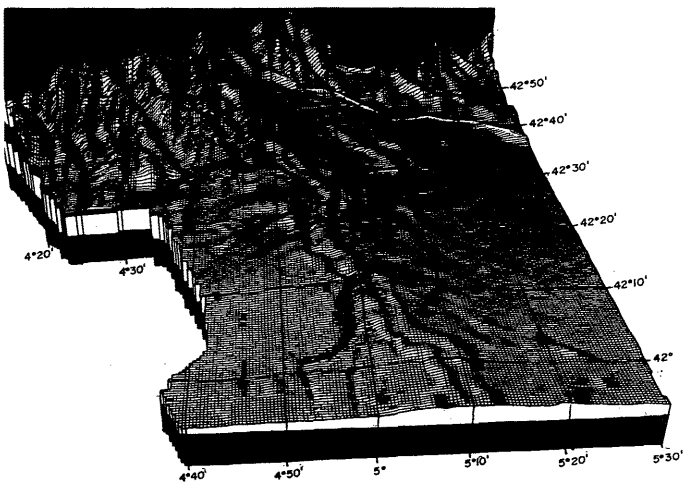
Quatre orientations différentes ont été représentées : SW (225°), SSW (200°), S (180°) et SSE (160°).

Après un essai à 50°, le choix de l'élévation de l'oeil de l'observateur a été définitivement fixé à 30°. Quant à l'exagération verticale adoptée elle a été de 8 fois.

Plusieurs essais de sortie couleur ont été réalisés. La solution adoptée, qui rend compte à la fois de l'importance privilégiée que nous attachons à certains reliefs et du pouvoir de discrimination de l'oeil, a été la suivante : 12 couleurs différentes correspondant chacune à une tranche de dénivellation de 200 mètres, ne comportant que 2 tons de bleu (2000m-2200m et 2200m-2400m).

Nous avons procédé, dans un but essentiellement pédagogique à un carroyage des coordonnées géographiques qui ont été manuellement projetées sur les blocs. Dans le même esprit, et pour une représentation en noir et blanc, nous avons procédé à divers ombrages afin d'augmenter le contraste des reliefs les plus marquants.

Nous présentons ci-dessous un des résultats de ce travail (observateur placé au Sud) en faisant remarquer que les reliefs situés à l'amont sur fond noir apparaissent artificiellement tronqués.



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H-I5

Méthodologie d'une étude hydrobiologique dans la grotte marine de Bergeggi (mer Ligure)

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ABSTRACT - METHODOLOGY OF A HYDROBIOLOGICAL STUDY IN THE MARINE CAVE OF BERGEGGI (LIGURIAN SEA)

The submerged part of the cave was characterized by SCUBA diving. Simple methods were used to measure water movement, temperature and light and to sample water, suspended particulate matter and sediments. It has then been possible to put the biological zonation in relation with the environmental factor gradients.

L'exploration des grottes sous-marines exige en général l'utilisation de méthodologies gérées directement par le plongeur, étant donné que les techniques océanographiques traditionnelles s'avèrent inadéquates dans ces milieux. GILI et al. (1986) ont développé, par exemple, un système de prélèvement "ad hoc", capable d'exclure la présence du plongeur et la modification du milieu qui en résulte; ce système est chargé, cependant, d'une certaine complexité et de difficultés opérationnelles et ne peut être mis en place que dans un nombre limité de situations.

Au contraire, nous avons entrepris l'exploration des branches submergées de la grotte marine de Bergeggi (BIANCHI et al., 1988), avec une instrumentation ordinaire adaptée à l'usage par le plongeur ou avec des objets "bricolés"; moyennant quelques précautions, telles que la manoeuvre de l'instrument toujours à l'avant de l'opérateur (qui se plaçait à l'aval du courant par rapport à l'instrument), on est arrivé à limiter au maximum la perturbation du milieu.

Après l'exécution des relevés topographiques des ramifications submergées, par boussole, profondimètre et ligne métrique, nous avons effectué les mesures et les prélèvements suivants.
- Hydrodynamisme: boulettes en craie, selon la méthode établie par MUUS (1968) et déjà utilisée en grotte par PANSINI et PRONZATO (1982). La consommation de la craie étant proportionelle à l'agitation de l'eau, on peut calculer une vitesse "équivalente". BAILEY-BROCK (1979) a proposé une formule empirique, de laquelle nous avons tiré la suivante:

$$v = 3.65\ (M/B - 1),$$

où: v = vitesse en cm/sec, M = perte en poids (%) des boulettes de mesure, B = perte en poids (%) des boulettes de référence. Ce "blanc" était placé dans un bac déposé dans la partie la plus abritée de la grotte. Aussi bien le blanc que les boulettes de mesure sont restés en place pendant 24 h.
- Direction du courant: boulettes en sucre caramélisé melangé avec de la rhodamine. La rapide dissolution du sucre dans l'eau a permis de limiter l'exposition à 2 h, ce qui a mis en évidence la direction du courant d'eau, minimisant en même temps les phénomènes de diffusion latérale qui se seraient vérifiés avec des materiaux moins solubles. La direction prédominante du flux avait été supposée d'après les gradients de densité de l'eau et de saturation en oxygène mesurés; pour vérifier cette hypothèse, nous avons placé les sources du colorant en amont du flux et, à des intervalles de distances regulières en aval, nous avons échantillonné l'eau pour des analyses fluorométriques.
- Température de l'eau: un normal thermomètre à mercure de précision, laissé en place pour quelques minutes;
- Intensité de la lumière: irradiomètre océanographique; un éclair de la torche sous-marine précédait et signalait à l'opérateur de surface le moment de la lecture.
- Echantillonnage de l'eau: tubes en plexiglas de 250 cc, avec fermeture manuelle aux extremités par deux bouchons à vis en PVC; au laboratoire, ces échantillons ont été utilisés pour les déterminations du pH (pHmètre à électrodes), de la salinité (salinomètre à cellule) et de l'oxygène (méthode Winkler).
- Echantillonnage des particules en suspension: bouteille Niskin de 5 l, adaptée à la fermeture manuelle par le plongeur. On a évalué les teneurs en chlorophylle et en matériel organique.
- Echantillonnage des sédiments: carottier manuel enfoncé dans le fond (COLANTONI, 1982). Le sédiment déposé sur les parois rocheuses a été prélevé à l'aide d'une seringue en plexiglas de 250 cc avec piston en PVC et "aiguille" constituée d'un petit tube en silicone. Au laboratoire ont été mesurées la granulométrie et la teneur en carbone organique.

A partir des résultats obtenus par ces méthodes il a été possible de caractériser de façon satisfaisante l'environnement de la grotte, nous permettant de mettre en relation la zonation biologique aux gradients des facteurs ambiants (BIANCHI et al., 1988). En particulier, trois zones différentes ont pu être mises en évidence:
1) les parties proches des entrées, jouissant d'un bon échange d'eau (vitesse du courant supérieure à 10 cm/sec, sédiments graveleux, teneurs en chlorophylle du même ordre de grandeur des eaux extérieures) et avec un taux de recouvrement biologique avoisinnant 100%; la lumière est supérieure à 0.2 $\mu W/cm^2$.
2) les parties internes, plutôt confinées d'un point de vue hydrologique, avec augmentation de la sédimentation fine, obscurité totale et teneur en chlorophylle affaiblie; le recouvrement tombe au dessous de 40%.
3) les "lacs" internes, saumâtres et presque homéothermes, à pH réduit et à très pauvre peuplement biologique.

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H

I-I1

Bioclimate diversity and vegetation belts in Adriatic Archipelago

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RÉSUMÉ : Diversité bioclimatique et zones végétales de l'Archipel adriatique. Les climats insulaires adriatiques sont bien contrastés à minimums thermiques variant de +6° à -18°C, à précipitations moyennes de 150mm jusqu'à 1350 mm et secheresse durant 0 à 10 mois. C'est corrélé à 5 zones végétales: inframéditerranéenne à Thymelaeion des îles méridionales, puis thermoméditerranéenne à Oleo-Ceratonion, euméditerranéenne à Quercion ilicis, subméditerranéenne à Carpinetum orientalis des îles septentrionales et supraméditerranéenne à Seslerio-Ostryetum des monts insulaires.

INTRODUCTION. Up to recently, the classical phytogeographical schemes presented the zonal vegetation of Adriatic Archipelago after its geographical position, but neglecting its bioclimates. Thus all islands, except the northernmost ones, presented an ideal homogeneous zone of eumediterranean evergreen climax Orno-Quercetum ilicis. The subsequent detailed bioclimatic stress of this big zone by BERTOVIC (1975) resulted by its considerable climatic diversity.

Climate zoning in Adriatic islands (data computed from KIRIGIN 1971)

Belts:	SUBMEDITERANEAN	EUMEDITER.	THERMOMEDITER.	INFRAMEDITER.
TEMPERATURES				
Winter XII-II	5.8 - 7.9°C	7.1 - 9.5°C	9.2-9.9°C	above 10.5°C
Absol. minima	-10.8 to -18°	-5.0 to -7.2°	-4.3 to -6.6°	+6° to -2°C
Year amplitude	above 47.8°	41.5°-46.6°	38.5°-44.3°	under 38.5°C
Frosts in year	above 20days	3 - 25 days	1 - 15 days	0 to 1 day
Possible frost	4 - 7 months	2 - 5 months	1 - 3 months	0 - 2 months
PRECIPITATION				
Year means	1057-1344mm	883-1209mm	566 - 702mm	146 - 367 mm
Rainy days	above 105 d.	96 - 116 d.	93 - 107 d.	under 67 days
Summer rains	162-215 mm	78 - 179mm	50 - 87 mm	under 23 mm
Dryness period	0 - 1 month	1 - 3 months	3 - 5 months	6 - 10 months
Snowy days	3 - 6 days	1 - 3 days	1 - 2 days	- (absent) -
EMBERGER's p/t quotient	122 to 213	100 to 170	87 to 159	37 to 90
LANG's yearly rain factor	69-98 mm/°C	63-89 mm/°C	43-55 mm/°C	under 16 mm/°C

RESULTS. The above confrontation of the long-term climatological data in 16 insular meteorological stations well discredite the ancient unique climax scheme. The recent detailed vegetation mapping in the field resulted by another complex zonation parallel to this bioclimate diversity, including even 5 different belts marked by specific zonal climaxes. Despite the marginal northern position of this archipelago (43-45°N) in relation to the Mediterranean, its zoning is more xerothermic than expectable one. Thus the Mediterranean zoning there reaches its northernmost limits, although in the same latitudes of NE Italy and E Balkans a temperate deciduous vegetation widely predominate.

1. Coolest supramediterranean belt is the wettest one in islands, with regular frosts and some snow. Its climax of major insular mounts are the temperate submontane woods of Seslerio-Ostryetum carpinifoliae Horv.& Hic. It includes the peaks of Cres, Lošinj, Krk, Brač, Hvar and Pelješac.

2. Cool submediterranean belt is marked by less frost and some dryness, and by a summergreen climax of xeric woods Querco-Carpinetum orientalis Hic. It includes the lowlands of NE interior isles Cres, Krk, Pag and the high plateau of Brač.

3. Eumediterranean (mesomediterranean) belt is warmer than the precedent ones, with rare frost and more dryness. It is marked in Adriatic by semievergreen climax woods of the Orno-Quercetum ilicis Hic., including also some temperate deciduous taxa. It covers many intermediate Adriatic islands, except the northern and southern ones.

4. Warm thermomediterranean belt is marked by very rare and mild frost and few rains, and by the evergreen climax maquises of Oleo-Ceratonion Br.-Bl. including Ceratonia, Myrtus, Prasium, Pistacia lentiscus, Phillyrea angustifolia, Pinus halepensis, Juniperus phoenicea etc. It covers the external isles Lastiti, Vis, Lastovo, Pakleni, Šolta, Kornati, Premuda, Unije etc.

5. Warmest inframediterranean (xeromediterranean) belt is marked by a hot-dry subtropic climate, any frost nor snow, a long dryness, and by the summer-deciduous (wintergreen) scrublands of Thymelaeion hirsutae Tadr. of ultra-xerothermic Indo-Saharian type (Euphorbia dendroides, Artemisia arborescens, Juniperus lycia, Olea cium intricatum, Capparis sicula, Suaeda pruinosa etc). It covers the remote Mid-Adriatic isles Jabuka, Sušac, Palagruža, Lastovci etc.

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Kirigin, B. (ed.) 1971, Climatological data of SR Croatia. Građa za klimu Hrvatske, Hidrometeor. Zavod Zagreb, 2(2): 1-127.

I-I2

Synecology of forest lichens and bryophytes in Adriatic Islands

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RESUME : Synécologie des lichens et bryophytes silvatiques des îles adriatiques. La microvégétation lichenique des îles adriatiques est très diversifiée, présentant de nombreuses communautés pétricoles et arboricoles à plusieurs taxons endémiques. La végétation muscinale y est plus pauvre et bien développée seulement sur le sol des forêts. Les alliances licheniques épiphytes sont Xanthorion parietinae des arbres méditerranéens et Lecanorion subfuscae de ceux subméditerranéens.

INTRODUCTION. The cliffs and forests of Adriatic islands include an interesting microvegetation of lichens and bryophytes, so far few known phytosociologically, and never correlated to well defined forest phytocoenoses, except the lichen communities of Adriatic insular cliffs precised by LOVRIC (1981). Due to the predominating peculiar habitats of calcareous Karst, and to the frequent stormy winds, the cryptogamic microvegetation of Yugoslav coasts and islands has a rather deviating composition. The bryocoenoses there are poorer in comparison with other surrounding countries, but the lichen vegetation there is probably the richest one within the Europe, concerning especially the considerable lichen endemism. The insular forests present an interesting distribution model of this microvegetation: the bryophytes predominate only in the forest soil an sometimes in the very bases of trunks. Otherwise on the tree bark the lichen vegetation widely predominates, and the bryophytes there are often absent, or rare and subordinated within the arboricolous lichenocenoses. Only in the wet laurisilvae (Arbuto-Quercetum ballotae) of SE islands, occur also the well developed epiphytic bryophytes on the trees. A comparable distribution model occurs also in insular cliffs where the bryophytes are nearly lacking or are subordinated within the luxuriant lichens. Both anomalies are probably provoked by the strong and frequent aerosaline storms across the Adriatic Archipelago (Bora, Sirocco, etc.) that prevent the development and expansion of the generally hygrophilic bryophytes on trees and open cliffs. Thus they are successful only in the sheltered and shaded forest soils, and in caves and ravines. The used nomenclature of lichens is after KUŠAN (1953) and this one of bryophytes after PAVLETIC (1955).

RESULTS : Characteristic bryophytes in insular forest soil. The mediterranean evergreen forests and maquises (Quercetalia ilicis Br.-Bl.) across the Adriatic islands are marked by the next collective soil bryophytes: Riccia spec.div., Bryum canariense Brid., Cephaloziella baumgartneri Schif., Cololejeunea rosettiana (Mass.)Schif., Sphaerocarpus texanus Aust. and Grimmia anodon Br.eur. The appertaining forest communities include also other specific indicating bryophytes as follows.

1. Arbuto andrachnes-Quercetum ballotae Lov., the laurisilvae of SE Adriatic ravines and karst sinkholes: Gongylanthus ericetorum (Raddi)Nees, Grimmia sardoa De Not., Fossombronia loitlesbergeri Schif., Riccia raddiana Lev.& Jack. and R. levieri Schif.

2. Fico-Quercetum dalmaticae Lov., the relict semisempervirent premaquises of sinkholes and ravines in northern islands: Fabronia sendtneri Schpr., Fossombronia hussnotii Corb. and Cololejeunea minutissima (Sm.)Spr.

3. Alaterno myrtifoliae-Fraxinetum argenteae Lov., the stormy rockwoods in coastal escarpments of NE islands: Grimaldia dichotoma Raddi, Lunularia cruciata (L.)Dum. and Fossombronia echinata Macv.

4. Myrto-Pistacietum lentisci (Hic.)R.Mart., the lower and drier sclerophyllic maquises widespread along the shores of Dalmatian islands: Southbya nigrella (Not.)Spr., Riccia michelii Raddi and R. nigrella DC.

5. Myrto tarentinae-Pinetum pineae (Anic)Lov., , acidophilic pinewoods restricted to the flysch and dunes of SE Adriatic: Weisia dalmatica Latz., Pottia illyrica Latz. and Cephaloziella latzeliana Schif.

The xeric deciduous woods (Orno-Ostryetalia Jak.) of the submediterranean belt in northern islads and insular mounts, include another group of the collective soil bryophytes: Scapania aspera Bern., Pleurochaete squarrosa (Brid.)Lind., Trichostomum brachydontium Bruch., Scorpiurium circinnatum (Brid.)Fleisch. and Tortella tortuosa (L.)Limp. One studied 3 related forests:

6. Querco pubescentis-Carpinetum orientalis Hic., a zonal submediterranean climax in lowlands of northern islands: Entodon schleicheri (Br.eur.)Both., Leptodon smithii (Dicks)Mohr. and Dicranum muehlenbeckii Br.eur.

7. Seslerio-Ostryetum carpinifoliae Horv., the supramediterranean climax in major insular mounts: Scapania calcicola (Arn.& Pers.)Ingh., Cololejeunea calcarea (Lind.)Spr. and Tortella caespitosa (Schw.)Limp.

8. Castaneo-Quercetum pubescentis (Anic)Lov., acidophilic submediterranean chestnut-woods in flysch of northern islands: Pterogonium ornithopodioides (Huds.)Lindb., Fissidens taxifolius (L.)Hedw. and Hedwigia ciliata Ehrh.

9. Out of both precedent groups are the pinewoods Pinetum dalmaticae Horv. (alliance Orno-Pinion) in the insular stormy peaks and rocky ridges: Barbula adriatica Baum., Grimmia tergestina Tomm., Bryum torquescens Br.eur., Cheilanthela chloropus Lind.

The bark lichenocoenoses on trees (Lobarietalia (Matt.) Bark.) include two groups. Lecanorion subfuscae Ochs. occurs in the submediterranean trees of insular mounts, including the Blastenietum viperae Lov. in pines (Pinetum dalmaticae): Blastenia viperae Zahl. and Lecanora piniperda Körb. Xanthorion parietinae (Ochs.)Klem. occurs in evergreen mediterranean trees with 3 lichenocoenoses. Pertusario-Bacidietum fiumensis Lov. occurs in N islands on Fico-Quercetum: Bacidia fiumensis Zahl., Pertusaria ficorum Zahl. and moss Cryphaea arborea Lind. Dirino-Ramalinetum dalmaticae Lov. occur on maquis (Myrto-Pistacietum): Ramalina dalmatica Zahl., Dirina ceratonise (Ach.)Fr., Physcia ragusana Zahl. and Lecidea perexigua Zahl. Artothelietum as.nov. occur in Euphorbietum dendroidis: Artothelium adriaticum Zahl.

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I

I-I3

Native gymnosperms and their woods in Adriatic Archipelago

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RESUME : Gymnospermes spontanées et leurs forêts dans l'Archipel adriatique. La flore des gymnospermes insulaires adriatiques est la plus diversifiée parmi les îles méditerranéennes, y compris 16 taxons spontanés dont 10 indiqués par les flores classiques et les 6 suivants enregistrés par les études actuelles : Ephedra procera, Juniperus lycia, J. hemisphaerica, J. oxycedrus ssp. badia, Pinus nigra ssp. croatica et Abies pardei dont la synécologie est ensuite analysée.

INTRODUCTION. The classical floristic and phytogeographical reports on Adriatic islands prior to 1980ies documented there the presence of 10 species of the next native gymnosperms: Ephedra sphylla Forsk.: dunes of SE isles, Pistacio-Alsternetalia. E. nebrodensis Tin.: insular cliffs, Centaureo-Campanulion Hic. Cupressus sempervirens L.: SE isles only (ecology few known). Juniperus communis L.: NE island peaks, Seslerio-Ostryetum Horv. J. oxycedrus L.s.s.: widespread in maquis, Quercetea ilicis Br.-Bl. J. macrocarpa Sb. & Sm.: acide flysch, in pinewoods and oakwoods. J. phoenicea L.s.s.: frequent in maquis, Pistacio-Alsternetalia Mart. Pinus pinea L.: native in SE islands (ecology few known). P. halepensis Mill.s.s.: frequent in S isles, Prasio-Pinetum Lov. P. nigra ssp. dalmatica (Vis.) Franco: major mounts in southern Dalmatian islands, stormy ridges (Pinetum dalmaticae Horv.).

RESULTS. The recent detailed prospections across this archipelago added the next 6 native taxa of the gymnosperms, and they also elucidated the ecology of some precedent ones. The related vouchers are in Herberium ADRZ. Thus by the actual study, the gymnosperms in this archipelago include 16 native taxa, being probably the most diversified ones among the Mediterranean islands. Besides these ones, there are naturalized 7 exotic taxa within the synanthropic Robinietalia Neuh.: Pinus brutia Ten., P. pinaster Sol., Cupressus arizonica Greene, Thuja orientalis L. Taxus baccata L., Juniperus sabina L. and J. virginiana L.

1. Ephedra procera Fisch. & Mey. (E. graeca C.A.M.) is an East Mediterranean taxon with its westernmost outposts in SE Adriatic, within the Cysthoselino-Cupressetum (cf. infra).

2. Juniperus lycia L. (J. turbinata Guss.) occurs only in SE isles Vis, Korčula and Elafiti, mostly by the beaches within the backshore scrub of Ephedro-Juniperetum lyciae Quez. et al.

3. J. hemisphaerica Presl. (J. aetnensis M.G.) occur sporadically in the apical pinewoods (Orno-Pinion H.Em) of the major insular mounts of Krk, Brač and Pelješac.

4. J. oxycedrus s.l. ssp. badia (Gay.) Deb. is a robust arborescent type (to 12 m) of West Mediterranean, with its new easternmost outposts in the northernmost Adriatic islands Cres, Krk and Plavnik, growing within the windswept rockwoods of Lycio-Juniperetum badiae (Hic.) Lov. marked by J. oxycedrus ssp. badia V, Prunus spinosa ssp. istriaca V, Crataegus brevispina V, Lycium europaeum III, Rubus ulmifolius ssp. dalmatinus V, Rosa tomentosa ssp. kerstiana IV, Carduus micropterus V, Pallenis crostica IV.

5. Pinus nigra Arn. ssp. crostica Lov. (LOVRIC 1981) is endemic to NE Adriatic coast, including also some sites in the adjacent isles Krk and Prvic, within the stormy ridge pinewoods of Cotoneasstro-Pinetum nigrae Horv.

6. Abies pardei Gaus. (A. biokovoensis Kuš.) is subendemic of the Dalmatian coastal mountains where it forms the submediterranean firwoods (Ostryo-Abietetum Kuš.). Some isolated residual trees occur also in the northernmost Krk island, in the oakwoods.

One defined recently also the few known synecology and the related communities of some other conifers in Adriatic isles where only their presence and distribution has been precised:

Cupressus sempervirens ssp. horizontalis (Mill.) M.G. is the only native cypress of SE Adriatic, within the relict rockwoods of Cysthoselino-Cupressetum horizontalis (Anic) Lov., marked by C. sempervirens V, Phlomis fruticosa IV, Putoria calabrica V, Ephedra procera IV, Frangula nikolae III, Cytisus globiferum V, Cephalaria mediterranea V, Hermodactylus tuberosus III, etc.

Pinus pinea L. as native is rare in the flysch and dunes of SE isles Mljet and Elafiti, within the Myrto-Pinetum pineae (Anic) Lov.: P. pinea IV, Myrtus communis ssp. tarentina IV, Calycotome spinosa V, Teline monspessulana III, Lupinus iacromensis III, etc.

Reference

Lovric, A.Z. 1981, Nouveautés de la flore du Littoral croate. Oesterreichische botanische Zeitschrift, 119: 567-571.

I-I4

Diversity of the Oaks and Oakwoods in Adriatic Islands

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RESUME : Diversité des chênes et des chênaies des îles adriatiques. Parmi les îles méditerranéennes, les chênes insulaires adriatiques sont les plus diversifiés, y compris 16 taxons dont 11 sont enregistrés par les études actuelles : Quercus rotundifolia, Qu. calliprinos, Qu. macrolepis, Qu. virgiliana, Qu. brachyphylla, Qu. X saxicola, Qu. dalechampii, Qu. brutia, Qu. pedunculiflora, Qu. X streimii et Qu. conferta. On a également étudié leur synécologie et les phytocoénoses afférentes.

INTRODUCTION. There existed any special work on oaks in adriatic islands, and the classical floristic reports covering this archipelago prior to 1980ies, there confirmed only 5 oaks : Quercus ilex L.: widespread in maquis, Quercetalia ilicis Br.-Bl. Qu. coccifera L.: only SE isles, Orno-Quercetum cocciferae Hic. Qu. cretaea Lam.: native in Cres island only, acide flysch woods. Qu. pubescens Willd.: north isles, woods Ostryo-Carpinion Horv. Qu. cerris L.: flysch on island mounts, Orno-Quercetum cerridis.

The ancient indications of Qu. petraea and Qu. robur in this archipelago recently were not confirmed nor expectable, being probably confused with other vicarious taxa (LOVRIC 1981).

RESULTS. The recent detailed field studies on the Adriatic oaks, there added 11 other insular taxa whose vouchers are in Herberium ADRZ, and their nomenclature is mostly after the Flora Europaea (TUTIN et al., 1964-1980). One studied also their synecology and related phytocoenoses. Thus besides the Aegean islands, the Adriatic archipelago includes a richest oak assemblage among the mediterranean islands, including 16 diverse taxa.

1. Qu. rotundifolia Lam. (Qu. ballota Desf.) is a West Mediterranean oak with its easternmost outposts in SE Adriatic isles Korčula and Mljet. It grows there in the ravines and karst sinkholes, within the tall and humide subtropical laurisylvae of Arbuto-Quercetum ballotae Lov. with abundant lianes, mosses and vascular epiphytes. Indicators (presence symbols: I = 1-20% sites ... V = 80-100% ones): Qu. rotundifolia V, Qu. calliprinos III, Qu. conferta II, Qu. macrolepis II, Arbutus andrachne IV, A.X andrachnoides II, Juniperus macrocarpa V, Pistacia saportae III, and lianes Ruscus lexus V, Hedera taurica V, Smilax mauretanica IV, Rubia tucheri IV, and also epiphytes Ficus caprificus II, Parietaria judaica IV, Sedum maximum II, Polypodium australe III.

2. Qu. calliprinos Webb. (Qu. pseudococcifera Boiss.) is an evergreen East Mediterranean oak, with its westernmost outposts in SE Adriatic (Korčula and Mljet) within Arbuto-Quercetum.

3. Qu. macrolepis Kotschy (Qu. aegylops auct.) is the rarest island oak of Adriatic: Arbuto-Quercetum, Lastovo isle only.

4. Qu. conferta Kit. (Qu. frainetto auct.) is rare in SE Adriatic woods of Mljet and Pelješac (more frequent in mainland).

5. Qu. virgiliana Ten.s.s. (Qu. dalmatica Red.) is a very xeric and sclerophyllic semievergreen oak (spring-deciduous) with pungent leaves, frequent in northern isles Krk, Plavnik and Cres, growing there in the mixed semievergreen pramaquises of a relict Tertiary origin (Fico-Quercetum dalmaticae Lov.) marked by a rich dendroflora of even 58 coexisting different trees and shrubs e.g. Qu. virgiliana V, Qu. X saxicola III, Ficus caprificus V, Acer marsicum V, Fraxinus argentea V, Colutea gallica V, Euphorbia wulfenii V, etc. This wood occurs chiefly in ravines and sinkholes.

6. Qu. brachyphylla Kotschy is an East Mediterranean oak, with its NW outposts in Adriatic islands Krk, Korčula and Mljet, in semievergreen pseudomaquis Pistacio-Quercetum brachyphyllae Quez.

7. Qu. X saxicola Vuk. (Qu. virgiliana X brachyphylla) is a hybrid in N isles Krk and Cres, within the Fico-Quercetum woods.

8. Qu. dalechampii Ten. (Qu. spannina auct.) is rare in N island hills of Krk and Cres, within the Seslerio-Ostryetum Horv.

9. Qu. brutia Ten. occurs only in Krk island, in the wet valley carrwoods of Fraxino-Quercetum brutiae (Karp.) Fuk.

10. Qu. pedunculiflora Koch (Qu. hess Kotschy) is an Oriental deciduous oak with its westernmost outpost in Baška valley of Krk island, in the wet tall carrwoods of Vitici-Quercetum pedunculiflorae Lov. marked by Qu. pedunculiflora V, Qu. X streimii IV, Ulmus canescens V, Carpinus caucasica II, Thelycrania australis V, Vitex IV, Gladiolus illyricus IV, Dryopteris borreri III, etc.

11. Qu. X streimii Kotschy (Qu. pedunculiflora X pubescens) is a rare hybrid in Krk island, within the Vitici-Quercetum.

Reference

Lovric, A.Z. 1981, Some rare semisempervirent oaks in Adriatic coastal Karst. Šumarski List (Zagreb), 105: 119-132.

I-I5

Distribution and synecology of Adriatic insular Filicales

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RESUME : Répartition et synécologie des fougères insulaires adriatiques. La flore des Filicales (Polypodiaceae s.lat.) de l'Archipel adriatique (21 taxons) est assez pauvre parmi les îles méditerranéennes. Près de 14 taxons indiqués par les flores classiques, on y a récemment recensé 7 fougères supplémentaires : Asplenium csikii, Ceterach javorkeanum, Pteris cretica, Dryopteris pallida, D. borreri, Polypodium interjectum et Pteridium tauricum dont la synécologie est également étudiée.

INTRODUCTION. So far existed any special survey on the Adristic insular ferns, except someones on the endemic Phyllitis hybrids. The general flores covering this archipelago till now documented there only the presence of 14 insular species of true ferns or Filicales (Polypodiscese s.lst.), and their nomenclature is mostly after the Mediterranean fern list of GREUTER (1985) : Asplenium trichomanes L.: widespread in the cliffs (Asplenietes). A. ruta-muraria L.: frequent in insular cliffs (Asplenietes). A. petrarchae (Guer.) DC.: coastal cliffs, Centaureo-Campanulion Hic. Ceterach officinarum DC.: coastal cliffs, Centaureo-Campanulion. Cheilanthes pteridioides (Rchb.)Chr.: walls, Parietarietalia Br.-Bl. Ch. persica (Bory) Matt.: SE Adristic, Ephedro-Cysthoselinetum Lov. Adiantum capillus-veneris L.: frequent in caves, Adiantion Br.-Bl. Anogramma leptophylla (L.) Link.: SE isles, Homalothecio-Polypodion. Asplenium onopteris L.: widespread in maquis, Quercion ilicis Br.-Bl. Polystichum setiferum (Forsk.)Moore: N isles, Vitici-Quercetum Lov. Polypodium australe Fée: S isles, Homalothecio-Polypodion R.Mart. Phyllitis hybrida (Milde)Chr.: endemic, N isles (ecology few known). Ph. sagittata (DC.) Guin. & Heyw.: N isles, Adianto-Phyllitidetum Hic. Ph. scolopendrium L.: N isles only, Castaneo-Quercetum (Anic) Lov.

The ancient indications on Asplenium adiantum-nigrum, Dryopteris filix-mas, Polypodium vulgare, Polystichum lobatum and Pteridium aquilinum s.s. in these islands recently were not confirmed nor ecologically expectable, being probably the Mid-European extrapolations confused with other vicarious taxa.

RESULTS. The recent detailed prospections of the Adristic insular ferns in the field added 7 other taxa so far unknown in this archipelago, whose vouchers are now deposed in the Herbarium ADRZ: Asplenium csikii, Ceterach javorkeanum, Dryopteris borreri, D. pallida, Polypodium interjectum, Pteridium tauricum et Pteris cretica. Their synecology and communities were studied, too.

1. Asplenium csikii Deg.& Kümm. is chiefly a SE European fern, recently registered in the major insular mounts of Cres, Krk, Brač and Pelješac, mostly on their apical cliffs within the alliance Edraianthion Lak.

2. Ceterach javorkeanum (Vida) Sóo (Asplenium ceterach ssp. bivalens Greut. et al.) is also a SE European fern of the Balkans and Pannonia that is recently registered in the Adristic insular mounts (Cres, Krk, Brač, Pelješac, etc.), chiefly in the apical cliffs of Edraianthion, together with Asplenium csikii. Contrary to this, the typical Ceterach officinarum DC.s.s. is a Mediterranean fern that is in Adristic islands mostly restricted to their warmest coastal cliffs.

3. Dryopteris borreri (Newm.) Ober. is rare in this archipelago and restricted to the northernmost islands Krk and Cres only, where it grows in the wet valley carrwoods within Vitici-Quercetum pedunculiflorae Lov.

4. Dr. pallida (Bory) Chr. is there also rare and registered only in the Dalmatian insular peaks of Brač and Pelješac, growing mostly in montane screes of Geranietum dalmatici Lak. et al.

5. Polypodium interjectum Shiv. in this archipelago is rare and restricted to the northernmost islands Cres and Krk, growing in the acide flysch substrata within the chestnut woods of Castaneo-Quercetum pubescentis (Anic) Lov.

6. Pteridium tauricum Grosg. (Pt. aquilinum ssp. brevipes Vuljf) occurs sporadically on the acide insular flysch woods e. g. in Castaneo-Quercetum of N islands, and within the Pistacio-Quercetum brachyphyllae Quez. et al. of the SE ones.

7. Pteris cretica L. occur only as naturalized in old walls (Kentrantho-Parietarion R. Mart.) of SE Adristic isles.

Concerning the ecology of Phyllitis hybrida, it occurs chiefly in coastal rockwoods of Alterno-Fraxinetum argenteae Lov. By the 21 known taxa, the fern flora of Adristic Archipelago is poorer than in the most other Mediterranean islands.

Reference: Greuter, W. (ed.), 1985: Med-Checklist 1. Pteridophyta. OPTIMA, XXII + 32 p., Genève & Berlin.

I-I6

Botanical peculiarities of stormy mounts in N.E. Adriatic Islands

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RESUME : Singularités botaniques des monts orageux des îles adristiques septentrionales. Les îles dalmates méridionales plus élevées dépassant 500m ont un étagement altitudinal comparable à celui de la Dalmatie continentale. Par contre, les sommets orageux des îles nord-est (surtout Krk) sont marqués par une végétation spéciale de Cotonesstro-Pinetum, Pilosello-Festucetum fallacis, Festuco-Stipetum, Myosotido-Galanthetum, Minuartio - Daphneetum alpinae et Micromerio-Onosmetum crosticae.

INTRODUCTION. The peaks of the higher Adristic islands overpassing 500m include an apical vegetation different from their lowlands and coasts: Krk (569m), Cres (650), Lošinj (588), Brač (778) and Hvar (623). This altitudinal zoning of the southern Dalmatian islands is mostly comparable to this one of the Dalmatian mainlands, with next apical communities (LOVRIC 1975) : xeric deciduous woods of Seslerio-Ostryetum Horv., windswept ridge pinewoods of Pinetum dalmaticae Horv., degraded deciduous scrub of Frangulo-Cersetum mahaleb Pold., then various secondary grasslands e.g. Satureio-Edraianthetum Horv., Festucetum illyricae-valesiacae Rit., Carici-Seslerietum interruptae Horv., and Campanulo-Moltkietum petraeae Hic. in apical cliffy crags. An exception was the few studied apical vegetation in stormy N isles.

RESULTS. The recent studies evidently documented that the windswept mounts of northernmost Adristic islands overexposed to strong Bora gusts (NE wind) have an apical vegetation divergent from the Dalmatian mainlands. A most peculiar montane flora and communities, including even the subalpine belds and sinkhole snowfields, and cliffs with numerous endemics and disjunct relicts, occur especially in very stormy Mt Obzova Gora of Krk island. Despite its modest height of 569m only, this ridge is overexposed to the strongest hurricane winds of Adristic with maximal gusts to 180-210 km/h, frosts to -18°C and winter snow cover. Thus it includes the paleoendemic communities of Pleistocene glacial affinity, and an intersting subalpine and oromediterranean flora: Ostrya carpinifolia ssp. corsica Rouy, Acer velutinum Boiss, Cersus cupaniana (Guss.) M.G., Amelanchier cretica Pers., Daphne alpina L., Anthyllis montana L., Minuartia capillacea Graeb., Festuca rubra ssp. fallax Thuil., Myosotis speluncicola Schott, Valeriana montana L., Fritillaria montana Hpe., Arabis hornungiana Schur., Cymbalaria pallida (Ten.) Watt, being absent in other Dalmatian islands, but also the endemics Pinus nigra ssp. crostica Lov., Onosma crostica M.G., Campanula staubii Uech., Micromeria kerneri Murb., Asperula rigens M.G., Sedum dinaricum M.G., etc. The most peculiar communities are (presence symbols: I = 1-20% sites...V = 80-100% ones):

1. Cotonesstro-Pinetum nigrae Horv., rocky ridge pinewoods.

2. Pilosello-Festucetum fallacis (Mort.) Lov., acide grassland in stormy flysch: Festuca fallax V, Pilosella officinarum V, Asperula scabra V, Potentilla tommasiniana IV, Seseli nitidum III.

3. Festuco-Stipetum eriocaulis Lov., calcareous montane grasslands of Krk, Prvic and Biokovo: Festuca lepidosa V, Stipa eriocaulis V, Bupleurum veronense V, Eryngium dalmaticum IV, Colchicum kochii III, Ornithogalum gussonei IV and Centaurea huteri III.

4. Minuartio-Daphneetum alpinae Lov. is a local community of the barren stony ridges in Mt Obzova only, eroded by strongest hurricanes: Daphne alpina IV, Minuartia capillacea V, Asperula rigens V, Thymus malyi IV, Anthyllis montana III, Edraianthus hercegovinus II.

5. Myosotido-Galanthetum nivalis Lov., is a peculiar local chionophilic community of Obzova, in its insular snowfiels within the karst sinkholes and shady NE cliff-ledges, covered by snow for 3-5 months: Galanthus nivalis s.l.IV, Myosotis speluncicola III, Fritillaria montana IV, Valeriana montana III, Muscari kerneri V.

6. Micromerio-Onosmetum crosticae Lov., stormy and sunny montane cliffs of Krk and Velebit: Onosma crostica V, Alyssoides sinuata V, Micromeria kerneri IV, Campanula staubii IV, Sedum dinaricum V, Cysthoselinum tomentosum III, Aethionema thomasiana IV, and lichens Blastenia cretacea IV and Heppia adristica III.

7. Cetarscho-Cymbalarietum pallidae Lov., cool and shady NE cliffs in Mt Obzova and Lika highland: Ceterach javorkeanum V, Cymbalaria pallida IV, Arabis hornungiana IV, Sedum purpureum III, Asplenium csikii IV, then the lichens Verrucaria dinarica IV and Caloplaca likensis II, and the moss Pseudoleskea catenulata III.

By these 7 communities, Mt Obzova differs from all other isles.

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I

I-I7

Phytogeography of native woody Liliales in Adriatic islands

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RESUME : Phytogéographie des Liliales lignescentes spontanées des îles adriatiques. L'Archipel adriatique présente 7 taxons spontanés des Liliales lignescents: Asparagus acutifolius, Ruscus aculeatus, Smilax aspera, Sm. nigra et récemment on y a enregistré aussi Smilax mauretanica, Sm. willkommii et la grande liane Ruscus laxus (R. barrelieri) dont la synécologie est étudiée.

INTRODUCTION. The woody monocots are a remarkable feature of the tropical floras, and in the Mediterranean coasts this life form reaches its northernmost limits. Thus the Mediterranean palms in the native flora of Adriatic are lacking, and Chamaerops humilis L. there occurs only naturalized from cultivation in SE Adriatic, especially in Lokrum islet by Dubrovnik. Concerning the exotic woody Liliales, within the ruderal rockbush Opuntio-Agavion (Adam.) Lov. in this archipelago the next related taxa occur as naturalized from the cultivation (cf. details in LOVRIC 1984, 1985): Agave americana L. (A. altissima Zum.) across this archipelago, and A. ingens Bgr. is naturalized only in the warmest southern islands of Dalmatia. Yucca includes there 3 naturalized species: Yu. recurvifolia Salis. (Yu. "gloriosa" auct.adr.) is widespread in Adriatic insular walls and ruins, but Yu. smalliana Fern. (Yu. "filamentosa" auct.adr.) is naturalized only in cooler northern islands of Kvarner Gulf, and Yu. aloifolia L. grows chiefly in the warmest SE islands. The very native lignescent Liliales (Asparagaceae and Smilacaceae) there include 7 taxa, but in the classical flora concerning this archipelago only 4 ones have been reported (Asparagus acutifolius, Ruscus aculeatus, Smilax aspera and Sm. nigra), and the recent detailed field prospections there added Smilax mauritanica, Sm. willkommii and the big liane Ruscus laxus (R. barrelieri) whose vouchers are in Herbarium ADRZ.

RESULTS. The genus Asparagus within this archipelago is presented by 4 species, but 3 of them are herbaceous. So A. officinalis L. s.str. grows there as sporadically naturalized from the cultivation in northern islands of Kvarner Gulf. A. tenuifolius Lam. occurs chiefly in the major insular mounts of this archipelago, within the deciduous spical woods Seslerio-Ostryetum carpinifoliae Horv. A. maritimus (L.)Mill. (A. acaber Brig.) grows mostly along the stony shores within the xerohalophytic vegetation of Crithmo-Limonietalia, and especially in the Atriplici-Asparagetum maritimi Lov. of the minor rocky islets.

1. Asparagus acutifolius L. is the unique lignescent species of this genus within the Adriatic. It is widespread across this archipelago growing in different sempervirent woods and maquises of Quercetalia ilicis Br.-Bl. in nearly all islands.

The Smilax presents there a richest assemblage of this genus within the Mediterranean, including 4 different insular taxa:

2. Sm. aspera L. s.str. is widespread across this archipelago within the evergreen woodlands of Quercetalia ilicis.

3. Sm. nigra Willd. occur only in SE Adriatic where it is rare on the islands Korčula and Mljet, growing in the insular ravines and karst sinkholes within the humide laurisilvae of Arbuto andrachnes-Quercetum ballotae Lov.

4. Sm. mauritanica Desf. (Sm. nigra X Sm. aspera ?) is an intermediate taxon between the both precedent ones and it is perhaps of a hybrid origin. In this archipelago it is more frequent than the typical Sm. nigra, and it grows in SE islands within the Arbuto-Quercetum, but also sporadically in some NE isles especially in Grgur and SE Krk (by ports Baška and Vrbnik) within the semievergreen woods of Fico-Quercetum dalmaticae Lov.

5. Sm. willkommii M.G. (S. aspera ssp. balearica Bon., Sm. tragacantha Lov.) so far has been usually quoted to be an endemic of the Baleares islands, but recently one registered its new disjunctive outposts in NE Adriatic islands of Kvarner Gulf: SE Krk (by Baška), Prvic, Grgur and Goli. It grows there within the stormy coastal rockwoods of Alaterno-Fraxinetum argentae Lov. overexposed to the strongest Bora winds. This is a quite distinct taxon very divergent from all other Smilax species, for being any liane but a true condensed shrub to 70 cm, with the numerous short rigid stems and densely reticulate-intricated lateral branches forming a pungent echinate cushion of tragacanthic type, with the minute and narrow sagittate leaves (to 1 x 2-3 cm) whose upper half is transformed into a rigid thorn, and these leaves are subequal or shorter than the alternating stem thorns. Its numerous axiller branches are almost completely transformed into the long ramified thorns without leaves.

The genus Ruscus there includes 3 taxa. Among them, R. hypoglossum L. is only naturalized from cultivation in the northern islands Krk and Rab, and it is native in adjacent mainlands.

6. R. aculeatus L. s.str. is widespread across this archipelago within the evergreen woods of Quercetalia ilicis.

7. R. laxus Sm. (non Asch.& Gräb., R. barrelieri M.G., R. "ponticus" auct.adr.) is the most robust woody monocot of Adriatic and also the very biggest member of its genus. Thus it has a quite distinct habit for being the true lignescent liane up to 230 cm tall, with the medium sized phylloclades (1.5 - 2.5 x 3 - 4 cm) that are herbaceous with a few pungent apex (being intermediate between these ones of R. aculeatus and R. hypoglossum), and with the big fruits 1.1 - 1.7 mm. Its general habit is comparable to the Canarian Semele, but its phylloclades and flowers belong indiscutably to a Ruscus. It grows in the ravines and sinkholes of SE islands, especially in Korčula and Mljet, winding on the scrub understory of the laurisilvae of Arbuto-Quercetum ballotae. It is probably a relict survival from the subtropical Tertiary laurisilvae.

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I-I8

Geobotany of Sedum (Crassulaceae) in Adriatic Archipelago

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RÉSUMÉ : Géobotanique du Sedum (Crassulaceae) de l'Archipel adriatique. Le karst insulaire adriatique présente une flore intéressante des crassulacées. Le genre Sedum y est représenté par 15 taxons et Umbilicus par 4 espèces dont les nouveautés enregistrées tout récemment dans la flore insulaire adriatique sont Sedum telephium, S. litoreum, S. brevifolium, S. clusianum, S. rohlenae, S. dinaricum et Umbilicus chlorantha.

INTRODUCTION. The widespread dissected rockeries predominating across the calcareous karst of Adriatic islands are the distinctive habitats of the native Crassulaceae and of other resisting succulents. The classical insular flora indicated there the next 9 species of the genus Sedum (LOVRIC 1984).
S. maximum (L.) Hoff.: widespread in woods (Orno-Ostryetalia Jak).
S. sediforme (Jacq.) Pau.: S islands, garrigues Cisto-Ericion Hic.
S. acre L.s.s.: widespread in grasslands Scorzonerion villosae Hic.
S. bolonienae Lois.: flysch grasslands, Scorzonerion villosae Hic.
S. neglectum Ten.: frequent on hills, Festucion illyricae Ritter.
S. hispanicum L.: hill grasslands, Chrysopogoni-Satureion Hic.
S. ochroleucum Chaix: frequent in Chrysopogoni-Satureion Hic.
S. album L.s.s.: old walls and ruins, Kentrantho-Parietarion Mart.
S. rubens L.: rare, wet grasslands Trifolio-Hordeion Hic.

The Umbilicus there was indicated by 3 species in walls:
U. horizontalis (Guss.) DC.: frequent in Asplenio-Umbilicetum Hic.
U. rupestris (Sal.) Dandy: SE isles, Kentrantho-Parietarion Mart.
U. parviflorus DC.: rare in SE isles, Kentrantho-Parietarion.

Among the cultivated Crassulaceae, the sporadically naturalised ones within the Parietarietalia Br.-Bl. there are e.g. Sempervivum tectorum L. and Cotyledon orbiculata L.

RESULTS. The more detailed field prospections of these islands recently registered another Umbilicus species and also 6 additional rare taxa of Sedum in insular cliffs, including 2 endemics. The related vouchers are in Herbarium ADRZ.

1. Umbilicus chlorantha Held.& Sart. occurs only in SE Adriatic isles (Hvar, Elafiti, Pelješac), in the stormy seacliffs Ephedro-Cythoselinetum palmoidis Lov.

2. Sedum litoreum Guss. is a Mediterranean taxon with its northernmost outposts in the remote Mid-Adriatic isles (Vis archipelago), mostly in the dry scrub of Thymelaeion hirsutae Tadr.

3. S. telephium L. ssp. purpureum (L.) Sch.& Kell., is a temperate taxon, rare in the peaks of northernmost isles (Krk and Prvic), cool-shady cliffs of Ceterach-Cymbalarietum pallidae Lov.

4. S. brevifolium DC. (S. globiferum Pour.) is a rare West Mediterranean taxon with its isolated easternmost outposts in northern Adriatic isles Krk, Prvic, Goli and Grgur, in stormy aerosoline seacliffs of Aurinio-Astragaletum dalmatici Lov., overexposed to the strongest Bora winds.

5. S. clusianum Guss. (S. gypsicolum Boiss.& Reut.) is also a W Mediterranean taxon with its easternmost outposts in NE Adriatic isles as above (Krk, Prvic, Goli, Grgur), but it grows there chiefly on the dry and stormy spical cliffs of insular mounts, within Micromerio-Onosmetum creticae Lov., very exposed to the hurricane winds of Bora type.

6. S. rohlenae Dom. (S. montenegrinum Horak) is an Eastern Adriatic endemic of the Dalmatian coastal mountains that is recently registered also on some major insular mounts of Krk, Prvic, Brač, Pelješac, etc. It is there abundant in the dry spical cliffs within the alliance Edraianthion Lak.

7. S. dinaricum M.G. (S. orientale auct.adr. non Boiss.) is an interesting NE Adriatic endemic of the Croatian coastal mountains, and it is recently registered also on the major insular mounts of Krk, Prvic, Brač and Pelješac, growing in the dry spical cliffs within the Micromerio-Onosmetum creticae. It is a distinct and very decorative under-shrub, with the brown-reddish stem, contrasting blue-violet leaves and conspicuous golden-yellow flowers.

Thus by these studies, Adriatic Archipelago includes all together 15 taxa of Sedum, and 4 ones of the genus Umbilicus.

Reference

Lovric, A.Z. 1984, Native succulents of the Dinaric Karst I - II. Vjesnik Kaktusara (Zagreb), 2 (1): 3-7, 2 (2): 4-9.

I-I9

Investigation of transpiration of Mediterranean species Cercis siliquastrum leaves

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Introduction.Cercis siliquastrum L. (Caesalpinaceae),the Judas tree, is a native shrub or tree of the coast and islands of the Mediterranean area of Yugoslavia.The investigation of transpiration(Tr) of leaves was carried out using STOCKER's method (1,2) in natural conditions.Stomata openning degree was determined by infiltration method.Microclimatic factor investigations were also performed.

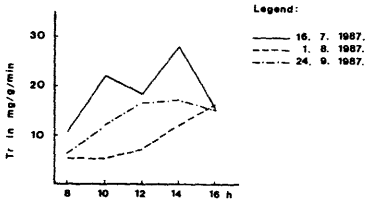

Fig.1. Transpiration values of Judas Tree leaves during a day in a vegetation season

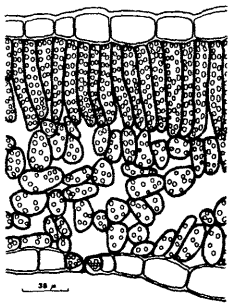

Fig 2. Transverse section of Judas Tree leaf

Results.
-The roundish,deeply cerdate,glabrous leaves of C.s. are dersiventral,amphistomatic and are on the average 184u thick.Stomata density of upper epidermis was 23.7/mm^2 and lower epidermis 273.0 /mm^2 .Stomata dimensions (in u) on the upper surface (27.36X17.18) and lower surface (27.30 X 16.98) are rather similar.-The biggest among the measured Tr values was 28.34mg/g/min on 16.07 at 4h p.m.and the minimal Tr value was 5.26mg/g/min on 1.08 at 10h a.m.-The average quantity of transpired water in a min.was 13.99mg per gramme on a leaf.-In July and September the Tr value was considerably higher in comparison with the values measured in August. -Positive correlation between Tr,microclimatic factors and openings of stomata was found.

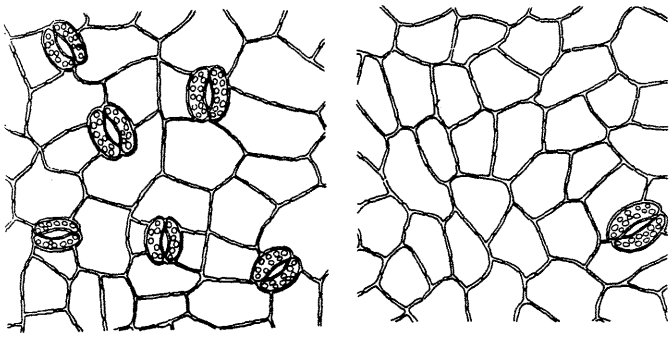

Fig.3. Epidermis of Judas Tree leaf in surface view: A-lower epidermis, B-upper epidermis

Discussion.
-The results which we have came to in our researches (3,4) fit in with the results which already had enable to draw a comparison of C.s.Tr intensity and the Tr intensity of other submediterranean and eastern mediterranean species.(5,6).The ampitude of the Tr intensity of these species is very high,going between 2.65 and 19.81(daily sum of Tr g/g).It is obvious that C.s.has a great need for water which places it into the group of species in the mediterranean,with a very high Tr intensity (8.74).-The Tr intensity of the species mainly depends on the plant species genetical code,the leaves structure and ecological factors of the habitat.

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I-I10

Ecologie et végétation de quelques îlots au voisinage de la Crète

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Dans le cadre de l' étude des biotopes importants de Crète nous avons entrepris l'étude de la flore et de la végétation de petites îles au voisinage de la Crète. Dans cette contribution nous décrivons le végétation des îles suivantes:
1. Grambuses: (Agria Grambusa et Imeri Grambusa).
2. Dionysades: (Paximada, Dragonada et Giannisada).
3. Elaphonisos.

RECHINGER (1951) a donné quelques notes sur la végétation de ces îles. Selon la classification du bioclimat méditerranéen d'Emberger (1955),les îles Grambuses se situent dans l'étage subhumide,de Dionysades à la limite des étages subhumide et semiaride, alors que que celles d'Elaphonisos se trouvent dans l'étage semi-aride. Toutes les îles sont caractérisées par un hiver chaud.

1. GRAMBUSES: Les îles des Grambuses sont un groupement insulaire de la Mer Crétoise, qui se trouve au Nord-Ouest de Crète, constitué par les îles Agria Grambusa et Imeri Grambusa (Dimitraki).

1.1.IMERI GRAMBUSA (DIMITRAKI): La végétation de l'île est constituée par trois formations. a) La végétation des côtes rocheuses où dominent les espèces Inula candida ssp. candida, Capparis spinosa et Achillea cretica. Ces espèces rupicoles se mélangent avec les halophytes Arthrocnemum macrostachyum, Crithmum maritimum, Limonium frederici, Inula crithmoides, Frankenia hirsuta, Atriplex halimus et Sedum litoreum. b) Le végétation de la côte sablonneuse au Sud-Est de l'île. L'influence humaine et la petite largeur de cette zone n'a pas permis à cette végétation de bien se développer, vers une association ammophile typique. c) Sur la partie centrale se développent des phryganes à Euphorbia dendroides, Coridothymus capitatus, Thymelaea hirsuta, Ballota pseudodictamnus et Phlomis fruticosa.

1.2.AGRIA GRAMBUSA: Le végétation ici est constitué par deux formations: Les phryganes et les halophytes. Les halophytes qui forment une bande le long des côtes entrent souvent vers l'intérieur de l'île et ils se mélangent avec les phryganes. La zône des halophytes est plus large au Nord de l'île, où l'influence des embruns est plus forte.

2. DIONYSADES: Les îles de Dionysades sont un groupement insulaire, constitué de trois petites îles qui se trouve à dix kilomètres au Nord-Est de Crète, en face du golfe de Sitia.

2.1.PAXIMADA: L'île de Paximade est la plus petite, la plus difficile à aborder et la plus éloignée de ces trois îles. Le géomorphologie de l'île ne permet pas des activités humaines; en consequence la végétation se maintient à une situation naturelle. L' influence de la mer est évidente dans toute la végétation où participent et souvent dominent les halophytes Suaeda vera, Salsola aegaea, Mathiola sinuata et Malcolmia flexuosa. Malgré la participation abondante des halophytes la végétation présente une différenciation en s'éloignant du bord de la mer vers l'interieur où la participation de Euphorbia dendroides est plus élevée.

2.2.DRAGONADA: Les halophytes forment ici une zone littorale étroite où dominent les: Arthrocnemum macrostachyum, Salsola carpatha, Limonium graecum, Limonium ocymifolium, Limonium sitiacum, Frankenia hirsuta et Malcolmia flexuosa. Après cette zone se développe une varieté du phryganes ou des broussailles.
- Dans les parties basses de l'île il y a une formation des phryganes denses à Thymelaea hirsuta et Coridothymus capitatus.
- Sur les pentes calcaires ces phryganes s'enrichissent avec d'autres taxons phryganiques (Teucrium gracile, Fumana thymifolia, Phagnalon graecum, Euphorbia dendroides, Teucrium brevifolium, Sarcopoterium spinosum etc.) et des Graminées (Hyparrhenia hirta, Stipa capensis).
- Au Nord-Est, le long du littoral Juniperus phoenicea contitue de brousailles importantes de 2-3 mètres de hauteur. A cause de son étendue et de son relief plat Dragonada a subi des essais de colonisation et d'exploitation, dont les résultats sont évidents sur le végétation naturelle. Les buissons de Juniperus phoenicea ont subi une dégradation et portent des traces de coupes et d' incendies. Toute la végétation et, particulièrement les phryganes, subissent le pâturage saisonnier.

2.3.GIANNISADA: Les caractères principaux de l' environnement naturel sont les côtes calcaires abruptes à halophytes et rupicoles et la végétation homogène des phryganes tout au long de l'île.
3. ELAPHONISSOS:a) Sur les dunes dans la partie orientale de l'île se développe une association de Ammophiletum arenariae à Ammophila arenaria, Elymus farctus, Centaurea pumilio, Pancratium maritimum, Otanthus maritimus et Silene succulenta. En arrière du Ammophiletum sur les sables se rencontrent quelques arbustes de Juniperus macrocarpa. b) Sur les côtes rocheuses il y a des halophytes comme Atriplex halimus, Eryngium maritimum, Inula crithmoides etc.). Sur le plateaux central se développent des phryganes à Coridothymus capitatus, Ballota pseudodictamnus, Phagnalon graecum, Ruta chalepensis etc.).

CONCLUSIONS: En conclusion la végétation de petites îles étudiées est constituée:
1. Des associations de phryganes, occupant en général le centre des îles.
2. Des brousailles à Juniperus phoenicea à Dragonada et quelques arbustes de Juniperus macrocarpa à Elaphonisos.
3. Une zône périphérique des halophytes, qui varie selon l' altitude, les vents dominants et la grandeur de l'île.
4. Des associations ammophiles à Elaphonissos et Imeri Grambusa.
5. Les influences humaines (tourisme, pâturage, chasse) sont plus évidentes à Elaphonissos et à peu près nulles à Paximada.

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I

I-I11

Nouvelles découvertes en Italie d' Euphorbia Wulfenii Hoppe et considérations sur son milieu, morphologie et caryologie

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ABSTRACT: New records of Euphorbia wulfenii Hoppe in Italy, and considerations on its habitat, morphology and caryology. The main area of Eu. wulfenii includes the Yugoslav and Albanian coasts, with some isolated outposts elsewhere in S European coasts. The new localities of Italy are registered in some ravines of Apulia and Lucania. Its caryotype is very similar to Eu. characias L.

INTRODUCTION : Euphorbia wulfenii Hoppe (Eu. veneta auct. p.p.) a une aire de répartition méditerranéo-orientale. Elle est indiquée par SMITH et TUTIN (1968) en Grèce, Albanie, Yougoslavie, Italie et France. Une répartition très détaillée des localités connues est rapportée par FUKAREK (1957), PULEVIC (1971) et par BIONDI (1984). Ce taxon présente une aire prépondérante le long des côtes adriatiques des Balkans, surtout en Yougoslavie et en Albanie et il remonte au nord jusqu'à Trieste (entre Miramare et Duino). Quelques localités sont connues aussi en Grèce, surtout dans le Peloponnèse. Ce taxon est présent aussi au Monte Conero en Italie centrale (BIONDI 1981) et elle a été signalée aussi au Gargano par Tenore et Rabenhorst dans XIXème siècle, repris par FENAROLI (1970) mais récémment ici elle n'a plus ete retrouvée. On en trouve même une station disjointe en France entre Ventimiglia et Nice et en Italie en Ligurie occidentale en Val Roia, indiquées par PIGNATTI (1982) et aussi une autre isolée tout orientale, en Turquie à l'île de Prinkipo (Mer de Marmara).

RÉSULTATS : Les nouvelles découvertes en Italie sont situées dans les ravines de la Pouille et de la Lucanie. Dans la Pouille on la trouve à la Gravina di Laterza et Gravina del Varco (Taranto), puis en Lucanie à la Gravina di Matera et dans la localité dite Murgia Timone près de Matera. Dans toutes ces localités examinées, Eu. wulfenii est très nombreuse et surtout au fond des ravines et dans la partie inferieure des pentes ou elle préfère les lieux plus humides. Plus rarement on la retrouve aussi dans le territoire environnant où Eu. wulfenii forme des petits peuplements au bord des sentiers, des cultures, des décharges et des carrières. Elle y est accompagnée surtout par les espèces caractéristiques des Quercetea ilicis et des Quercetalia ilicis. Il faut remarquer que localement Eu. wulfenii ne se trouve pas entremêlée avec Euphorbia dendroides L. qui est présentée ailleurs dans l'aire en question, ce que on peut aussi verifier par exemple au Monte Conero ou aux plusieurs localités balkaniques étudiées par PULEVIC (1971). Eu. wulfenii est indiquée par PIGNATTI (1982) comme un taxon typique des rochers côtière et des localités decouvertes qui se trouvent à 300-350m s/m et à 20-25 km de la mer. Celles-ci sont les plus internes de la Peninsule italienne et elles sont alliées évidemment aux conditions microclimatiques des ravines et des territoires environnants qui y simulent les conditions du type côtier.

Dans les nouvelles localités découvertes Eu. wulfenii montre un considérable degré de variabilité, surtout concernant la forme et la couleur des glandules des inflorescences qui sont jaunâtres avec la forme d'une demi-lune - mais quelquefois elles sont rougeâtres et de forme variable ressemblant à Eu. characias L. Ses bractées sont generalement soudées en forme d' un entonnoir — mais dans un exemplaire elles etaient complètement plâtes.

L'étude caryologique effectuée sur les spécimens des localités nouvelles a révélé un nombre chromosomique de 2n = 20 (CESCA 1967) et la formule caryologique suivante:

$$14m + 2m^{S} + 2sm^{S} + 2st$$

Celle-ci montre clairement deux pairs de chromosomes à satellites. Ce caryotype de Eu. wulfenii est très semblable au caryotype de Euphorbia characias L. et peut être qu'il s'agit de deux variétés de la même espèce et non de deux espèces différentes.

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I-II1

Influence du paturage par la chèvre sur la structure d'un Phrygana insulaire (Naxos, Cyclades)

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Introduction Dans le cadre d'une approche des écosystèmes types méditerranéens insulaires nous avons abordé, entre autre, l'étude d'un phrygana à Genista acanthoclados et Thymus capitatus sur sol rouge méditerranéen tronqué (absence d'horizon humifère), dans la partie est de l'île de Naxos, située dans une zone climatique médit. sub-aride. La présentation et la phytomasse de ce phrygana ont fait l'objet de deux publications (C.I.E.S.M., 1985 et 1986).

Dans le présent article nous analysons l'évolution du recouvrement végétal dans une zone clôturée de 600m2, à l'abri du pâturage par la chèvre (charge normale I-3ch/ha).
L'étude se base sur la comparaison de deux cartographies minutieuses planes du même carré expérimental de I5m de côté (225m2) à 3 ans et demi d'intervalle.

Résultats/Discussion TO (mars I984) Le phrygana se présente sous la forme d'une mosaïque d'une dizaine d'espèces de ligneux bas xéromorphes à feuilles persistantes, Quercus coccifera (chêne kermès nain), Olea europea silvestris (olivier sauvage), Pistacia lentiscus (lentisque), Thymus capitatus, Erica verticillata, Cistus monspeliensis et creticus, dont certains sont globuleux et épineux, Genista acanthoclados et Sarcopoterium spinosum. Cette formation buissonneuse et épineuse, sclérophylle, a une hauteur moyenne de 30 à 50 cm et recouvre 40% de la surface du sol.

A l'intérieur du carré expérimental nous retrouvons toutes les espèces végétales présentes dans le phrygana (à l'exception d'E. verticillata); les recouvrements par espèce sont voisins de ceux observés dans le phrygana. Nous notons la prédominance de G. acanthoclados -I6,67%-, T.capitatus -8,60%-, Q.coccifera -7,20%- et dans une moindre mesure C.monspeliensis et creticus -4,26%- (répartition égale entre les deux). Le recouvrement total est de 38,4%.

TI (oct. I987) La morphologie et l'aspect de la végétation dans le carré expérimental sont bouleversés, contrastant en cela avec l'image toujours identique du phrygana sous l'influence du pâturage par la chèvre.

Le recouvrement végétal est maintenant de 59,I % (augmentation de 54%) et la hauteur moyenne 0,5 - I,0 m.

Nous notons la présence significative de deux nouvelles espèces: Cistus salviaefolius (0,32%) et Fumana sp. (0,84%).

Les espèces comme Q.coccifera et O.e.silvestris, qui subissent directement-et ce sur toutes les parties végétales-les conséquences de la dent de la chèvre, montrent une tendance colonisatrice marquée; ainsi le recouvrement du chêne kermès est porté à I2% (augmentation relative de 66%)ilprésente une stratification verticale -20, 40, 60 et plus de 60 cm- ce qui représente une augmentation importante de la phytomasse, du simple au double (Tsiourlis, I986); l'olivier recouvre maintenant I,30% soit une augm.de I00%.

Les espèces dont certaines parties seulement sont consommées comme les cistes (boutons floraux) et le lentisque (baies), montrent également un dynamisme accentué: plus du doublement du nombre de cistes accompagné d'une augmentation du recouvrement de I50%, tandis que l'augmentation est de 38% pour le lentisque.

Enfin les espèces délaissées par les caprins en temps normal, G.acanthoclados et T.capitatus dans une moindre mesure, présentent une augmentation relative de I/3 de leur recouvrement et cela surtout par la croissance des individus déjà bien implantés.

Quant à S.spinosum, bien que ce soit une espèce faisant partie du menu des caprins elle ne semble pas avoir été favorisée par l'absence de pâturage mais a plutôt subi de manière plus prononcée la concurrence des autres espèces (chêne et cistes).

Le nombre total des individus a plus que doublé, de 540 à II34, les espèces dominantes par leur volume (G.acanthoclados et Q.coccifera) présentant une croissance relative moindre du nombre de pieds comparée à celle des plus petites espèces (Fumana, cistes).

Nous notons l'apparition de superpositions interspécifiques végétales, qui concernent environ I/I0 de la végétation, phénomène quasi inexistant en I984 (I %); la principale tendance est l'expansionnisme du chêne kermès qui tend à étouffer des parties de G.acanthoclados (3% de celui-ci), des cistes entiers (5%) et moins la variété de thym; l'olivier croît aux dépens de G.acanthoclados; les cistes à leur tour tentent une domination essentiellement sur le thym (4% de celui-ci) et s'installent sur le pourtour de G.acanthoclados (I0% des cistes); d'autres combinaisons de moindre importance sont relevées également.

Une dernière observation, conséquence des superpositions végétales, est la présence d'individus morts, phénomène relativement restreint en I984; ainsi sous l'action colonisatrice du chêne kermès et des cistes nous notons en % relatifs par espèce que 7% de G.acanthoclados, II% de T.capitatus sont dans cet état et que 2,5% des cistes et 4% de S.spinosum le sont également sous l'action du chêne.

	Recouvrement % I984	Recouvrement % I987	Nombre /84	Nombre /87
Genista acanthoclados	I6,67	2I,90	94	II2
Thymus capitatus	8,60	II,35	I68	234
Quercus coccifera	7,20	II,97	2I	25
Olea e.silvestris	0,56	I,26	5	9
Pistacia lentiscus	0,65	0,90	2	5
Cistus sp.	4,26	I0,64	2I8	506
Sarcopoterium spinosum	0,32	0,20	I4	I3
Fumana sp.	0,09	0,84	I6	207
Juniperus phoenicea	0,0I	0,05	2	3
Total	38,46	59,II		

Cette étude est réalisée à l'aide d'une bourse de recherches octroyée à l'auteur par le Département Environnement de la C.E.E. et s'insère dans le cadre de deux programmes de la Section d'Ecologie de l'Univ. d'Athènes (sous la responsabilité du Prof. Matsakis), l'un co-subventionné par la C.E.E. et l'autre par le Minis. Agriculture grecque.

I-II2

Sur le peuplement microfaunistique de deux îlots volcaniques de la côte méditerranéenne Espagnole

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SUMMARY

In this paper is studied the lichen inhabiting microfauna in two little islets of Spanish mediterranean coast, particularly the nematofauna. Some regards on ecological and faunistic aspects are exposed. The nematocoenosis is very representative, with detritophageous and saprobiontic forms almost exclusively.

RESUMEN

En esta nota se estudia el poblamiento microfaunístico liquenícola en dos islotes volcánicos del litoral mediterráneo español, particularmente la nematofauna. Se expone algunas consideraciones sobre los aspectos ecológicos y faunísticos. La nematocenosis es muy representativa, con formas detritófagas y saprobiónticas casi exclusivamente.

On a étudié à cet égard deux îlots d'origine et de nature volcanique, mais à des caractéristiques un peu différentes: le Columbrete Grande et l'île Mayor. Dans le premier cas il s'agit d'un îlot du petit archipel des Columbretes, à 35 Km de la côte continentale ibérique (Castellón), en pleine mer; dans le second cas, l'île Mayor est un petit îlot situé à l'intérieur d'une petite mer littorale, la Mar Menor (Murcie), au SE, près du Cap de Palos.

Dans les deux cas il s'agit d'îlots de nature éruptive, mais tandis que les Columbretes sont de roche volcanique basique (type basaltique), l'île Mayor est constituée par riparites et riolites récentes, probablement pliocoeniques, avec des andésites. C'est pour ça qu'il-y-a de l'intérêt de comparer le peuplement microfaunistique de ces deux sortes d'îlots.

Le matériel étudié comporte exclusivement des lichens (Xanthoria aureola) dans tous les échantillons. La nature de ce matériel est très uniforme dans les deux îlots. Cette circonstance a permis des comparaisons très valables, avec une certaine similitude dans les résultats. Il s'agit de petites masses de lichens dont la réaction du milieu est acide (pH= 5-5,5).

La microflore est relativement pauvre en bactéries, mais avec abondance de cyanophycées (Nostoc, Oscillatoria). La microfaune hydrophile présente des rotifères, tardigrades, thécamoebiens, ciliés et nématodes. La composition relative de cette biocoenose hydrophile est approximativement la suivante (par ordre de dominance): tardigrades, 40%; ciliés, 25 %; rotifères, 20 %; nématodes, 10 %; et thécamoebiens, 5 %.

On a étudié, surtout, la nématofaune. À cet égard, les résultats concernant les nématodes sont les suivants: Pelodera (P.) teres, 42 %; Ditylenchus intermedius, 19 %; Plectus cirratus, 13 %; Panagrolaimus rigidus, 10 %; Tylenchus (F.) filiformis, 8 %; Mesodorylaimus bastiani 3 %; Rhabdolaimus terrestris, 2 %; et Aphelenchoides parietinus, 2 %.

Du point de vue écologique on peut dire que, dans l'ensemble, seulement se trouvent des éléments détritophages et saprobiontiques (représentés par des tylenchoidés (12%), des araeolaimoidés (32 %) et des rhabditoidés (50 %)) pratiquement, étant les éléments bryophages (représentés par des dorylaimoidés (6 %)) seulement dans un échantillon avec une espèce (Mesodorylaimus bastiani), avec une absence totale des formes prédatrices (mononchoidés et tripyloidés).

Dans l'ordre faunistique, les espèces trouvées sont propres des biotopes de ce type: il s'agit d'une nématofaune caractéristique bien définie. Toutes les espèces trouvées sont des formes communes et cosmopolites dont l'intérêt biogéographique est très faible. Cependant, il faut ténir compte du peuplement récent de ces petits îlots volcaniques.

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I-II3

Données préliminaires sur le peuplement d'Orthoptères de certains écosystèmes typiques de l'Egée*

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Introduction.Deux séries d'échantillons quantitatifs et semi-quantitatifs ont été fait à Naxos, en début de l'été (1987) et en fin de printemps (1988) et ont permis d'estimer, en première approximation, la composition et le spectre faunistique, la densité et la biomasse du peuplement orthoptérologique de 4 types représentatifs d'écosystèmes insulaires égéens: -un maquis clair, un phrygana-maquis dégradé, un phrygana et une oliveraie(ancienne plantatió non exploitée). Les 4 biotopes sont adjacents et sis sur un versant est, entre 0,5km et 1,8km de la mer, de 50m à 250m d'altitude, sur terrain calcaire rocailleux. Ils subissent tous une pression de pâturage "libre" par les chèvres, pendant la plus grande partie de l'année (charge: 3individus/ha en moyenne).

Les estimations ont été effectuées sur des spécimens récoltés dans des surfaces d'échantillonnage constituées d'une part par des parcelles carrées de 10m X 10m et par des "transects" de 25m X 2m d'autre part. On a tenu compte du pourcentage des animaux échappés et on estime que le degré de représentativité des échantillons atteint au moins 80%.

Structure de la végétation. 1.Maquis: Recouvrement végétal env.58%. Principales espèces: Juniperus phoenicea 42%(ht moy.2,75m), Olea europaea silvestris 10%, Pistacia lentiscus 10%, Quercus coccifera 1,5%.- 2.Phrygana-maquis dégradé: Recouvrement végétal 46%. Principales espèces: Quercus coccifera 20%, Genista acanthoclados 8%, Pistacia lentiscus 7,5%, Thymus capitatus 7%, Calycotome villosa 2%. - 3.Phrygana: Recouvrement végétal 60%(ht moy.0,8m).Genista acanthoclados 15%, Thymus capitatus 9%, Quercus coccifera 4,5%, Cistus creticus 3%, Pistacia lentiscus 3%.- 4.Oliveraie: densité env.100 arbres/ha(ht moy.9m).Présence sporadique:Pistacia lentiscus.(Données: MATSAKIS-KARAMAOUNA, LEGAKIS, TSIOURLIS, MAGIORIS:C.I.E.S.M. 1984 et 1986).

Résultats globaux (voir Tableau ci-dessous). 1.Des différences apparaissent entre les 4 biotopes, aussi bien dans le cas de l'échantillon des débuts de l'été 1987(26-28.VI) que dans celui de la fin du printemps 1988(30.IV-01.V): Elles portent sur la composition,la densité et la biomasse.(N.Dans les cas où le nombre de données permettait des tests statistiques, les différences s'avèrent significatives). 2.Dans l'ensemble, huit espèces différentes au moins ont été signalées, mais dans chaque biotope 2 à3 sont dominantes (rarement les mêmes dans 2 biotopes différents). 3.A titre indicatif, on peut retenir le fait que les densités sont supérieures, en moyenne et dans l'ensemble, en début de l'été (1987) qu'en fin de printemps (1988). 4. On doit relever par ailleurs une dominance des Acrididae, adultes ou sub-adultes en majorité, en début de l'été et une dominance des Tettigonidae, immatures en majorité, en fin de printemps. 5.La biomasse dépasse 120gr/ha poids sec (fin juin 1987); cependant, elle oscille entre 3 et 14gr/ha, probablement de façon transitoire, en fin avril, au moment de l'apparution des jeunes tettigoniens.

Tableau synoptique

	maquis	.phryg.-maq.	phrygana	oliveraie
Densité: ind/ha (1)	940	1709	1160	1067
(2)	667	367	167	1067
Biomasse: gr/ha (1)	112	128	124	149
(2)	8	3	?	14
Composition: % (1)				
A.Oedipoda caerulescens	27,6	6,4	---	46,9
Oed.miniata min.	27,6	3,2	---	31,2
Calliptamus barbarus	8,5	6,4	3,4	---
Calliptamus italicus	6,4	3,4	19,0	---
T.Tylopsis lilifolia	----	12,7	6,9	---
Larves	8,5	54,2	51,7	9,4
Divers[x]	21,3	13,8	19,0	3,1
Composition: % (2)				
A.Larves	98	95	?	95
T.Larves	2	5	?	5

(1): Echantillon de juin 1987 (2): échantillon avril-mai 1988
A: Acrididae T: Tettigonidae x: y compris indéterminés

*Recherches réalisées dans le cadre du programme ENV-593-G(B), Direction XII, C.E.E.

I-II4

Synecology of Crayfish and Herpetofauna in Adriactic Islands

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RESUME : Synécologie des écrevisses et de l'herpétofaune des îles adriatiques. Les biotopes typiques dulçaquicoles dans l'Archipel Adriatique sont confinés aux îles pluvieuses septentrionales présentant les biotopes d' Austropotamobius italicus, Triturus vulgaris, Hyla arborea, Rana ridibunda, Natrix natrix et Emys orbicularis. Ils sont absents des îles sèches méridionales de Dalmatie qui sont plus riches en lézards et serpents dont la synicologie y est également étudiée.

INTRODUCTION. The freshwater habitats of the crayfish and amphibians in the Adriatic Archipelago are rather rare, due to the lacking precipitations and especially to the predomination of the porous Karst substrats being unsuitable for the forming of surface waters tat there sink immediately into the subterranean cavities. Thus the stable and typical freshwater habitats there are restricted to the most rainy northernmost islands of Kvarner Gulf, especially in the islands Cres and Krk where occur the crayfish and some amphibians. More southwards on dry Dalmatian islands occur only some unstable seasonal tarns and the brackish lagoons where the crayfish is lacking, and the amphibians are rare including only Bufo viridis and Bombina variegata. These hot-dry douthern islands in Dalmatia are but the richest ones in reptilians, and especially in different lizards. The main studied freshwater habitats are the next two ones: the well conserved Vrana lake, a deep rocky oligotrophic basin in Cres island, and in the Krk island the Ponikve flat lakelet, and the Velarika rivulet presenting the unique permanent running water of the entire archipelago. Both freshwater sites of Krk recently are partly degraded by the hydrotechnical regulations for water supply.

RESULTS. The insular crayfish in the fresh waters of Cres and Krk has been defined by STANKOVIC (1961) to be Austropotamobius italicus Fax., but it is rather deviating from its West Mediterranean type especially concerning a minor size and the major spinescence, and this may be probably a separate insular subspecies. It occurs either in the muddy-shingly bottoms within the calciphilic karst hydrophytes of the alliance Coleogeto-Najadion Lov., and also on the rocky bottoms covered by the calcifying water mosses of Fontinalion antipyreticae Hüb.

Among the amphibians, the most widespread ones across this archipelago are the swamp ubiquitarians Bufo viridis Laur. and Bombina variegata kolombatovici Bedr., being the most resisting amphibians to a periodical aridity. Thus during the summer, they find their refuge under the stones and in karst pores. Their habitats include the dessiccating tarns of Isoëtetalia Br.-Bl., and also the subsaline swamps of the Bolboschoenion Sóo and Ruppietalia Br.-Bl. Other insular amphibians are related to the stable freshwater habitats and they occur almost only in the northern islands of Kvarner Gulf. The Hyla arborea L. of these islands is ecologically rather divergent from its mainland populations, for there it is lacking from its usual forest habitats and it is usually found by the springs and within the caves, mostly correlated with the skiophytic ferns of Adiantion Br.-Bl.

The Urodela are presented chiefly by Triturus vulgaris tommasinii (Walt.), an endemic subspecies of East Adristic karst waters and there it lives, also as the crayfish, between the calciphilic hydrophytes of Coleogeto-Najadion. Other rare amphibians of N islands are Rana ridibunda Pall. and Salamandra salamandra (L.) whose synecology was not studied.

The freshwater reptilians found only in Cres and Krk are the turtle Emys orbicularis (L.) and serpent Natrix natrix (L.), both living mostly within the reeds of Phragmitetalia Tx.& Prs. The terrestrial turtles are presented only by Testudo hermanni Gmel., that is frequent in the major southern Dalmatian islands, but rare up to absent in northernmost ones. It occurs chiefly within the garrigue scrub of Cisto-Ericion Hic. Concerning the terrestrial serpents of archipelago, Vipera ammodytes (L.) is frequent in some major islands but rare up to absent in many minor islets. It is there also ecologically divergent from its mainland populations, for it is there rare in its usual habitats of open rocks and grasslands and occurs mostly in the woods of Orno-Quercetum ilicis Hic and of Carpinetum orientalis Hic. Vipera berus L. occurs only in the northernmost Krk island, within the montane woods of Seslerio-Ostryetum carpinifoliae Horv. The largest and frequent insular serpent is Coluber carbonarius (Bonap.) living chiefly in the deciduous thornbush of Paliuterum Hic. Telescopus fallax (Fleisch.) occurs in many islands, almost in the grasslands of Artemision lobelii. Other rare insular serpents are also Coluber najadum (Eich.), Elaphe situla (L.), E. quatuorlineata (Lacep.) and Malpolon monspessulanus Herm., whose synecology is not studied.

The saurians include Ophisaurus apodus (Pall.), frequent in many isles within the flysch grasslands of Scorzonerion villosae. The geckos include Tarentola mauretanica (L.) frequent on the islands in old houses and ruins within Kentrantho-Parietarion R. Mart.; and more rare Hemidactylus turcicus (L.) of southern Dalmatian islands (synecology not studied). The true lizards include 6 main insular species with numerous endemic subspecies. So the Algyroides nigropunctatus (Dum.& Bib.) is restricted to montane screes of Peltarion alliacese Hic. in the northernmost islands Krk and Prvic. Lacerta trilineata Bedr. is frequent in insular scrub of Cisto-Ericion. The endemic Podarcis oxycephala (Dum.& Bib.) occurs in the mediterranean grasslands of Cymbopogono-Brachypodion Hic. in the southern Dalmatian islands only. P. taurica is there presented chiefly by ssp. fiumana (Wern.) being widespread in the grasslands Scorzonero-Chrysopogonetalia Hic.& Horv. across the archipelago. P. sicula (Raf.) presents some insular endemics within the summer-deciduous scrub Euphorbietum dendroidis Guin.& Drou. of S external isles: ssp. pelagosae (Bedr.) in Palagruža, and ssp. cazzae (Schr.) in Sušac. The reputed black lizard Podarcis melisellensis (Braun) is the most diversified in insular endemics. So its ssp. melisellensis s.str., in Brusnik islet and ssp. pomoensis (Wett.) in Jabuka and also ssp. kammereri (Wett.) in Barjak, all occur in the wintergreen scrub Levastero-Capparetum siculae Lov., while other endemics e.g. ssp. lissae (Wern.) in Vis and ssp. galvagnii (Wern.) in Svetac both live in xeric grasslands of Stipion capensis Br.-Bl. (cf. RADOVANOVIC 1951).

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I-II5

Nesting areas and synecology of Seabirds in Adriatic Islets

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RESUME : Aires de nidification et synécologie des oiseaux marins de quelques îlots adriatiques. Dans l'Archipel adriatique, on a trouvé 27 espèces d' oiseaux marins - pour la plupart en migration - et seulement chez dix espèces on a pu confirmer la nidification : Larus cachinnans, Sterna hirundo, S. albifrons, Puffinus puffinus, Calonectris diomedea, Phalacrocorax aristotelis et récément, on a confirmé aussi Gelochelidon nilotica, Hydrobates pelagicus, Oceanodroma leucorrhoa et Fratercula arstica nidifiant sur quelques îlots peu accessibles.

INTRODUCTION. The coastal avifauna in Adriatic Archipelago is rather poor if compared with other Mediterranean islands, and especially in relation to the Atlantic islands in NW Europe. In this archipelago one indicated 27 seabird species, but the classical studies prior to 1980ies (cf. LOVRIC 1981) there documented the nesting only for 6 ones: Larus cachinnans, Sterna hirundo, S. albifrons, Phalacrocorax aristotelis, Puffinus puffinus and Calonectris diomedea. The recent detailed studies across this archipelago added 4 other coastal nesters: Gelochelidon nilotica, Oceanodroma leucorrhoa, Hydrobates pelagicus and Fratercula arctica. Thus the rest of 17 seabirds noted in this archipelago are never registered in nesting but only during their seasonal migrations e.g. Sula bassana L., Stercorarius skua, St longicaudus, Hydroprogne caspia, Haletor pygmaeus, Phalacrocorax carbo (L.), Rissa tridactyla (L.), Larus marinus L., L. ridibundus L., L. melanocephalus, L. minutus, Chlidonias niger, Ch. leucopterus, Ch. hybridus, Sterna sandvicensis, Mergus serrator and Podideps cristatus. The nomenclature of bird species is after MATVEJEV and VASIC (1973).

RESULTS. Seabirds include two species nesting chiefly on coastal dunes, beaches and sandly islets (eyots) within the psammophytic vegetation of Ammophiletea Br.-Bl. Among the Adriatic islands, such habitats with the related nesting birds are well developed only in the loess and flysch islets within the Losinj Archipelago in N Adriatic.

1. Sterna albifrons Pall. occurs in the sandy eyots by Losinj within the psammophytes of Ammophiletalia.

2. Gelochelidon nilotica (Gmel.) is a very rare nester of the loess sandy islets Srakane and Palacol within the Losinj group, nesting associated with Sterna albifrons in the psammophytic vegetation of Eriantho-Agropyretum maritimae (Hic.) Lov.

The skerry birds include two species nesting mostly in the subhorizontal stony shores, and in the minor rocky islets and reefs within the xerohalophytic vegetation of the Crithmo- Limonietalia Br.-Bl.:

3. Larus cachinnans (L.C. michahellis) is the most frequent seabird within the Adriatic Archipelago, and the nesting colonies there occur in numerous rocky islets and reefs, sometimes also in the rocky capes of major islands. The nesting sites are variable, so among the xerohalophytic vegetation of Microrrhinion litoralis (Hic.) Lov., and also in the aerosaline shrublands of Thymelaeion hirsutae Tadr.

4. Sterna hirundo L. nests in some minor Adriatic islets, especially in Galun and Kormat within the Kvarner Archipelago and in the minor islets of Kormati Archipelago, often in the mixed colonies associated with Larus cachinnans.

The seacliff birds include other 6 ones nesting in the stormy coastal escarpments of craggy islets and in lofty major islands, within the cliff vegetation of Euphorbietalia dendroidis Zoh.

5. Phalacrocorax aristotelis desmarestii is the second frequent coastal nester of this archipelago, since the gulls. The nesting sites lie within the aerosaline cliff vegetation of the alliance Aurinio-Capparion Lov. The richest colonies persist in the Kornati and Lastovci, and Vis and Senj Archipelago.

6. Puffinus puffinus yelkouan there is a rare nester, so far registered in the remote islets of Vis Archipelago in central Adriatic, and also in the stormy islets Prvic and Grgur in NE Adriatic. Both sites are in seacliffs (Aurinio-Capparion).

7. Calonectris diomedea is also in Yugoslavia a rare nester, so far registered in the seacliffs of Mid Dalmatian islands, often associated in the colonies of Phalacrocorax aristotelis within the phytocoenosis Aurinio-Brassicetum frutescentis.

8. Hydrobates pelagicus is a very rare nester registered so far only in the remote volcanic islets (guyots) of the Vis Archipelago in central Adriatic, and especially in the igneous seacliffs of Jabuka and Brusnik overexposed to the Sirocco storms from open sea. The nests are in the cliff pores within the endemic xerohalophytic phytocoenosis of Puccinellio teyberi-Centaureetum crithmifoliae (Lov.) Lov.

9. Oceanodroma leucorhoa castro is the most rare seabird of Adriatic, and there is registered sporadically as nesting only on the craggy islet Prvic (NE Adriatic). They are associated with Fratercula, in the lofty seacliffs overexposed to the strongest Bora hurricanes, within the endemic aeolian phytocoenosis Aurinio mediae-Astragaletum dalmatici Lov.

10. Fratercula arctica is also very rare in NE Adriatic. The ancient indications in Krk and Pag recently are not confirmed, and actually is registered in a sporadical nesting only in the stormy seacliffs of Prvic islet overexposed to the strongest Bora, within the Aurinio-Astragaletum vegetation.

Thus these richest nesting sites of seabirds in Prvic and also in the remote Mid-Adriatic islets need an urgent protection.

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I-II6

Breeding birds on the Island of Naxos (Cyclades, Greece). Eight breeding records new to the island. Differences with those of Krüper and Watson.

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This paper contains new data about breeding birds on the island of Naxos, Cyclades,Aegean sea.We visited Naxos from Febr.1984 - Dec. 1985 on a monthly basis,for 4-7 days at a time,as well as on March, April,June,August,November,1986 and on May 1987.Observations were made mainly on the southeastern part of the island and on the lagoon near the capital,but very often we covered all the island by car.

During the 19th and 20th century many observers have visited the island of Naxos.However the breeding birds have been studied only by Krüper and Watson in the past.Krüper visited Naxos during 1862 and recorded 42 bird sp. as definitely breeding as well as 9sp. as doubtful breeding.Watson visited the island during 1954 and 1959 and recorded the breeding Passeriformes.With respect to his study 32 sp. are definitely breeding and 3 sp.(Wren,Whitethroat,Stonechat) are douptful breeding on the island.(TAB.1).

According to our observations 42 sp. have been recorded as definitely breeding on Naxos.21 of these are Residents occuring all the year round and 21 sp. are Summer visitors.Although 4 sp. have been seen during the breeding season we keep our doupts and classify them as of uncertain seasonal status.(TAB.2);Finally the birds nº 5,28,29,35,38,40 in Table 2,are here recorded for the first time breeding on Naxos and nº 36,37 for the first time in all the Cyclades.

Comparing our data with those of Krüper and Watson we must note that 17 sp. that were definitely breeding according to them,have not been observed during the breeding season (nº 2,4,12,14,15,17, 20,22,25,28,33,34,37,38,43,44,48,TAB.1).Also 6 doubtful breeding species (nº 49,51,52,53,54,58,TAB.1) have not been observed from which the Egyptian Vulture and the White-tailed Eagle have not been recorded in all the Cyclades during the 20th century.According to our data 10 sp. of TAB.1.(nº 4,12,15,17,22,33,34,37,53,54) are Migrants,while 8 sp.(nº 2,14,20,25,28,38,48,52) were not observed from the study transects.Finally,3 sp. are Winter visitors (nº 43, 44,58),but very often some of them delay their departure until mid April.

From the Residents no 8,11,13,15,18,20 are very common while no 4,6 and 16 are uncommon. Bonelli's eagle is very rare, Kestrel's population is constant. Concerning Summer visitors, no 25, 27,28,32 are noumerous in their breeding areas while no 35,36,40 are very rare. Marmora's warbler was observed in areas with law vegetation where Cistus sp. was dominant.

TABLE 1. Species observed by Krüper and Watson

Definitely breeding:1.Manx Shearwater 2.Cory's Shearwater 3.Shag 4.Lesser Kestrel 5.Kestrel 6.Eleonora's Falcon 7.Chukar 8.Herring Gull 9.Rock Dove 10.Scops Owl 11.Little Owl 12.Alpine Swift 13.Swift 14.Pallid Swift 15.Shorttoed Lark 16.Crested Lark 17.Grag Martin 18.Sand Martin 19.Swallow 20.Richard's Pipit 21.Tawny Pipit 22.Yellow Wagtail 23.White Wagtail 24.Woodshat Shrike 25.Lesser grey Shrike 26.Hooded Crow 27.Raven 28.Olive-tree Warbler 29.Olivaceus Warbler 30.Orphean Warbler 31.Garden Warbler 32.Sardinian Warbler 33.Subalpine Warbler 34.Spotted Flycatcher 35.Black-eared Wheatear 36.Blue-rock Thrush 37.Nightingale 38.Blue Tit 39.Great Tit 40.House Sparrow 41.Greenfinch 42.Goldfinch 43. Linnet 44.Corn Bunting 45.Cretzshmar's Bunting 46.Cirl Bunting 47. Black-headed Bunting 48.Common Bulbul.

Doubtful breeding:49.Egyptian Vulture 50.Griffon Vulture 51. Whitetailed Eagle 52.Golden Eagle 53.Little ringed Plover 54.Common Sanpiper 55.Turtle Dove 56.Wren 57.Whitethroat 58.Stonechat.

TABLE 2. Species observed by writer

Residents:1.Shag 2.Griffon Vulture 3.Bonelli's Eagle 4.Buzzard 5.Kestrel 6.Peregrine Falcon 7.Chukar 8.Herring Gull 9.Scops Owl 10.Little Owl 11.Crested Lark 12.White Wagtail 13.Hooded Crow 14.Raven 15.Sardinian Warbler 16.Blue-rock Thrush 17.Great Tit 18. House Sparrow 19.Greenfinch 20.Goldenfinch 21.Cirl Bunting.

Summer visitors:22.Eleonora's Falcon 23.Rock Dove 24.Turtle Dove 25.Swift 26.Sand Martin 27.Swallow 28.House Martin 29.Tree Pipit 30.Woodchat Shrike 31.Olivaceus Warbler 32.Orphean Warbler 33.Garden Warbler 34.Whitethroat 35.Rüppell's Warbler 36.Marmora's Warbler 37.Red-breasted Flycatcher 38.Wheatear 39.Black-eared Wheatear 40.Ortolan Bunting 41.Cretzschmar's Bunting 42.Black-headed Bunting.

Doubtful breeding: Manx Shearwater (on 4.4.'85),Tawny Pipit (on 5.8.'84), Wren (on 12.3.'84 and 13-18.4.'84),Icterine Warbler (on 20.5.'84,one indiv.).

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I-II7

A first review on the insular endemic Spiny Mouse of Crete Acomys minous (Rodentia : Murinae)

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A B S T R A C T

The subject of this review is a little known rodent of the Cretan fauna, Acomys minous Bate 1905,or as Dieterlen remarks (1963), "...the only european member of an arid and warm zones prefering genus...".

The literature that deals exclusively with the Cretan Spiny Mouse is very poor compared with the bibliography that concerns its African relatives.It is not surprising that the first study on the biology and ecology of the animal has been carried out just in 1963 by Dieterlen,while immediately after that,Matthey worked on the karyotype of a few specimens obtained by the former.

The exact taxonomic position of the Cretan Spiny Mouse is not clear enough,a fact common with most of its congeneric forms. Since 1905,the year that Dorothea Bate described the animal from a small number of specimens (3),only a few publications deal with this murid until today and almost none of them refer to the animal with the same name! Bate in her first publication(1905) named the Cretan Spiny Mouse as A.dimidiatus minous,giving also a brief description as well as basic mesurements of the animal. In 1913,she mentioned it again in her "Mammals of Crete" but under the name A.minous,not making clear the reasons for this transition of the taxonomic level.

Aharoni (1932) treats A.dimidiatus as a subspecies of A.cahirinus and the same did Ellermann & Morrison-Scott (1951) in their "Cheklist of Palaearctic and Indian Mammals" setting the cretan form under the species level of cahirinus.Ellermann, in a previous publication (1949,reprinted in 1966) separated cahirinus and dimidiatus into different species treating the Cretan Spiny Mouse as A.dimidiatus minous again!

Subsequently,Zimmermann (1953) brings back the Aharoni statement,referring to the animal as A.c.minous.He also gave a more detailed description and complete morpnometric data,relied on twenty-five specimens. However,Zahavi & Wahrman (1956) separated the "minous" form again as a species "per se" on a chromosomic basis, while Dieterlen a few years later (1963),seems to be in doubt when referring to the systematic status of the rodent.(Although he shows the tendency to set apart the Cretan Acomys).

The situation appeared to be more clear after the exhaustive study,both on the number and the morphology of the chromosomes,made by Matthey in 1963.He claimed that the Cretan Spiny Mouse belongs to a different species than those of Palaestina and Cyprus,while he gave a dendrogram of the possible evolutionary relationship between the three murids.

From that period on,the animal has been treated as an endemic species of the island (Ondrias 1966,1967,Graf 1986),while any further research concerning whichever aspect of its biology,seems to be interrupted.It is therefore evident,that additional studies on this point need to be done in the near future.

The exact routes that explain the present distribution of Spiny Mice in Crete,Asia Minor and Cyprus remain still unknown, but some considerations on this point may be expressed. The latest theories concerning the Oligocene and Miocene geology of the Aegean archipelago,impose the existence of a landmass extending over the present Aegean area,including Crete(Sondaar,De Vos & Dermitzakis 1986 and Dermitzakis 1987). The fossil mammals of that age being found on the island of Crete,belong to a "balanced,continental" fauna,suggesting a normal connection between Crete and the mainland of Greece (Dermitzakis & Sondaar 1978). A complete lack of fossil mammals in the Pliocene strata of the island, indicates a possible disappearence of a big part of the existing fauna during that time (Dermitzakis & De Vos 1987). The mammal fauna that appeared again on the island,is not over 2 million years old (Lower Pleistocene) and "unbalanced" in structure (Dermitzakis and De Vos 1987).

The only possible routes of a Pleistocene European murid invasion to the island of Crete are those from Peloponessus via Kythera and Antikythera and from Rhodos via Karpathos and Kasos (Derm. & De Vos 1987). The ancestor of the Cretan Spiny Mouse seems to have followed one or both of the above routes of immigration,since Miocene Acomys occupied an area extending over the Greek and Asia Minor mainland (Dieterlen 1963).

Not so much is known untill now about the reproduction,feeding habits and behavior of the Cretan Spiny Mouse.The only data available,are the morphometric studies of Bate (1905) and Zimmermann (1953) and the observations on an experimental population that Dieterlen created (1963) from 7 animals captured on the island.The environment that seems to be optimal for the Cretan Spiny Mouse consists (according to Dieterlen 1963) of rocky phryganic areas of southern exposure with many rifts for sheltering. All the sites,where the animal has been recorded up to now (Bate.1905,Zimmermann 1953 Dieterlen 1963,Graf 1986),belong to the above described biotopes and were placed in the vicinity of the coastal region of Crete. No information on the altitude that the animal can reach has been provided until now. Here,it must be underlined that there is clear evidence of an extencive disturbance or even destruction of a big part of the possible biotopes of this species,mainly because of the uncontrolled urbanisation and the increased touristic activities over the last fifteen years.

Also we have no idea about the ecological relationship,as well as the competitivenes of the Spiny Mouse against its relative murids (house mice and rats). Bate (1905) and Dieterlen (1963) noted the ability of the animal to enter the human habitations in periods of harsh natural environmental conditions,but there is no evidence about its ability to compete against other mice,already settled there.

A second point of interest is the study of the highest altitude that the species can survive on Crete.The purpose of such an investigation is to provide information on the ecological plasticity of the mammal and therefore to give some ideas on how long (on the point of time) it inhabits the island. Since no total submergion of Crete has taken place in the Late Cenozoic era (Dermitzakis 1987),it is more reasonable to suggest an older existence of the genus on Crete, than to accept the immigration way as the only possible for its present existence on the island. If the animal can survive in altitudes higher than 1000-1500 m,the possibility of a withdrawal of the species on higher biotopes, during the Pliocenic tectonic events,has to be also in mind.

In conclusion, we should underline the necessity of a further research both on systematic and ecological directions in order to keep a viable population level of this rare (?) and endemic species on the island of Crete.

I-II8

First data on the Avifauna of Rhodopos Peninsular (W. Crete)

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This work gives data on the bird species that were observed during automn 1987 and spring 1988, throughout the peninsular of Rhodopos and the exact dates of observations.It is connected with a conservation program titled:"Registration of the wetlands and the other important bird areas of Crete"(University of Patras).

The Rhodopos peninsular is situated on the northwestern part of Crete.There are only some villages at the base of the peninsular and the rest of the area is deserted.The peninsular is crossed by some rural roads,one of them leads to the onyx mine.The grazing is intense but no other activity seems to disturb the area.

The highest hills are Onyx (748m) and Mouri (747m).

There are five basic types of biotops that we encountered:
A) Areas around human habitation with gardens,fields,hedges etc.
B) Rocky and earthy coasts and ravines.C) Semi-abandoned fields, meadows.D) Territories dominated by maquis and phrygana.E) Small forests by Querqus sp.

Among the above mentioned species,some are winter visitors,others are residents and most of them are passage migrants and summer visitors.

Comments

This is the first time that a study of the avifauna of Rhodopos peninsular is to be attempted.It seems to have a great importance for the migration of birds,as it serves as a restiring and feeding station for them.The number of migratory birds which were observed during our visits proves that it is situated on a migration road passing from Crete and continuing either to Kythera-Peloponnisos or to Cyclades.

The variety of biotops is adequate for the migration and probably breeding of passering birds.

The absence of human activities (out of grazing) establishes the peninsular ideal for the feeding and migration of raptors.We observed 7 species of raptors,5 of which are endangered and protected by the directive 74/409/CEE.

The list of the species and the dates of observations

1.Egretta garzetta(B)2/10,20/4
2.Buteo buteo(F)22/4
3.Buteo rufinus(F)22/4
4.Aquila chrysaetos(F)22/4
5.Gyps fulvus(F)22/4
6.Hieraaetus pennatus(F)22/4
7.Pandion haliaetus(F)22/4
8.Falco tinnunculus(F)22/4
9.Alectoris chukar(D)22/4
10.Coturnix coturnix(D)22/4
11.Larus argentatus(F)3/10,20,22/4
12.Streptopelia turtur(E)22/4
13.Apus apus(A)20,22/4
14.Upupa epops(D)22/4
15.Oriolus oriolus(D)22/4
16.Anthus pratensis(C)22/4
17.Delichon urbica(A)20,22/4
18.Hirundo rustica(A)20,22/4
19.Corvus corone cornix(F)20,22/4
20.Corvus corax(F)3/10,22/4
21.Troglodytes troglodytes(B)22/4
22.Galerida cristata(C)20,22/4
23.Lullula arborea(C)22/4
24.Passer domesticus italiae(A)3/10,20,22/4
25.Muscicapa striata(C)22/4
26.Ficedula albicollis(D)20,22/4
27.Ficedula hypoleuca(D)20,22/4
28.Cettia cetti(D)20/4
29.Sylvia melanocephala(D)20,22/4
30.Sylvia hortensis(D)22/4
31.Phyllosc. collybita(E)20,22/4
32.Saxicola torquata(D)22/4
33.Saxicola rubetra(C)22/4
34.Phoenicurus phoenicurus(G)22/4
35.Phoenicurus ochruros(D)22/4
36.Oenanthe oenanthe(C,D)20,22/4
37.Oenanthe hispanica(C)20,22/4
38.Erithacus rubecula(A)20/4
39.Luscinia megarhynchos(D)22/4
40.Turdus merula(D)20,22/4
41.Turdus philomelos(E)20/4
42.Monticola solitarius(B)20,22/4
43.Parus major(A,E)3/10,20,22/4
44.Fringilla coelebs(A,D,E,)20,22/4
45.Carduelis chloris(A)22/4
46.Card. carduelis(A,D,E)20,22/4
47.Acanthis cannabina(D)20,22/4

A,B,C,D,E : Types of habitats encountered,see preceding page.
F : The birds were observed only in Flight.

I-III1

Morphological differentiation in Albinaria populations (Gastropoda, Pulmonata) from the Aegean Region

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Data have been assembled on 36 different quantitative characters (mainly different lengths and angles of the shell) for 18 populations belonging to 8 species of the genus Albinaria. In every population 20 individuals were measured. The populations were collected from several localities in the Cyclades, in Ikaria, Psara and Crete islands and Mt. Hymettus. The dendrogram, based on these measurements, did not coincide with the one provided from the electrophoretic study of 27 genetic markers. (Mylonas et al 1987, Ayoutanti et al 1987, Ayoutanti et al, in this issue). The genetic markers permitted the construction of a tree reminding grossly the actual geography and probably having a good correspondance with some paleogeographic aspects, thus indicating that the information they conveyed is related to historical processes rather than to ecological similarities. The morphological characters seem to depict these last ones, since they provide a "patchy" tree, without correspondance to the actual geography neither to the presently accepted taxonomic delineations of the Albinaria species. A further analysis of the morphological characters was pursued.

Morphological characters could be strongly correlated. From the inspection of all possible correlations, we were able to join them in 6 groups. Members within each group are correlated but there is no correlation between members belonging to different groups. There are two major groups. The first consists of most of the length measurements and the second of most of the angle measurements. Thus all 36 measurements should not be taken as independent (all of them providing the same amount of information) when considered in their totality.

Inspite of the apparent discordant results between electrophoretic and morphological data we decided to investigate the possible concordance of every morphological character apart with the pattern exhibited by the electrophoretic data. Correlation coefficients were computed first between the distances provided by the electrophoretic data (genetic distances) and those with every morphological character, then between the value of the first principal component of the electrophoretic data (this component exemplifies even more closely the "historical" pattern) with the mean value of every morphological character at a time. Three characters only showed moderate correlations (0.25 to 0.52) in both series, with electrophoretic data: the angle of the apex of the shell and two (correlated between themselves) measurements of the prolongation of the shell mouth. This should not necessarily be interpreted as originated by a historical process: the correlation is not very strong and the electrophoretic pattern indicates a loose east to west pattern which could be related to an ecological gradient.

On the contrary correlations between geographic latitude and mean values for every morphological character were stronger for two of them: the angle formed by the suture of the last whorl and the axis (0.49) and the number of stries per mm (-0.61). For this last character smooth shells (without stries) are commonest in the north, while striated ones in the south. The same gradient is encountered in altitude. It is quite probable that these gradients are the result of natural selection. For the exact mechanism of its action several hypotheses could be formulated.

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Mylonas, M., C. Krimbas, S. Tsakas, A. Ayoutanti, 1987. The genus Albinaria Vest (Gastropoda,Clausiliidae). Is there any true species? Biol. Gallo-Hell. 13:161-164

I-III2

The differentiation and distribution of the genus Mastus (Gastropoda, Enidae) in the Aegean Archipelago

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The genus Mastus Beck,1837 with an almost continuous distribution from Italy to Turkey, is strongly differentiated in the Aegean. According to the existing data eight of the nine species of this genus appear in the Aegean (M.dirphicus, M.pupa, M.pusio, M.turgidus, M.olivaceus, M.ehrenbergi, M.rossmaessleri.,M.carneolus). Five of them are endemic of the Greek Islands. Heller J. in 1976 tried to give an extensive taxonomic study and biogeographical conclusions based on the whole Enidae fauna of the Aegean. But the incomplete description of most species (no measurements, no description of genitalia) and the large gaps of their distribution led to a reasonable criticism for the taxonomy as well as the biogeographical conclusions (Mylonas 1982).

The systematic collection of samples in more than 40 islands in addition with ecological observations enabled us to study the characteristics of the shell and of the reproductive system of many populations of the genus Mastus.

The following represent our main observations and conclusions:

1. The biological cycles of all the mentioned species and their ecological requirements and positions resemble in a high degree.

2. There are only two cases where we met sympatric populations of different species. In Syros, the species M.pupa and M.pusio and in Ierapetra (Crete) the species M.pupa and M.olivaceus.

3. Any one of the species, no matter how peculiar it is, appears variable in shell form and tends to reach the form of M.pupa.

4. The reproductive system has a main basic form with some peculiarities but no sharp discontinuities. Only in the populations of Makronissos isl.and Viannos (Crete) the divertikel of the bursa copulatrix is missing. But this is not of taxonomic significance (Forcart, 1940).

5. The ecological, morphological and anatomical observations do support the opinion that the species mentioned in the Aegean are only different forms, subspecies of a single species, M.pupa.

6. The sympatricity of M.pupa with M.pusio in Cyclades and M.olivaceus in Crete, may indicate that these forms are found very close to their complete differentiation into clear species.

The distribution of Mastus in the Aegean.
M.pusio ■, M.dirphicus □, M.turgidus ●, M.olivaceus ○
M.ehrenbergi ▼, M.rossmaessleri ▼, M.carneolus ●
M.pupa ▨

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I-III3

Genetic differentiation in Albinaria populations from the Aegean Region

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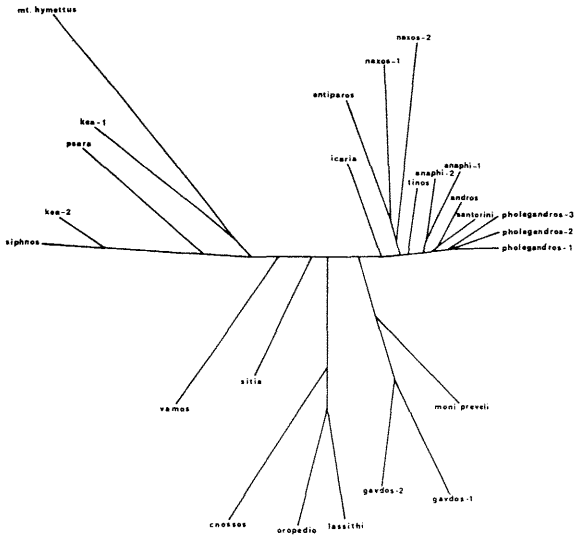
New data, presented here, have been assembled concerning the genetic differentiation and speciation occuring in populations belonging to the genus Albinaria. This land mollusc inhabits many islands of the Greek archipelago including the Cyclades, Dodecanese and Crete as well as the continental masses East and West of the Aegean. Local populations and especially those from different islands may display different morphological features that enabled taxonomists to distinguish several taxonomic units (subspecies, species). However, their taxonomic status has been recently questioned and is subject to revision (Mylonas et. al., 1987).

A genetic study was undertaken using 27 different electrophoretic markers comprising more than one hundred segregating allozymes. Samples of 25 populations were examined (14 from the Cyclades, 1 from Icaria, 6 from Crete, 2 from Gavdos, 1 from Attica and 1 from Psara). The genetic distances between populations were computed using the D_{χ^2} estimator (Krimbas and Sourdis, 1987) and an unrooted tree was constructed by the Neighbor Joining Method, which seems the most efficient for recovering reliable trees.

The examination of the tree reveals a rather good general correspondance between genetic similarity and geographical position. As a matter of fact there is a significant positive correlation coefficient (0.39) between geographic distance and genetic distance for every couple of populations, but the correlation is not very high. The topology of the tree provides an explanation for this situation. All east Cycladian populations together with the one from Icaria are clustered in a rather compact group. This might indicate that the taxonomic units Albinaria coerulea, A. brevicollis (and perhaps A. puella) belong to the same biological species. Cretan populations are found together and subsequently, in the central part of the tree but not necessarily in their geographic order within this island. The left part of the tree includes all "western" populations, those from Attica and the West Cyclades, together with the northern population from Psara. In this respect the tree agrees with the taxonomists who recognize different species in these areas (A. grisea, A. discolor, A. turrita and A. sp. aff. chia). Thus East and West Cyclades are set apart, Cretan populations intercalating between them.



This pattern is also exhibited by the distribution of the values of the first principal component of the gene frequencies: West populations have negative values followed by those of Crete with the same sign but near zero while the East Cycladic populations display positive values.

How could we interpret this pattern? Obviously the relation of Crete to the Cyclades is not a direct one but twofold, to an eastern and to a western branch, as if a barrier, an internal sea between Crete and Cyclades, prohibited at the times of the genus expansion a direct contact. Is this pattern compatible with the hypothesis of a land arc connecting Peloponnesus-Crete-Dodecanese islands as postulated by biogeographers or is the present Albinaria distribution much more recent as taxonomists are driven to believe?. The distribution of fossil dwart hippopotami and elephants as well as that of the extant scorpion species Jurus dufoureius (Brulle) were taken to plead in favor of an old land brdige (Vachon 1953). Of course more data are needed especially on Peloponnesian population of Albinaria in order to elucidate this situation.

Krimbas, C.B. and J. Sourdis, 1987: Recent improvements in handling allelic isozyme data for tree construction. Isozymes: Current Topics in Biol. Med. Res. 15:49-62

Mylonas, M., C. Krimbas, S. Tsakas and A. Ayoutanti, 1987: The genus Albinaria Vest. (Clausiidae, Gastropoda). Is there any true species? Biol. Gallo-Hell. 13:161-164

Vachor, M., 1953: Sur la repartition du grand scorpion noir des iles de la mer Egee: Jurus dufoureins (Brulle). Revue Gen. Sci. 60:96-100

I

Biogeographical analysis of the Herpetofauna of the Greek Islands

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Although the herpetofauna of the Greek islands, compared with other animal groups, is one of the best known especially after the works of Werner, Wettstein, Clark, there is no attempt for a contemporary biogeographical analysis, except of a short announcement of Beutler in 1979.

The species - area relationship, the species distribution and the recent paleogeographical data, gave us the opportunity to discuss the distribution pattern of the reptiles in the Greek area.

The number of species precent and the area for:

a. The Ionian eslands
b. The Aegean islands which are found close to the Greek mainland,
c. The Aegean islands which are found close to the Asia Minor,
d. Both the Aegean and the Ionian islands,
e. The Cyclades and
f. The islands of the southern Aegean arc, are strongly correlated.

Based on the equations of the species - area relationship (fig.1) we observed that:

1. Slopes, with a range from 0.18 to 0.25, are lower for the coastal islands and higher for the central Aegean islands. But in general the relatively low z-values indicate that the factor "insularity" is not strong enough for the reptiles in this area.
2. The factor C of the species-area equation, with a range from 0.17 to 0.76, separate the six curves in three distinct groups. An upper one for the Ionian islands, a lower one for the islands of the southern arc and an in-between group for all the other curves. This is an indication that the islands of the southern Aegean arc are relatively "empty" of reptiles while the Ionian islands re latively "rich".

a:	Y = 0.76 + 0.18X	n= 5	r=0.48	0.10 < P<0.15
b:	Y = 0.54 + 0.19X	n= 8	r=0.76	P<0.05
c:	Y = 0.46 + 0.22X	n=14	r=0.59	P<0.05
d:	Y = 0.42 + 0.23X	n=54	r=0.67	P<0.05
e:	Y = 0.39 + 0.25X	n=21	r=0.71	P<0.05
f:	Y = 0.17 + 0.24X	n= 5	r=0.86	P<0.05

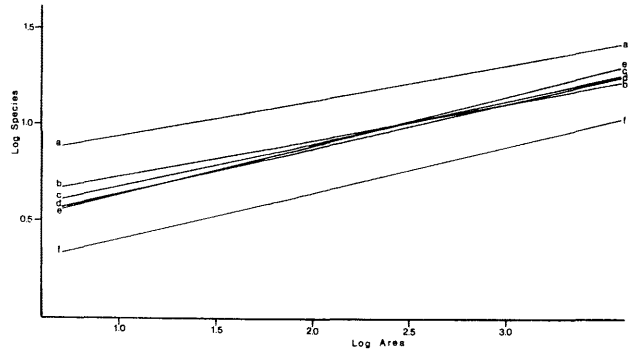

Fig. I

The recent distribution of the reptiles and their ecological requirements show that "emptiness" and "richness" are related mostly to historical events and not to recent ecological conditions.

Most of the existing data seem to be in agreement with the following hypothesis. Reptiles invated the Greek area mainly from the north. This invation influenced the Ionian islands, the Peloponnes and the central Aegean islands. A second invation from the east influenced only the islands that are found close to the Asia Minor. Non of the invations reached the islands of the southern Aegean arc, as these islands were isolated and never since the time of invation connected with the mainland. From paleogeographic maps presented by Dermitzakis we know that the southern islands were connected with the mainland (Peloponnes or Asia MInor) until the Messenian, so, the history of most of the species that form the recent Greek herpetofauna could not be older than this period.

Beutler, A. 1979. General principles in the distribution of Reptiles and Amphibians in the Aegean: Biol. Gallo-Hell. VIII: 337-341.

Apport de la paléogéographie, de la biogéographie et de la cytotaxonomie à l'étude de l'endémisme. Exemple : la Corse

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Des recherches conjointes à partir de différentes disciplines: paléogéographie, biogéographie et cytotaxonomie ont permis d'établir des corrélations entre les hypothèses paléogéographiques concernant l'histoire de la Méditerranée et le peuplement de la Corse.

L'inventaire des endémiques corses comprend 281 taxons (sensu lato), soit 11,16 % de la flore totale insulaire (2517 taxons d'après GAMISANS, 1985).

Leur répartition géographique révèle l'existence d'endémiques corses, cyrno-sardes, baléarico-cyrno-sardes, pyrénéo-corses, alpino-corses ou encore localisées en Corse (Sardaigne), Calabre et (ou) Sicile. D'autres enfin possèdant une aire disjointe et, restreinte à la Méditerranée occidentale, ont été pris en considération car leur distribution semblait étroitement liée à l'histoire paléogéographique de ce domaine.

L'appartenance de ces taxons aux différents éléments biogéographiques méditerranéens (sténo-méditerranéen, eury-méditerranéen et méditerranéo-montagnard) et extra-méditerranéens (boréal, orophile centre et sud européen et eurasiatique) a été établie et quantifiée.

Dans la mesure des connaissances caryologiques, ces taxons ont été distribués dans les 4 classes cytotaxonomiques, à savoir: les paléoendémiques, les patroendémiques, les schizoendémiques et les apoendémiques, afin de déterminer l'âge relatif des endémiques et des taxons correspondants.

Enfin les hypothèses paléogéographiques reconnues aujourd'hui ont été brièvement esquissées et servent de support aux propositions exprimées.

Les paléoendémiques sont tous de distribution baléarico-cyrno-sarde et se rattachent uniquement à l'élément méditerranéen. Ils constituent une flore paléogène développée *in situ*. Aucun endémique baléarico-cyrno-sarde n'a été recensé dans les éléments extra-méditerranéens. Les Baléares étaient donc séparées du bloc corso-sarde lorsque les éléments européen (boréal et orophile centre et sud européen) et eurasiatique ont pénétré en Corse et en Sardaigne.

L'endémisme commun à la Corse (Sardaigne), la Calabre et (ou) la Sicile ainsi que celui caractérisé par des espèces à aire morcelée et restreinte à la Méditerranée occidentale relèvent de cette chaîne montagneuse qui, à la fin de l'Oligocène, s'étendait de la chaîne bétique à la Kabylie jusqu'à la Calabre et jouxtait le microcontinent corso-sarde permettant des échanges floristiques et l'installation d'une flore commune. Bien qu'aucun paléoendémique n'ait été décelé, cet endémisme apparait encore comme très ancien.

Une nouvelle étape s'établit avec la préorogénèse et l'orogénèse alpines. Sont parvenus en Corse, et nettement moins nombreux en Sardaigne les orophytes centre- et sud-européens caractérisés par un schizoendémisme important à l'intérieur de grands complexes dont les taxons vicariants sont distribués sur les montagnes méditerranéennes. Ces taxons ont servi de filtre pour les éléments circumboréal et eurasiatique arrivés ultérieurement et dont le degré de différenciation est moindre (subsp. ou var.). Enfin des genres d'origine eurasiatique ou boréale très communs dans les Alpes manquent en Corse. L'île devait donc être séparée du continent quand la plupart d'entr'eux sont parvenus en Méditerranée.

Il est intéressant de souligner que l'endémisme pyrénéo-corse est d'origine méditerranéenne (élément méditerranéo-montagnard) alors que l'endémisme alpino-corse appartient en grande majorité à l'élément orophile centre- et sud-européen avec un endémique rattaché à l'élément eurasiatique.

A partir du Miocène inférieur, la Corse est définitivement isolée. L'évolution se poursuivra sur place comme en témoignent les nombreux apo-endémiques qui sont sympatriques avec les espèces dont ils dérivent.

Dans toute étude sur l'endémisme, apparaît la nécessité de ne jamais séparer la paléogéographie des autres disciplines biologiques. Défini par ses caractères morphologiques et caryologiques, l'endémique forme aussi une unité historique dont l'interprétation est associée aux multiples renseignements susceptibles d'apporter une information (distribution géographique, origine liée aux éléments biogéographiques, parentés et ancienneté, paléogéographie etc.). Il est le témoin d'événements passés liés à la paléogéographie du territoire étudié ou au contraire le reflet d'une spéciation récente et souvent intense.

Dans ce contexte, la Corse, par sa richesse floristique et l'importance de son endémisme, par sa localisation en Méditerranée occidentale, objet d'actifs bouleversements et remaniements paléogéographiques, constitue un domaine remarquable à étudier dont les différentes investigations utilisées soulignent l'originalité et la spécificité.

I-III6

Endémisme insulaire et diversité taxonomique

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(Biogéographie des Orthoptères de la Grèce insulaire - D'après les données de F.WILLLEMSE, 1984)

I. Analysant la répartition des espèces endémiques insulaires de l'Egée (28% du total d'espèces présentes dans les îles) d'une part entre les différentes îles et d'autre part entre les familles, sous-familles et genres représentés, on est amené à relever:

A.1. L'absence de limites absolues entre les secteurs insulaires, en ce qui concerne l'extension de l'aire de répartition des espèces endémiques (voir Tableau I et Carte). 2.L'inégalité, en règle générale, de l'aire de répartition des endémiques d'un secteur donné, une répartition identique entre 2 espèces n'étant réalisée dans aucun cas pratiquement. 3.L'agencement géographique "en mosaïque" dans la majorité de cas (voir Carte). B.1.L'apparution d'endémiques au sein de la majorité de familles et de10 sous-familles présentes en Grèce insulaire. 2.Par contre - ainsi qu'il a été souligné par F.Willemse et autres auteurs - une tendance prononcée à la différenciation d'espèces endémiques au sein d un certain nombre de genres, (voir Tableau II).

II. Sur la base des éléments ci-dessus et en se rapportant à une proposition formulée précédemment, à savoir la tendance à la diversité taxonomique à tous les échelons et l'asymétrie générale de la composition taxonomique et de la répartition géographique (double condition rendant compte d'une "régulation faunistique" générale, J.MATSAKIS, 1984, 1988), l'auteur est amené à mettre l'accent sur l'importance de l'apport de l'étude de l'endémisme dans la compréhension de la structure des peuplements et des faunes, dans le sens suivant: - Les espèces endémiques, tout en étant par définition, les espèces dont l'origine et l'évolution sont géographiquement les mieux circonscrites, n'échappent pas moins, dès le départ pour ainsi dire, au principe de la régulation faunistique générale, autrement dit à la règle de l'asymétrie de répartition et de différenciation taxonomique, conditions sine qua non pour une diversité aussi élevée que possible à toute échelle spatiale.

FIGURE 1. Répartition de 7 espèces endémiques illustrant l'agencement "en mosaïque".

Dans les tableaux et la figure ci-dessous sont condensés et brièvement commentés les principaux faits dégagés de l'analyse de l'endémisme insulaire égéen chez les orthoptères:

TABLEAU I. Répartition des espèces endémiques dans les divers secteurs insulaires de l'Egée et nombre d'espèces partagées par 2 secteurs ou plus.

	SP.S.(13)	CR.(13)	CY.(7)	SP.N.(3)	N.E.(5)	(Cont)
SP.S.	12	1	1	-	-	(+)
CR.		10	3	-	-	-
CY			2	2	-	-
SP.N.				0	-	(1)

COMMENTAIRES. 1.Les endémiques d'aucun secteur ne sont exclusivement cantonnées à l'intérieur de ses"limites". 2.Au niveau d'espèces individuelles il y a "passage"des SP.N. aux Cyclades et de celles-ci à Crète et les SP.S.

TABLEAU II. Répartition des endémiques par niveau taxonomique (et taux respectif)

	Grèce	Egée(tot)*	Endémisme*
F	9	8 (88,9%)	5 (62,5%)
sF	31	28 (90,3)	10 (35,7%)
G	101	64 (63,4)	16 (25%)
SP	313	139 (44,4%)	38 (27,3%)

COMMENTAIRES. On relève une représentation taxonomique de plus en plus faible lorsqu'on passe de l'échelon de la famille à celui de la sous-famille et l'espèce, avec une baisse particulièrement accentuée au niveau du genre.

SP.S.:Sporades du Sud - CR.: Crète - CY.: Cyclades - SP.N.: Sporades du N. - N.E.:îles du NE Egée. F, sF, G, SP: familles, sous-familles, genres et espèces. - *: compte non tenu des troglobies, insuffisamment explorées.

J.MATSAKIS, 1984:Biol.Gallo-Hellen.,11 2. 1988:Biol.Gallo-Hellen.,15, 2. - F.WILLEMSE, 1984 Fauna Graeciae

I-IV1

Destruction de quelques biotopes côtiers menacés en Grèce

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INTRODUCTION-Les biotopes en question se trouvent en Grèce méridionale ou centrale au domaine du Oleo-Ceratonion en climat euméditerranéen subaride à subhumide. En conditions spéciales - différentes de celles qui régnent à l'espace occupé par la végétation zonale ("climacique") - y sont été developpées des communautés plus ou moins azonales (4).

PLAGES SABLEUSES-Le type le plus commun des plages sableuses le long des côtes de l'île Tinos (Cyclades, Mer Egée centrale), battues par des vents forts, de constitution du sable siliceuse, était caractérisé autrefois, il y a quelques années, par une ceinture sableuse bordée vers l'intérieur par un Agropyretum mediterranei (flore tolerante à la salinité) et ensuite des dunes hautes mobiles avec Ammophiletum arundinaceae; enfin un Juncetum maritimi-acuti en milieu saumâtre entre les dunes et en arrière de celles-ci. Les hommes ont déraciné à la côte la végétation autochtone et surtout les plantes des dunes dans cettes plages,comme dans plusieurs autres semblables en Grèce. Ils ont planté à leur place des denses rangs à Tamarix. Les Ammophila, qui ont pu survivre, sont parsemées de feuilles des Tamarix. De plus les Tamarix ne laissent pas suffisamment les rayons du soleil,le vent et le sable volent, qui sont nécessaires pour le développement normal des Ammophila, d'atteindre celles-ci. À cause de cela les Ammophila et le sable sont disparus. À leur place sont émergées des pierres et des roches ou bien le sol sableux devient une terre compacte. La plage et la plaine en arrière de la plage sont dès lors souvent inondées par les vagues des tempêtes. Les psammophytes de nos côtes, dont quelqu'unes sont extrêmement menacés (p.ex.Pancratium maritimum, Eryngium maritimum, voir aussi 6), devront être estimés pour leur contribution à la formation des dunes (5) ainsi que pour leur rôle important dans les écosystèmes côtiers, un fait qui est reconnu ailleurs, bien que seulement une partie des sites à dunes y est bien conservée (8).

ACCUMULATIONS DE FEUILLES DE POSIDONIA-Une grande partie du sable littoral et les feuilles de Posidonia oceanica échouées en masse par la mer sur certains rivages (p.ex. au sudest de Tinos) sont directement ôtées par les hommes et maintenant souvent remplacées par des routes, de l'asphalte, des gravois et des balayures. Les feuilles mortes de Posidonia contribuent à la stabilisation du sable et ont, d'autre part, une valeur nutritive importante pour quelques psammophytes côtiers de même que pour les écosystèmes marins benthiques (fonds sableux, détritiques côtiers, prairies à Cymodocea et à Posidonia). Divers poissons, comme p.ex. Lithognathus mormyrus et Mullus surmuletus, se nourrissent des denses populations animales de Solemya togata, Gammarus etc. de ces fonds (7). D'autres poissons (p.ex. des Spicara smaris) cherchent l'abri de la frondaison des Posidonia (3). Les plus grands essaims des poissons S. smaris et Boops boops autour de l'île Tinos se trouvent, le plus souvent, sur une prairie de Posidonia au voisinage d'une telle plage à grandes concentrations de feuilles mortes de ce phanerogame. Les feuilles échouées sur la plage contiennent eux-même une faune quantitativement riche à Idotea baltica basteri et Orchestia montagui, qui serve comme nourriture de divers oiseaux, p.ex. de Corvus corone sardonius.

CÔTES ROCHEUSES-Les côtes rocheuses sont habitées par une végétation supralittorale halophile i.e. un Crithmo-Limonion à Crithmum maritimum et Limonium cancellatum. Au dessus de cette ceinture s'installe souvent (p.ex. aux Cyclades) un Capparo-Amaracion à Capparis spinosa, Cirsium chamaepeuce, Centaurea mixta, Ficus carica etc. sur champs rocheuses. En tels versants escarpés peut on rencontre des oiseaux nidifiants (Falco eleonorae etc.). Les côtes rocheuses sont jusqu'à présent, moins menacées que les plages sableuses, car ils occupent la majorité du rivage aux endroits étudiés par moi (Cyclades,Crete,Peloponnèse). Mais aussitôt qu'une région deviendra accessible par la route, la flore autochtone sera décimée. Aux Cyclades, qui sont fréquement battues par des vents violents, la côte rocheuse passe, le plus souvent, vers l'interieur à un phrygana grec. Il s'agit dans la plupart des cas d'un Coridothymion, parfois identifié plus précisement comme un Sarcopoterio-Ballotetum acetabulosae. La végétation en tels phrygana des côtes sudes et estes de Tinos était autrefois très riche en espèces et occupait environ 85% de la surface du sol rouge méditerranéen tronqué qui recouvre les roches à schiste avec une minorité de chaux et de marbre. Les espèces prédominantes y sont Thymus capitatus, Helichrysum siculum et Teucrium polium. Dans tels endroits les phrygana sont peu à peu déracinés et souvent presque complètement eliminés par intervention de l'homme. Par consequence se produit une érosion de la terre et une déstabilisation des procédures importantes pour le climat et la vie de la région y compris la dépendance mutuelle entre les divers organismes et facteurs abiotiques.

RUISSEAUX-La végétation des ruisseaux-en part temporaires- de la Grèce centrale et méridionale a une composition floristique qui montre des affinités à l'association de Nerium oleander-Tamarix tetrandra Krause et al.(voir 4);mais T. tetrandra, l'une des deux espèces nominales de cette association n'a pu être trouvé par moi à aucun ruisseau intact des Cyclades. À Tinos, sur un total de 22 mesurages de ruisseaux"temporaires"-le type le plus repandu aux Cyclades- j'ai rencontré les espèces prédominantes Vitex agnus-castus et Nerium oleander(à une constance de V chacun), Rubus sp.(IV); Inula viscosa(III), Arundo sp.(III), Platanus orientalis(I). Les ruisseaux sont en danger immédiat par les balayures et surtout par leur transformation en routes. Cette situation contribue entre autres aux inondations pendant la saison des pluies, à un abaissement du niveau d'eau souterraine et au manque d'eau en été.

CONCLUSIONS GÉNÉRALES-Il faut céder le pas aux écosystèmes naturels, qui sont mieux adaptés que les anthropomorphes dégradés aux conditions de chaque région, pour la conservation de l'équilibre de l'environnement. Il est surtout nécessaire de prendre maintenant des mesures pour une protection globale des biotopes entiers et de la nature en son ensemble et non seulement de certaines espèces isolées.

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L-I1

The identification of Decachlorobiphenyl as an environmental contaminant in sediments from the Po River (Italy)

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Analyses of chlorinated hydrocarbons in sediments recovered in 1977 from this coastal area (Frignani and Ravaioli, 1982) had shown the presence in the chromatograms of a large peak with a relatively high retention time. This work is based on the identification of this peak as decachlorobiphenyl (DCB) and reports some considerations on its source and behavior in sediments off the Po delta.

Sediment samples were collected in 1979 at eleven locations (Fig. 1) with a Van Veen grab and carefully handled to avoid contamination. The analyses were carried out on the top 3 cm of the sediment according to Bopp (1979) and Bopp et al. (1981). The PCB content of samples was calculated peak by peak on the basis of the average Aroclor 1254 and 1260 compositions reported by Webb and McCall (1973). Cs-137 activities were also determined because they are correlated with the fine sediment fraction and can be used as an indicator of the sediment texture (Albertazzi et al., 1984). Weight loss on ignition (LOI) at 375 °C for 16 hours was chosen as an index of the organic matter concentration in sediments. The analytical results are summarized in Table 1.

Table 1. Concentration ranges and average values in bottom sediments classified according to their lithology (Shepard, 1954).

Sample n.	DCB ng/g	PCBs ng/g	Cs-137 pCi/kg	Lithology	LOI %
11	0.2	8	80 ± 19	sand	1.36
6	1.0	21	113 ± 18	sandy silt	0.78
1,7,9	11.8 1.0-21.9	84 39-110	295 258-330	silt	4.52 4.00-5.06
2,3,4, 5,8,10	6.0 2.0-8.8	64 39-85	400 203-484	clayey silt	4.55 3.04-6.35

From these data some simple considerations can be drawn: 1) peak by peak composition points out that the PCBs in sediments are mainly derived from mixtures such as Aroclor 1254 rather than Aroclor 1260; 2) DCB concentrations range from 0.2 to 19.9 ng/g (dry weight) and these values are surprisingly high (up to 19% of the amount of PCBs in sample 9); 3) a comparison with sediment samples from other areas (Tyrrhenian Sea, Raritan Bay) shows that DCB in sediments off the Po delta have a different source from ordinary PCBs. In fact DCB, the fully chlorinated biphenyl, was produced in a factory in Brescia (Italy) from 1973 to 1975. Although the period of commercialization was short, the compound was synthetized as a reaction intermediate until 1980. Therefore high DCB concentrations and DCB/PCB ratios are characteristic of the sedimentary materials carried to the sea by the Po River; 4) there is no significant correlation between these chlorinated hydrocarbons and Cs-137 activities in sediments. This means that PCBs and DCB do not show a great affinity for all fine particles, as already pointed out by Frignani and Ravaioli (1982). The correlation in fact is stronger for the silt fraction.

Fig. 1

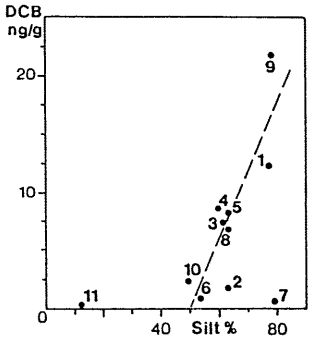

Fig. 2

The relationship between the DCB concentration and the silt content of the samples is shown in fig. 2. The correlation is significant at a high level (r = 0.85772) if samples 2, 7 and 11 are not considered. This observation points out that other factors besides the grain size composition of the sediment influence the DCB concentration. In fact the superficial sediments in the area can present very different levels of DCB because of the different accumulation rates of recent materials from the Po effluents. Therefore sample 11, which is a relict sand scarcely influenced by deposition of recent fine particles, shows the minimum concentrations of both DCB and PCBs. The silty sediment at station 7 also shows a low DCB content (and a very low DCB/PCB ratio) because it is only marginally influenced by the river flow. On the other hand the sediment at station 2 is characterized by a low concentration of DCB and a relatively low DCB/PCB ratio which may be due to its very fine grain size composition and to its distance from the delta. A decrease of the PCB content in superficial sediments off the delta with increasing distance from the coast was also reported by Frignani and Ravaioli (1982).

The Po River is the only significant source of DCB in this area. Therefore the importance of DCB as a tracer for the sediment originating from the Po is clear. If the maximum pollution occurred during the period of its commercialization, a peak value should be found in sediments deposited in the years from 1973 to 1975.

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L-I2

Trends in chlorinated hydrocarbons in organisms from the Gulf of Venice

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An investigation was carried out during 1986 and 1987 to establish the actual levels of chlorinated hydrocarbons (HCH, DDTs and PCBs) in two species, Mytilus galloprovincialis and Engraulis encrasicholus, for which comparison over a relatively long time can be done for the Gulf of Venice (North Adriatic Sea).

In order to assure the comparability of the results, sampling, sample preparation and analysis procedures similar to those used in a previous monitoring program (1977 - 1979) were adopted. Shortly, composite samples of soft parts of mussels and skinned fillets of anchovies were prepared. Organochlorine concentrations were determined by gas chromatography after Soxhlet extraction with n-hexane, cleanup with H_2SO_4 and Florisil, and separation of PCBs from DDTs on silica gel. The quality control of the analytical data was based on the results of two intercalibration exercises done in 1976 and 1984, respectively.

Chlorinated hydrocarbon concentrations in mussels and anchovies of the present study are reported in Table 1 and compared, using the variance analysis, with published results for the same species sampled from the same area (1; 2). Data demonstrate the overall decline of the magnitudo of Σ HCH and ΣDDT residues both in mussels ($p < 0.01$) and anchovies ($p < 0.05$). For HCH and DDT it is likely that the greatest input occurred in the past, before the ban in the use of chlorinated pesticides by Italian regulations. This is consistent with the increase of the amount of DDT degraded (DDD and DDE) versus the amount of ΣDDT between 1976/79 and 1986/87. A significant decrease ($p < 0.05$) with time of mean concentrations of PCBs was also observed in mussels, while PCB levels in anchovies appear almost unchanged. This finding may indicate that there is a trend towards a wider distribution of smaller PCB residue concentrations in the Adriatic ecosystem.

Table 1. Temporal comparison of chlorinated hydrocarbon levels in organisms collected from the Gulf of Venice. Concentrations (means ± SD) are expressed in ng g^{-1} wet tissue weight.

Mytilus galloprovincialis			
Sampling period	1976	1977/79	1986/87
Sample No.	6	15	7
Wet/Dry wt. ratio	5.5 ± 0.3	5.8 ± 1.1	5.8 ± 1.1
EOM % wet wt.	1.4 ± 0.3	1.7 ± 0.6	1.4 ± 0.2
Σ HCH	2.4 ± 1.9	1.2 ± 1.0	0.4 ± 0.1
Σ DDT	9.5 ± 6.2	13.0 ± 7.0	2.6 ± 0.7
Σ PCB (Aroclor 1254)	56 ± 26	41 ± 27	19 ± 5
Engraulis encrasicholus			
Sampling period	1976	1977/79	1986/87
Sample No.	0	10	7
Wet/Dry wt. ratio		4.2 ± 0.4	4.1 ± 0.3
EOM % wet wt.		1.8 ± 1.1	1.5 ± 0.8
Σ HCH		2.7 ± 1.7	0.9 ± 0.4
Σ DDT		53 ± 38	15.2 ± 7.6
Σ PCB (Aroclor 1260)		155 ± 75	138 ± 77
References	(1)	(2)	Present study

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Effects of polychlorinated biphenyl on marine phytoplankton

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The two representative autochtonous isolates from the Gulf of Triest, Northern Adriatic, the chlorophyte Dunaliella sp. and the diatom Nitzschia sp. were exposed to the 5 concentrations of PCB Aroclor 1254 dissolved in acetone (1 % v/v).

The response of the two algae on PCB was entirely different. Dunaliella sp. grew at all PCB concentrations. At the lowest PCB level (.1 ppb) the growth was increased over the control culture containing only acetone. The higher PCB levels caused reduced final yields (Fig. 1). The $LD_{50/6}$ was computed to be as high as 50 ppb, a dose unlikely to be encountered in marine pollution situations. On the other hand, Nitzschia sp. was depressed in growth even at the lowest Aroclor levels (Fig. 2). The decrease was significant ($P < .001$) at all PCB concentrations and the testing yields have never exceeded 20 % of the control.

The phytoplankton assemblages of the Gulf of Triest are dominated by these two types of algae. The green small microflagellates dominate in number, while the diatoms product the major part of organic matter. In case of eventual increased environmental PCB level, and presuming that the two types of algae would behave in the same way as they did in the laboratory, one can predict that

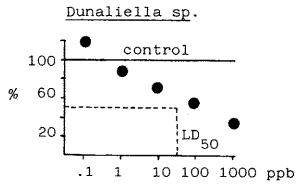

Fig.1

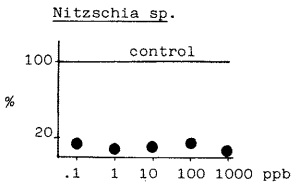

Fig.2

Figs. 1 and 2 Final yields of Dunaliella sp. and Nitzschia sp. cultures exposed to the various levels of PCB

the diatoms would be severely decimated in such situation. Hence environmental PCBs may alter marine trophic pathways by reducing phytoplankton size towards smaller species and thus devert the flow of biomass from harvestable fish to jellyfish and other gelatinous predators (O'Connors et al., 1978).

The PCB residues in the final particulate matter revealed that the proportionally highest amount of pollutant, regarding its initial concentration in the experimental solutions, was accumulated by algal cells at the lowest PCB concentration.

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Levels and trends of the pollution of chlorinated hydrocarbons in Mussels from the Rijeka Bay

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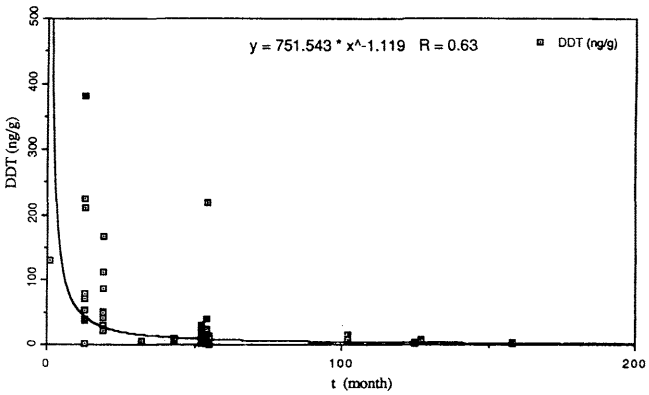
The contamination of the Adriatic Sea by higher molecular chlorinated hydrocarbons has been relatively well documented (PICER et al., 1978; FOSSATO, 1982). The Rijeka Bay, a semienclosed basin, is especially susceptable to pollution and is usually considered to be a heavily stressed ecosystem. The trends of chlorinated hydrocarbons concentrations found for mussels (Mytilus galloprovincialis) of the Rijeka Bay are presented in Fig. 1. As can be seen, the levels of DDTs and PCBs significantly decreased during the period of investigation. The area distribution of DDTs and PCBs concentrations confirms the local sources of pollution and the level of persistent chlorinated hydrocarbons in the mussel tissue. This is especially apparent for the PCBs concentrations. Namely, concentrations of PCBs are significantly higher in comparison with DDT and its analogues in the samples collected in the vicinity of the industrial pollution sources. In the samples collected far away from the industrial sources of pollution, the concentrations of DDT and analogues were higher than the PCBs concentrations. It is also interesting to note that the concentrations of DDT do not differ significantly between the investigated locations. Mollusca pollution level by persistent chlorinated insecticides appears to be the same throughout the coastal zone of the Rijeka Bay. Such a conclusion comes unexpectedly because it is well known that urban waste waters are relatively rich in persistent chlorinated insecticides. Possibly this could be caused by a higher usage of DDT and its analogues for pests control in agriculture amd forestry in recent years, and because the coastal zone is a typical karstic region. Once applied, the persistent chlorinated insecticides enter the Rijeka Bay with drainage waters.



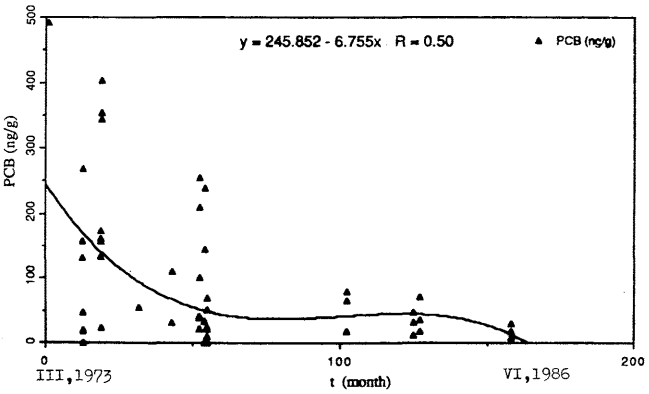


Fig.1. DDT_{total} and PCB in mussels from the Rijeka Bay sampled from March 1973 to June 1986.

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L-I5

PAH in recent Sediments of the Eastern Adriatic Coast determined by UV-fluorescence spectroscopy method

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The samples of recent sediments from the offshore Adriatic sea and from the coastal area in two bays were collected in July 1987. One bay is under the strong anthropogenic influence (Kaštela Bay - Split area) and the other is relatively unpolluted area (Boka Kotorska Bay) (Figure 1).

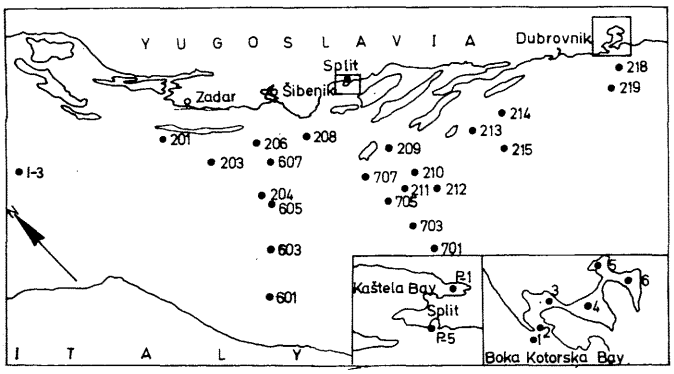

Figure 1. Investigated area

The samples of sediments after freeze drying were analysed by fluorescence spectrosopy (UVF) method (IOC, 1982) in order to provide information on the levels of hydrocarbons generally present in the sediments of the East part of the Adriatic sea. The contents of PAH in sediments collected from the offshore area are presented in the Table 1. They ranged from 0.29 to 1.21 µg/g dry weight chrysene equivalents and 3.57 to 14.35 µg/g dry weight Kuwait oil equivalents. For unindustrial area of Boka Kotorska Bay the levels of PAH ranged from 1.45 to 5.10 µg/g dry weight chrysene equivalents and 17.17 to 60.20 ug/g dry weight Kuwait oil equivalents. The samples from Split area are subject to domestic and industrial inputs. The content of PAH in these sediments is 15.38 µg/g dry weight chrysene equivalents (mean value).

Hydrocarbons present in the marine sediments are derived from a wide range of sources. Emission spectra of the sediment samples from offshore area were generally similar. Spectra from polluted area were with predominant aromatics with 2-4 rings. Concentration of PAH in surface sediments was law in offshore area, it was higher in the Bay of Boka Kotorska and the highest in Split area. This characteristic of Boka Kotorska Bay is the consequence of shipping loss, and for Split area is of petroleum and petroleum products, diagenetic and combustion origin. We can speculate that the contents of PAH in surface sediments in the offshore area are the consequence of sedimentation processes in the whole of the Adriatic Sea (Pigorini, 1968).

Table 1. Distribution of contents of PAH in recent marine sediments from the Adriatic Sea. The values are given in µg/g dry weight in chrysene and Kuwait oil equivalents

Station	Area	Water Depth (m)	Sediment type	Contents of PAH: Chrysene	Contents of PAH: Kuwait oil	DW/WW
201	Offshore	64	Sand	0,45	5,42	1,48
203	"	157	Sand	0,67	8,09	1,53
204	"	260	Mud	0,63	7,56	2,80
206	"	200	Muddy sand	0,52	6,21	2,30
207	"	150	Mud	0,33	4,14	1,83
208	"	140	Mud	0,33	3,91	1,47
210	"	108	Mud	0,30	3,69	1,57
211	"	148	Sand	0,62	7,39	2,00
212	"	150	Muddy sand	0,68	8,16	2,28
213	"	130	Mud	0,29	3,57	1,44
214	"	145	Mud	0,53	6,40	2,00
215	"	212	Mud	0,41	5,08	1,60
218	"	200	Mud	0,87	10,49	1,50
219	"	200	Mud	0,54	6,55	2,61
601	"	122	Mud	1,21	14,35	2,1
603	"	240	Mud	0,83	9,91	2,0
605	"	260	Mud	0,74	8,86	2,7
607	"	200	Mud	0,42	5,13	3,1
701	"	117	Mud	1,06	12,68	2,4
703	"	130	Mud	0,65	7,77	2,0
705	"	170	Muddy sand	0,55	6,57	2,1
707	"	152	Mud	0,48	5,81	2,8
1	Boka	77	Sandy mud	1,45	17,17	1,61
2	Kotorska	50	Muddy sand	1,68	18,96	1,45
3	"	43	Mud	2,35	27,73	2,15
4	"	43	Mud	5,10	60,20	1,92
5	"	32	Mud	4,77	56,56	2,50
6	"	34	Mud	3,52	41,74	2,10
P-1	Split	14	Mud	12,34	148,86	1,98
P-5	"	7	Mud	20,46	240,10	1,63
I-3	Offshore	40	Muddy sand	1,00	11,84	-

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L-I6

Seasonal fluctuations of organochlorine compounds in the water of the Strimon River (N. Greece)

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This study aims to monitor the pollution of the water of the Strimon river by organochlorine compounds HCB, Lindane, Heptachlor, Aldrin, Dieldrin, DDT and its metabolites DDD and DDE, PCB's. Samples of mussels (*Mytilus galloprovincialis*) from the Strimonikos gulf were also collected and analysed for the above compounds to compare the results of this study with a previous one by Kilikidis et al. (1981).

The R.Strimon rises on M.Scombio (Bulgaria) and flows out into the Strimonikos gulf (N.Greece). 115 km of the Strimon's 330 km total length pass through N.Greece, via Kerkini Lake (a man-made lake). Four sampling locations (1,2,3,4) were selected along the river and three in the Strimonikos gulf (A,B,C), as shown in fig. 1. Sampling took place monthly from Oct. 1985 to Sep. 1986. For the determination of organochlorine compounds in the water and mussel samples, Gas Chromatography methods were used according to the techniques of Jensen et al. (1973) and Johnson (1965).

HCB, Lindane and Aldrin were only detected in the water samples of the Strimon river. The seasonal changes in the concentration of the above compounds are shown in fig. 2 and the corresponding concentrations in table I.

HCB, Lindane, DDT, DDD and DDE were detected in the mussel samples. The analytical concentrations of these compounds per sampling location compared with the previous study by Kilikidis et al. (1981), are shown in table II.

The presence of HCB, Lindane and Aldrin in the water samples of the Strimon river indicate agricultural pollution of the river because of the extensive cultivation of the catchment area. Although the use of Aldrin has been officially prohibited in Greece since 1972, its presence presumably shows that it is still in use unofficially or that it comes from Bulgaria.

The later is more likely because the detection of Aldrin was seasonal and its concentration was at first higher in sampling location 1 than in location 4.

The absence of PCB's in the mussel tissues was probably due to the decrease of the pollutant sources in the catchment area. In contrast to the previous study, the concentrations of Lindane were significantly increased.

In conclusion, the pollution of the Strimon river by organochlorine compounds has effects on the water quality of the Strimonikos gulf.

Table 1. Concentrations of organochlorine compounds in water of R.Strimon (ppt)

Date	HCB 1	HCB 2	HCB 3	HCB 4	LINDANE 1	LINDANE 2	LINDANE 3	LINDANE 4	ALDRIN 1	ALDRIN 2	ALDRIN 3	ALDRIN 4
10/85	0.9	1.8	1.3	1.1	1.3	2.6	1.7	1.2	-*	-	-	-
11/85	2.1	2.2	2.2	1.5	3.4	4.5	6.7	7.7	-	-	-	-
12/85	1.8	2.1	2.4	2.2	4.6	6.3	7.8	7.9	-	-	-	-
1/86	1.3	1.0	0.8	1.2	1.8	2.3	1.6	3.4	5.8	5.0	5.3	4.2
2/86	0.9	1.2	1.0	1.8	1.3	2.4	2.4	3.6	5.9	5.0	5.8	6.6
3/86	1.1	1.5	1.6	1.5	2.1	2.3	5.1	8.2	15.3	12.0	12.4	15.4
4/86	1.3	1.8	1.7	1.6	11.0	12.6	11.8	12.1	8.8	9.7	10.2	14.2
5/86	2.4	2.0	1.9	2.8	10.8	10.5	11.0	11.3	-	-	-	-
6/86	2.2	2.5	3.0	2.0	9.0	3.0	3.1	2.3	-	-	-	-
7/86	1.4	1.0	0.8	1.2	4.6	2.1	2.3	2.8	-	-	-	-
8/86	0.9	1.0	0.8	0.9	1.2	0.6	0.4	0.5	-	-	-	-
9/86	1.0	0.8	0.5	1.0	0.6	0.4	0.3	0.7	-	-	-	-

*Below detection limit (<0.9 ppt)

Table 2. Concentrations of organochlorine compounds in mussels of Strimonikos gulf (ppb w.w.)

Organochlorine compounds	This study A	This study B	This study C	Previous study* A
HCB	1.7	1.9	0.5	2.0
LINDANE	1.3	1.1	0.4	0
ALDRIN	0	0	0	0.7
pp'DDT	5.0	4.0	1.6	6.0
pp'DDD	6.0	3.8	2.6	7.0
pp'DDE	6.7	3.3	2.1	8.0
PCB's	0	0	0	261.0

*Kilikidis et al (1981)

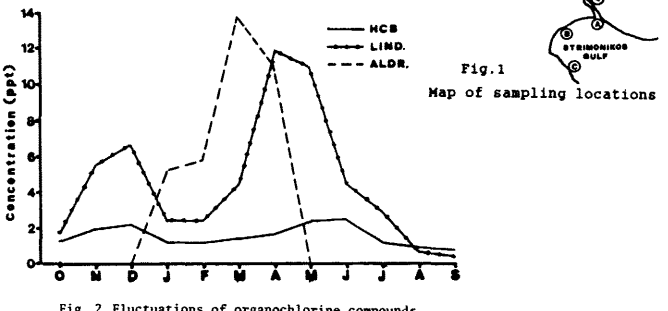

Fig.1 Map of sampling locations

Fig. 2. Fluctuations of organochlorine compounds during Oct. '85 - Sept. '86.

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Polychlorinated biphenyls in the seawater off Erdemli - Cilician Basin

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ABSTRACT

The dissolved and particulate PCBs in the surface sea water of Northeastern Mediterranean were measured monthly for the period of November 1984 to September 1985. In contradiction to the findings of Baştürk, *et.al.*, (1980), where they claimed the absence of PCBs in the region, considerable quantities (range 1.5 - 38 ng/l, mean 13 ng/l) were measured and the average concentrations were found to be comparable with the ones reported from the other parts of the Mediterranean. Rainfall and sea water temperature are the two parameters primarily responsible from the time variation of the PCBs concentrations in the region.

Niveaux en pesticides organochlorés et en PCBs dans les Moules présentes dans la baie d'Alger

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RESUME

Les concentrations en aHCH, GHCH, pp'DDT, pp'DDE, pp'DDD et PCBs ont été déterminées dans des échantillons de Moules (Mytilus galloprovincialis ou Perna perna), collectés entre février 1985 et juin 1987, au niveau de 6 stations situées dans la baie d'Alger.

Ce travail entre dans le cadre du programme de surveillance continue MED-POL III.

INTRODUCTION

Cette étude présente les résultats obtenus sur la présence d'insecticides et de PCBs dans des Moules prélevées trimestriellement dans la baie d'Alger.

MATERIEL ET METHODES

Les prélèvements de Mytilus galloprovincialis ou Perna perna (en fonction de leur disponibilité) ont été effectués dans des zones côtières types :

a) qui sont préalablement exposées à ce genre de pollution :
   - station portuaire, subdivisée en trois sous-stations :
     . CM : eaux non renouvelées,
     . IJN : eaux peu renouvelées,
     . EJN : eaux soumises aux influences du large,
   - station Bordj-El-Kiffan (BEK) - coincées entre deux émissaires,

b) qui sont au contraire abritées :
   - station des îlots Sandja (est de la baie),
   - station du Chenoua (80 km ouest d'Alger).

Une classe de taille de 4-5 cm a été prise en compte.

Les méthodes de traitement et d'extraction suivent le protocole préconisé par UNEP/FAO/IAEA (1982).

L'analyse a été effectuée par chromatographie en phase gazeuse (VARIAN 3700 équipé d'un ECD) et sur une colonne en verre OV-17 3 %/Gas-Chrom QII 80-100.

RESULTATS ET DISCUSSIONS

Les résultats (cf. Tableau 1) sont rapportés en ppb de poids frais.

Les concentrations en PCBs correspondent à la somme des pics de DP3, DP5, DP6.

On constate d'emblée des valeurs élevées de pesticides organochlorés et PCBs à Bordj-El-Kiffan, comparables à celles obtenues dans la lagune de Venise par FOSSATO and CRABOLEDDA (1979).

L'influence des émissaires est ressentie au niveau de la station Sandja.

Dans le port d'Alger, nos résultats restent inférieurs à ceux donnés par PICER et al. (1984) au niveau d'une zone équivalente.

Une diminution du taux en PCBs de la sous-station typiquement portuaire vers la sous-station la plus ouverte est enregistrée. Ce phénomène de dilution est inversé pour les insecticides.

Tableau 1. Valeurs moyennes (en ppb de poids frais) en organochlorés au niveau de Moules de la baie d'Alger.

		aHCH	GHCH	pp'DDE	pp'DDT	pp'DDD	PCBs
M. galloprovincialis							
CM	1985	0.05	0.63	0.93	3.17	1.11	107.74
	1986	0.09	0.90	0.88	3.50	1.95	127.37
IJN	1985	0.08	0.85	2.91	4.08	3.34	56.93
	1986	0.10	0.95	3.19	6.45	3.52	66.98
EJN	1985	0.12	1.03	3.27	6.55	3.61	30.47
	1986	0.10	1.16	3.86	7.24	4.07	39.49
BEK	1985	0.18	1.98	2.38	14.80	7.89	441.27
	1986	0.22	2.04	2.44	15.33	8.30	451.67
	1987	0.24	2.03	2.53	15.68	8.45	487.37
Perna perna							
BEK	1985	0.25	1.64	1.67	12.00	4.71	386.52
SANDJA	1985	0.05	0.65	1.00	3.62	1.93	17.66
	1986	0.04	0.66	1.10	4.24	2.10	21.47
	1987	0.06	0.70	1.20	4.02	2.91	19.98
CHENOUA	1986	0.03	0.17	0.25	2.26	0.38	3.69
	1987	0.06	0.18	0.32	2.86	0.48	3.02

Nous pouvons considérer la station du Chenoua comme station de référence. En effet, les valeurs obtenues sont inférieures à celles données par ALZIEU et al. (1976) pour une zone considérée comme salubre.

Les variations annuelles montrent :

- une augmentation en PCBs, HCHs et DDTs pour les stations de Bordj-El-Kikkan et du port d'Alger,
- une certaine stabilité pour les deux autres stations.

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L-II1

Effects of exposure to an organophosphorus pesticide on the ciliary activities of a marine bivalve

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The gills (ctenidia) of lamellibranch bivalves play a dominant role in controlling the interaction between the animal and its environment. However, not much is known about the responses of these bivalve organs to environmental stressors including chemical pollutants. Organophosphorus pesticides are known to be potent neurotoxins and may be expected to exert an effect on neurophysiological activities of such cilia. The present paper presents some preliminary results on the effects of exposure to MALATHIONE on the activities of the frontal cilia of Venus verrucosa.

Frontal ciliary activities were investigated using a procedure described in detail by Axiak and George (1987). Each bivalve had its left valve and mantle removed, allowed to recover for at least 2 h in running sea water and then introduced with its exposed half upwards, in a glass cubicle measuring 8 cm by 7cm and 6cm high and holding 300 ml of sea water maintained at 20°C at a salinity of 37 ppt and pH 8.4. Each preparation was observed under a binocular microscope at magnifications up to 75X. The activity of frontal cilia was investigated by measuring the rates of transport of Latex spheres, 8.06 µm in diameter, along the plical grooves of the inner demibranch by means of an eyepiece micrometer and a stopwatch. The mean rate of transport as measured in mm sec was calculated from a minimum of 10 observations at any one particular time. For any one animal, all observations and measurements were made on the same area of gill surface. In all cases, only particles unbound to mucus had their rates of transport measured. Measurements of particle transport were made for two hours prior to exposure and then 1, 2 and 3 hours after exposure. Animals were exposed to a nominal concentration of 4.75 ppm of MALATHIONE suspension in sea water.

Effects of exposure to MALATHIONE upon frontal ciliary activities as measured by rates of transport of particles along the frontal gill surface in half animal preparations are shown in the figure. The mean rate of frontal transport of eight preparations (ie. half animals) on exposure and in controls were calculated. The results are expressed as percentage of the rate of transport immediately prior to exposure for a particular animal. In the exposed preparations, the rate of transport decreased to 66 % of the initial values within 2 h of exposure. On the other hand, in the controls there was an increase in the rates of frontal particle transport up to the second hour. Such velocities were never found to be less than those reported prior to the water change at least up to 6 hours in the control runs.

T-test for paired comparisions indicated that the mean rate of frontal particle transport after 2 h of exposure was significantly lower than that immediately prior to exposure at $P < 0.05$ level of significance.

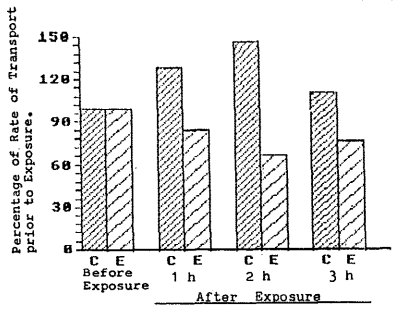

Figure 1. Venus verrucosa. Effects of exposure to 4.75 ppm of MALATHIONE on the frontal ciliary activities of the gills as shown by changes in the rates of transport of particles along their frontal surfaces. Results are expressed as percentage of the rate of transport immediately before exposure for a particular animal. Means of eight replicate runs for Exposed animals (E) and for controls (C).

The activities of frontal cilia of the gills of Venus verrucosa were found to be supressed on exposure to 4.75 ppm of MALATHIONE, as evident from decreased rates of particle transport across the gill's frontal surface. In a previous study (Axiak and George, 1987), the activities of these cilia were found to be enhanced on exposure to low levels of petroleum hydrocarbons.

Any decrease in the activity of the frontal cilia is expected to lead to a decrease in the rate of ingestion of food particles filtered by the gill of the exposed bivalve. The biological significance of this response is self evident especially if it is maintained over relatively long periods of time. Moreover, any altered ciliary activities may imply a direct or indirect effect of exposure to organophosphorus pesticides on the nervous control and/or on some other aspect of the physiological and/or biochemical processes linked with ciliary movement (e.g. on membrane bound factors responsable for ciliary membrane polarization, ATP production, etc.).

As yet, such a biological response has only been detected on exposure to relatively high levels of organophosphorus pesticides. Further investigations on effects of exposure to lower levels of of such contaminants, is in progress.

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Acknowledgements

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L-II2

Inhibition of Sardine liver esterases by organophosphate and carbamate pesticides in vitro

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To assess the potential hazard of organophosphate and carbamate pesticides on fish, the inhibitory effects on liver esterases of sardine (Sardina pilchardus Walb.) have been investigated in vitro.

Esterases belong to a very complex and polymorphic group of species and tissue specific hydrolizing enzymes. They are highly involved in organophosphate and carbamate intoxication, but little efforts have been spent on the assessment of the differential inhibition of their multiple molecular forms (2).

The methods for tissue extraction and electrophoretic separation of esterases by starch gel have been previously described (1). After separation of water soluble extracts the liver esterases of adriatic sardine were found to be multilocus variable. At least five esterase zones were identified (ES-I; ES-II^1; ES-II^2; ES-III; ES-IV) and among them only the ES-IV zone was monomorphic (Fig. 1). The other consisted of one or more bands that were distinguishable due to their electrophoretic mobility, substrate specificity and sensitivity to various inhibitors. After electrophoresis, gels were split into several horizontal slices and each one was incubated for 30 min. with different concentrations of pesticides. The slices were than stained with 1- and 2-naphtyl acetate and the intensity of the bands were compared to a control zymogram. Results are summarized in Table 1.

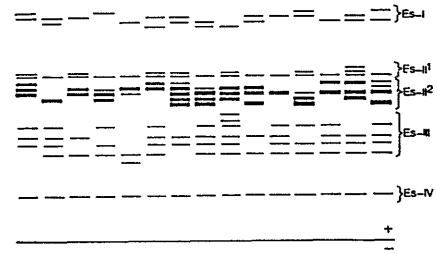

Figure 1. Esterase patterns in liver extracts from Adriatic sardine. The five zones of esterase bands are indicated.

Paraoxon, in the range of 10^{-3} to 10^{-6} M, was the most effective inhibitor to all liver esterases. On the contrary phosalone, a frequently used insecticide, did not show inhibitory effects on any of the esterase fractions. The other pesticides exibited different inhibition patterns, specific to various esterase fractions and dependent to the concentration. Esterases from the ES-I fraction were particularly sensitive to dichlorvos and carbaryl, while only the highest concentrations of malathion and guthion exibited evident inhibitory effects. This esterase fraction was not affected by baygon. The ES-II^1 fraction was inhibited by the highest concentrations of dichlorvos, bromphos, carbaryl and baygon but no effects were displayed by phosalone, malathion and guthion. The ES-II^2 and ES-IV esterases were the most resistant. The former were slightly affected only by the highest concentrations of bromphos, guthion and baygon, and similarly ES-IV were completely inhibited only by the highest adopted concentrations of dichlorvos and baygon and slightly depressed by guthion. On the contrary the ES-II^1 esterases were the most sensitive and, with the exception of phosalone, they were substantially affected by all pesticides, particularly by dichlorvos, malathion, carbaryl and baygon.

Table 1. Esterase activity in liver extracts from Adriatic sardine and the inhibitory effects* of various pesticides.

Pesticide	Conc. (M)	ES-I	ES-II^1	ES-II^2	ES-III	ES-IV
Control	-	+++	++	+++	++	+++
Dichlorvos	10^{-3}	-	-	+++	-	-
	10^{-4}	-	-	+++	-	+++
	10^{-5}	-	+	+++	-	+++
	10^{-6}	-	++	+++	-	+++
Bromphos	10^{-3}	-	-	++	+/-	+++
	10^{-4}	+	+	+++	+/-	+++
	10^{-5}	+++	++	+++	+/-	+++
	10^{-6}	+++	++	+++	+/-	+++
Phosalone	10^{-3}	+++	++	+++	++	+++
	10^{-4}	+++	++	+++	++	+++
	10^{-5}	+++	++	+++	++	+++
	10^{-6}	+++	++	+++	++	+++
Para-Oxon	10^{-3}	-	-	-	-	-
	10^{-4}	-	-	-	-	-
	10^{-5}	-	-	-	-	-
	10^{-6}	-	-	+	+/-	-
Malathion	10^{-3}	-	++	+++	-	+++
	10^{-4}	-	++	+++	-	+++
	10^{-5}	+	++	+++	-	+++
	10^{-6}	++	++	+++	+	+++
Guthion	10^{-3}	-	++	+/-	+	++
	10^{-4}	-	++	+	+	++
	10^{-5}	++	++	++	++	+++
	10^{-6}	+++	++	+++	++	+++
Carbaryl	10^{-3}	-	-	+++	-	+++
	10^{-4}	-	+/-	+++	-	+++
	10^{-5}	-	+	+++	-	+++
Baygon	10^{-3}	+++	-	+/-	-	-
	10^{-4}	+++	+/-	++	+/-	+
	10^{-5}	+++	+	+++	+/-	++
	10^{-6}	+++	++	+++	+/-	++

* The inhibitory effects were scored according to the control zymogram as follows: (+++ and ++) no inhibition; (++ and +) slight; (+/-) low and (-) complete inhibition.

The obtained results demonstrated that the inhibition of esterase isozymes by organophosphate and carbamate pesticides is more complex than it was expected and additional information are requested.

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L

Spatial distribution and speciation of Tin compounds in sediments of Alexandria coastal belt

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INTRODUCTION: There is a growing concern about the presence of anthropogenic alkyltin compounds in the environment. Methyl and butyltin compounds, which are widely used as stabilizers, biocides, antifouling agents in paints, and bacteriocides, escape into the environemnt causing serious problems.(1) Acute and chronic toxicity of tributyltin to non-target organisms at 0.1 - 1.0 $\mu g l^{-1}$ concentration has been recently documented for a number of marine species.(2,3&4) Publications on this topic for the Mediterranean are very scarce(5) and nothing is known about the occurrence of tin compounds in the Egyptian coastal sediments. The present study focusses on the spatial distribution and chemical speciation of organotin compounds in Alexandria coastal belt sediments.

METHODOLOGY: Sampling stations (35) covered an area of 45 Km from Agamy to Abu Kir, divided into 9 locations, and surface sediments were collected by a Van Veen Grab, and analysed by HDAAS according to the method described by Weber et al.,(6) for tri-, di-, mono-butyltin, tri-, di-, mono-methyltin and inorganic tin.

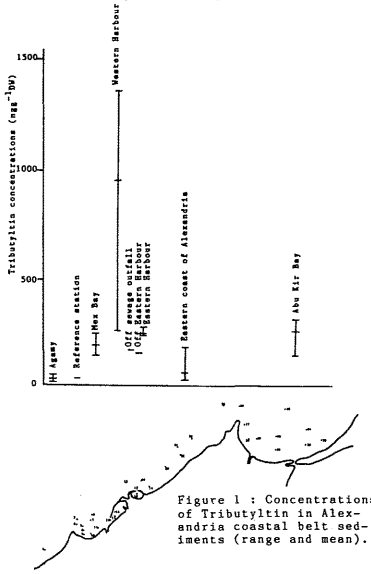

Figure 1 : Concentrations of Tributyltin in Alexandria coastal belt sediments (range and mean).

RESULTS: The results are given in Table 1 and shown in Figure 1 for tributyltin. All samples contained inorganic tin with concentrations (as Sn) ranging from 310 ngg^{-1} DW to 5200 ngg^{-1} DW. Mono-methyltin was detected in 31 from 35 samples and the concentrations ranged from undetectable to 1200 ngg^{-1} DW. Dimethyltin was detected in 29 from 35 samples with concentrations ranging from undetectable to 135 ngg^{-1} DW. Trimethyltin was present in 6 from 35 samples, ranging from undetectable to 80 ngg^{-1} DW. Monobutyltin was detected in all but one samples and ranged from undetectable to 450 ngg^{-1} DW. Dibutyltin was absent from 6 samples and ranged between undetectable to 425 ngg^{-1} DW. All samples contained tributyltin with concentrations ranging from 30 to 1375 ngg^{-1} DW.

Table 1. Spatial concentrations of Tin species in Alexandria coastal belt sediments [ng (aS Sn) g^{-1}DW].

	I Ref. Sc.	II Agamy	III Nex Bay	IV Western Harbour	V Off Sewage outfall	VI Off Eastern Harbour	VII Eastern Harbour	VIII Eastern coast	IX Abu Kir
Station No.	4	1-3	5-11	12-14	15	16	17-18	19-26	27-35
No. of samples	1	3	7	3	1	1	2	8	9
Inorg. Sn	310	488	2147	4720	2430	1080	3645	1075	2252
MBT	0.0	20	69	1000	85	0.0	300	41	127
DBT	15	12	35	77	70	45	23	23	43
TBT	0.0	0.0	0.0	80	0.0	0.0	23	0.0	3
Total MT	15	32	104	1136	155	45	545	64	173
% MBT/total MT	0.0	63	66	88	0.0	0.0	91	66	70
% DBT/total MT	100	37	32	7	45	100	4	32	30
% TBT/total MT	0.0	0.0	0.0	5	0.0	0.0	4	0.0	0.0
MBT	0.0	41	57	330	45	55	138	60	83
DBT	10	17	49	305	65	60	120	63	67
TBT	35	40	187	975	185	160	260	63	252
Total BT	45	97	294	1610	295	275	518	186	401
% MBT/total BT	0.0	38	19	22	15	20	27	32	20
% DBT/total BT	22	15	16	19	22	22	23	34	15
% TBT/total BT	78	47	65	59	63	58	50	34	65

DISCUSSION: The near-absence of trimethyltin in sediments is consistent with the findings of Donard and Weber(7) that trimethyltin remains predominantly in the dissolved phase. Thayer and Brinckman(8) found that trimethyltin produced by biological activity in the sediments, is able to react with inorganic mercury thus creating an abiotic pathway to methylmercury and dimethyltin. The extent of this transfer in the marine environment is not known at present. In the present study the high concentrations of tributyltin in sediments of Western Harbour, Eastern Harbour and Abu Kir Bay gives an indication that it originates from the use of tributyltin-based antifouling paints for ships and boats. Methyl- and butyltin compounds are omnipresent in Alexandria coastal sediments. Methyltin compounds appear to form within the environment by debutylation of tributyltin, and butyltin compounds are derived from anthropogenic sources. No significant correlations were found between organic carbon (0.3 to 13.4 %) and the alkyltin species concentrations. In San Diego Commercial Harbour the butyltin in sediment was 178 ± 200 ngg^{-1} DW and 9 ± 20 in the ecological area, while in honolulu Commercial Harbour it was 154 ± 244 and 75 ngg^{-1} DW in the ecological area.(9) Although Alexandria coastal sediment samples do not show a high level of tributyltin concentration in comparison to sediments of Vancouver Harbour (10800 ngg^{-1} DW).(10)

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Le Chrome chez les organismes marins : localisation microanalytique chez la Moule Mytilus edulis (Mollusque Bivalve), par sonde ionique et par sonde électronique

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Un des principaux intérêts de l'étude du métabolisme du chrome est dû au fait que,selon son état d'oxydation, il est soit biologiquement actif (Cr III),soit extrêmement toxique (Cr VI), mutagène, tératogène et cancérigène.Ce chrome hexavalant qui provient essentiellement de l'activité industrielle est un produit très polluant. Alors qu'il existe une abondante littérature relative à la toxicité du chrome vis à vis des Mammifères,il n'y a comparativement que peu de données relatives au comportement du métal dans les systèmes biologiques marins.Ceci est généralement dû au fait que les concentrations toxiques sont constatées à partir de 0,1 ppm et que ces doses traces nécessitent des méthodes d'analyse extrêmement sensibles.

Nous avons choisi, comme matériel d'étude, la moule *Mytilus edulis*,pour plusieurs raisons:ubiquité,intérêt économique et rôle de bioindicateur dans les phénomènes de pollution. Notre objectif est de déterminer le métabolisme du métal : sites de capture,de stockage et d'excrétion, à l'échelle cellulaire et subcellulaire.

Plusieurs techniques de microanalyse ont été utilisées. La spectrométrie de masse par émission ionique secondaire qui permet des investigations à l'échelle de l'organe et de la cellule a été utilisée sur plusieurs types d'appareils: microscope ionique CAMECA SMI 300,microsonde ionique RIBER MIQ 256 et microsonde ionique UC.HRL. SIM. La spectrométrie des rayons X qui permet des investigations à l'échelle de l'organite a été effectuée sur microsonde de Castaing couplée à un microscope electronique (sonde CAMEBAX).

Les résultats obtenus par analyse ionique montrent que la majeure partie du métal est captée par les branchies (Fig. 1 et 2 obtenues par microsonde UC.HRL.SIM.) Le courant d'eau branchial qui atteint ensuite les palpes labiaux est appauvri en chrome puisque on mesure dans ces organes, des teneurs en métal quatre fois plus faibles.Le stockage dans la glande digestive est peu élevé;il est notable dans le byssus.L'excrétion a lieu par le rein.On ne détecte pas de chrome dans les gonades. Les macrophages (Fig.2) participent activement à la capture et au stockage du métal. En outre,l'utilisation d'un système informatisé d'acquisition et de traitement d'images (NUMELEC PERICOLOR 2000),adapté à la microscopie ionique, permet une cytolocalisation extrêmement précise du chrome.

Tous les organites cellulaires ont été analysés et il apparait que les lysosomes des différents organes sont les organites cibles de bioconcentration du chrome qui y est toujours associé avec du phosphore (Fig.3),par le mécanisme d'une réaction phosphatasique acide. Le tableau résume les résultats obtenus par microanalyse X.

En conclusion,d'après ces premiers résultats,il apparait que le chrome a, dans les systèmes biologiques,un comportement différent de celui des autres métaux.En effet, comme nous l'avons montré(1),la glande digestive est généralement considérée comme organe cible prédominant de concentration de nombreux métaux(Al,Pb,Ag,U et Pu). En outre, nous avions détecté ces métaux dans les lysosomes et dans les sphérocristaux; ces derniers organites ne semblent pas être le site de bioaccumulation du chrome. Ces données doivent être nécessairement complétées par des études relatives à la cytotoxicité du chrome qui sont actuellement en cours de réalisation.

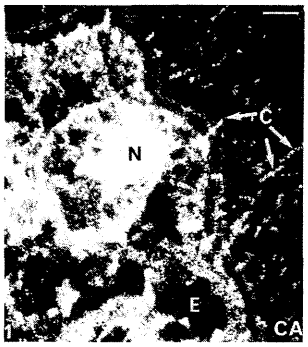

Fig.1.*Mytilus edulis*, Branchie.Image ionique de calcium montrant la topographie de la coupe. C:cils ,E:epithelium,N: noyau. Echelle : 2 µ.

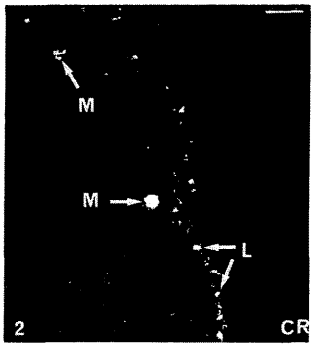

Fig.2.*Mytilus edulis*, Branchie.Image ionique de chrome obtenue sur la même coupe que dans la Fig.1.On remarque que le métal (L) est localisé le long du bord epithelial externe de la branchie et dans deux macrophages (M). Echelle : 2 µ.

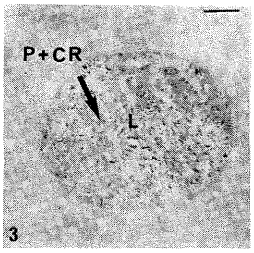

Fig.3.*Mytilus edulis*,Branchie.Micrographie electronique montrant un lysosome (L) de l'epithelium branchial,contenant des microaiguilles de phosphate de chrome(P+Cr) détecté par la sonde Camebax.Les points émissifs en chrome (L) visibles sur la Fig.2 correspondent à des lysosomes.Coupe non osmiée,non colorée. Echelle: 0,1 µ.

	Branchie	Palpe labial	Glande digestive	Rein	Gonade	Byssus
Cr	4516 ± 202	956 ± 98	234 ± 62	2604 ± 160	0	816 ± 136
P	208 ± 62	78 ± 40	24 ± 10	864 ± 94	0	0

Tableau.Microanalyse par sonde Camebax. Moyennes des concentrations en chrome et phosphore,exprimées en nombre de chocs enregistrés pendant 100 s., dans les lysosomes de branchie,palpe labial,glande digestive et rein et dans le byssus.

Ce travail a été réalisé dans le cadre d'un contrat (n° FRA/24G) avec le P.N.U.E. (Programme des Nations Unies pour l'Environnement) et avec la F.A.O.,Plan d'Action pour la Méditerranée (Programme MED POL phase II), avec le support financier partiel de l'I.N.S.E.R.M. (S.C.27) et la collaboration scientifique de P.Boumati,J.F. Cavellier et F.Escaig.

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L-IV2

Utilisation des enzymes hépatiques Cytochrome P-450 dépendantes, chez les Poissons marins, dans la surveillance de l'environnement

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Most drugs, toxics and pollutants absorbed whithin an organism are metabolized by enzymatic systems of biotransformation whose the pathways of which are :

- Phase 1: (mainly mixed function oxidase cytochrome P450 dependant) which is very often responsable for metabolic activation of the original component into "proximate carcinogen".
- Phase 2 : detoxication or conjugation of phase 1 metabolites with endogenous molecules.

An imbalance between these two phases could lead to a toxication (ultimate carcinogen) resulting in mutagenic or/and carcinogenic effects.

On a practical level, induction of xenobiotic biotransformation (such as pesticides, PCB, HAP...) in different representative benthic organisms (fishes, molluscs, vegetals...) must be correlated to physico-chemical parameters to demonstrate their ability to be used for evaluation of environmental health of coastal mediterranean ecosystems which remains to be studied.

La plupart des drogues, toxiques et polluants absorbés par un organisme sont métabolisés par les systèmes enzymatiques de biotransformation. Ces réactions diminuent l'activité des composés toxiques ou, plus fréquemment, augmentent leur hydrosolubilité facilitant ainsi leur élimination. C'est donc une détoxification.

Les activités enzymatiques de biotransformation interviennent essentiellement au niveau du foie, en deux étapes :

- Phase 1 : fonctionnalisation ou dégradation : les réactions d'oxydations, les plus fréquentes, sont cytochrome P450 dépendantes.
- Phase 2 : conjugaison : les xénobiotiques ou leurs métabolites sont liés, grâce à des enzymes de transferts, à des molécules endogènes et éliminés.

Actuellement, l'étude des phénomènes de biotransformation, et de leurs facteurs de variations, prend une place prépondérante en pharmacologie, toxicologie, cancérologie et, plus récemment, en écotoxicologie.

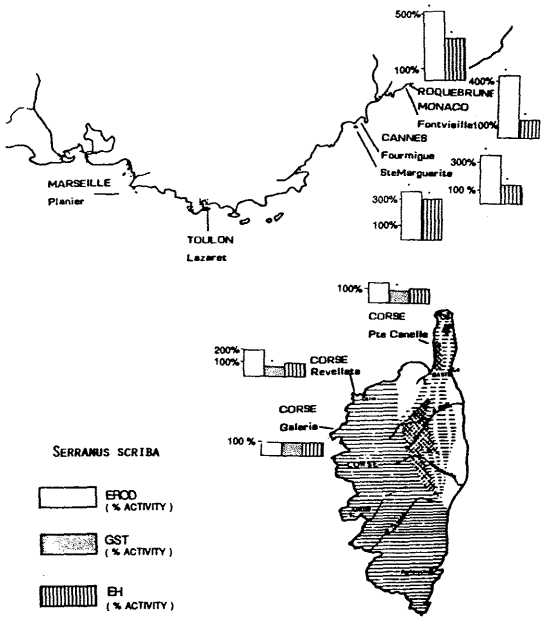
Dans l'optique d'appliquer les tests biochimiques, que nous étudions, à la surveillance des polluants en mer, nous avons créé, avec sept autres laboratoires, le G.I.C.B.E.M. (Groupe Interface Chimie Biologie Ecosystèmes Marins). Le titre du projet de recherche de ce groupe est :

"Activités des Systèmes de Bioprotection d'Organismes Marins représentatifs d'Ecosystèmes Côtiers en Mer Méditerranée".

L'originalité du projet est d'évaluer globalement la santé d'un écosystème marin (stabilité ou vulnérabilité) en étudiant *in situ* les corrélations qui existent entre les niveaux d'activités des systèmes de bioprotection (biotransformation des polluants organiques, induction des métallothionéines...) d'organismes benthiques côtiers et la présence dans le milieu (eau, sédiments) de molécules potentiellement toxiques.

Le choix judicieux de différents sites de prélèvements en Méditerranée (RNO) présentant des pollutions connues, d'origine différente (métaux lourds, HAP, PCB, lindane...) et à divers degrés, doit permettre de déterminer les systèmes de bioprotection concernés et leurs niveaux d'activités. Ainsi, l'application d'une batterie de tests simples et appropriés, sur des organismes représentatifs, permettra d'évaluer globalement la santé d'un écosystème donné et, éventuellement, de tirer rapidement un signal d'alarme quant à la présence, dans le milieu, de molécules potentiellement toxiques.

Deux missions préliminaires ont été effectuées, sur le navire "Winnaretta Singer" de l'Institut Océanographique de Monaco, pour vérifier, la faisabilité du projet. Pour les activités de biotransformation des foies de poissons, les premiers résultats sont encourageants.



Ces résultats préliminaires, exprimés en pourcentage par rapport aux mesures réalisées dans une zone non polluée (Galeria, Corse) doivent être corrélés aux dosages chimiques des polluants, actuellement en cours, avant d'être interprétés pour déterminer le niveau et le type des différentes inductions enzymatiques.

Tout d'abord, il apparait que dans le recueil des mesures *in situ*, le choix de l'espèce est primordial. Le rouget, *Mullus barbatus*, n'a pu être capturé que deux fois sur neuf stations. De plus, les différences liées au sexe, décrites précédemment, augmentent encore les difficultés d'utiliser cette espèce pour ce genre de tests biochimiques. Les deux espèces de serrans (*Serranus scriba* et *Serranus cabrilla*) présentent, au contraire, l'avantage de se capturer facilement et, aussi, d'être des hermaphrodites fonctionnels simultanés, ce qui élimine le facteur sexe.

En ce qui concerne les enzymes de biotransformation, l'activité de l'EROD (Ethoxy Résorufine-O-Dééthylase) semble être en rapport avec les degrés "supposés" de pollution des zones de prélèvement choisies.

L-V1

An intensive environmental study in the open waters of the Aegean and Ionian Seas - Results of 1986 -

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INTRODUCTION

An intensive environmental study of the open waters of the Aegean and Ionian Seas has been undertaken since 1986. In this paper, work so far is described and results on physical and some chemical parameters of two cruises during 1986 are discussed in more detail.

METHODOLOGY

A network of 30 sampling stations in the Aegean and 8 stations in the Ionian Sea was determined in accordance with MED POL guidelines (Fig.1). Sampling twice a year (winter and summer) has been carried out since March 1986 for the following parameters :

- Temperature, salinity and currents
- Dissolved oxygen and nutrients
- Heavy metals and petroleum hydrocarbons in seawater and in sediment
- Heavy metals and chlorinated hydrocarbons in fish
- Phyto and zooplancton analysis.

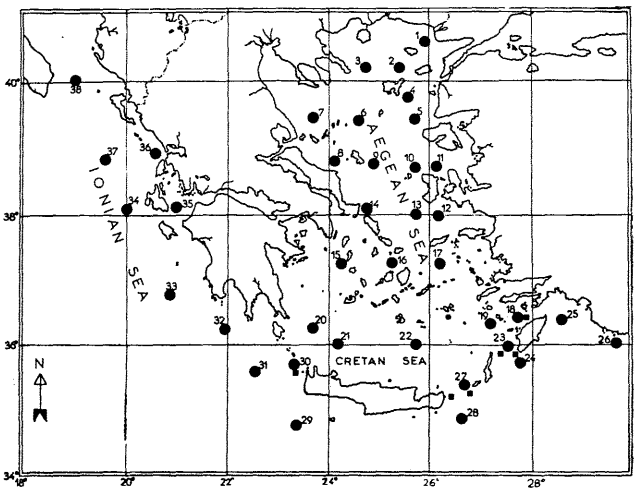

Fig.1 : General network of sampling stations in the Aegean and Ionian Seas.

RESULTS AND DISCUSSION

Although the results discussed in this paper cover a rather short period, preliminary conclusions can be drawn on the environmental quality of the Aegean and Ionian Seas.

Tracing the main surface waters, coming from the Black Sea and Levantine, a general cyclonic circulation is reconfirmed, while in many cases it is marked by mesoscale circulation features, which are observed over the Aegean Sea.

Nutrient and dissolved oxygen results do not show any considerable differences between northern and southern areas in the Aegean Sea. The eastern Ionian Sea on the other hand has different hydrological, nutrient and dissolved oxygen characteristics. Generally, the Aegean is poorer than the Ionian in nutrients and richer in oxygen; the Aegean Sea appears to be the poorest region in nutrients of the Mediterrannean.

TABLE 1

Concentrations of chlorinated hydrocarbons (in ng/g fresh weight) and heavy metals (in µg/g dry weight) in flesh of pelagic fish

STATION	SPECIES	ΣPCBs	ΣDDTs	ΣBHCs	Σrest	Cd	Ni	Cu
Alexandroupolis area	Engraulis encrasicholus	25.2	68.1	12.1	3.9	0.83	3.83	15.00
Chios area	Sardina pilchardus	18.0	34.5	15.2	2.8	0.63	3.77	21.36
Rhodes area	Boops boops	4.2	3.8	1.6	0.3	0.67	3.92	13.70

The levels of Cu, Ni and Cd in samples of demersal and pelagic fish are similar with those from other North and South Mediterranean regions (Table 1). The obtained results did not show any significant difference between samples from North and South Aegean. The chlorinated hydrocarbon levels in the fish are lower than those found ten years ago.

Finally the analysis of the various parameters shows that pollutant values in the open waters of the Aegean and Ionian Seas are of low levels.

L

Mapping of pollution induced degradation in coastal vegetation along Eastern Adriatic

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INTRODUCTION. The selected benthic organisms may be useful indicators of the long-term average effects of coastal pollution. They are less reliable for an exact evaluation of the pollution levels, for they hardly indicate 4 or 5 different degrees. They may be applied chiefly on the point stations and on singular coastal transects, but hardly for a consistent mapping of the pollution levels across the extensive coastal areas as is the Adriatic Sea. Therefore a simple and quick, not expensive but satisfactorily informative methodology, for the bioindicator mapping of the long-term pollution effects across the extensive coastal areas was needed. The general principles of such an ecozonal mapping have been explained in Lovrić (1982).

The main basis of the actual zonation map has been the vegetation mapping of Adriatic coastal phytocenoses that started from 1968 (cf. Lovrić 1975). Since 1975 in NE Adriatic were mapped also all accessible degradation effects of the polluted sea on the benthic algal vegetation and on the coastal halophytes including the changes in species, in communities, and the zoning perturbations (Lovrić 1985). By a selective combination of such effects that are easily registrable in the field, and presentable in degrees, we standardised a procedure for the ecozonal mapping of the coastal pollution effects by the indicating algal and halophytic vegetation. It offered the possibilities for the field distinction of 9 different degradation zones induced by pollution.

METHODOLOGY. These 9 degradation zones are well presentable by a coloured map with the different spectral colours that are defined by the combinations of the next phytoecological indicators registered by the field mapping.

1. Ultramarin - blue zone = the very purest and well conserved coasts with a most complete vegetation : the maximal diversity of algae and halophytes, then abundant calcareous algae and lignescent halophytes, including such sensitive groups as Neogoniolitho - Nemodermion, Cystoseirion strictae, Aurinio - Capparion, etc.

2. Pallid - blue zone = rather pure coasts with almost original natural vegetation : nearly complete coastal vegetation of algae and halophytes, luxuriant communities but decreasing diversity, perennial algae and halophytes prevailing, persisting such groups as Posidonion, Cystoseirion crinitae, Petroglossion, etc.

3. Green zone = less pure coasts with a seminatural vegetation: calcareous algae and woody halophytes disappearing, subequal rates of the perennials and annuals, and appearing of the first rare synanthropic (ruderal) species indicating a degradation.

4. Yellow zone = intermediate coasts: modest diversity, prevailing seasonal algae and annual halophytes, rarifying of Rhodophyta, Phaeophyta and halophytic Plumbaginaceae, ascending of the skiophytic circalittoral algae upwards in turbid waters.

5. Orange zone = semidegraded coasts with a synanthropic vegetation: prevailing of Chlorophyta, Cyanophyta, and nitro-halophytic Chenopodiaceae - Salsolaceae (the main vegetation types are Ulothrici - Bangion, Rhodymenion, and halophytic Cakiletalia).

6. Red zone = medium - degraded coasts with an oversimplified vegetation: very scarce species diversity, even the resisting Chlorophyta and Chenopodiaceae rarified, the circalittoral skiophytes in turbid waters growing closely by the shoreline (the main vegetation types are Ulvion, Enteromorphion, and ruderal Chenopodietalia).

7. Brown - chestnut zone = overdegraded coasts with the disappearing macrovegetation: only the last rare Chlorophyta and Chenopodiaceae persisting, Cyanophyta and diatoms widely predominating.

8. Violet zone = very devastated coasts without macrovegetation: even the microcoenoses of Cyanophyta and diatoms rarified (the unique persisting microvegetation group is Microcoleion).

9. Black zone = quite destroyed and azoical coasts: no vegetation, only the bacteria persisting.

RESULTS. From 1975, by this procedure we prospected during 14 years the most of Adriatic islands, Yugoslav mainland coasts and estuaries, incliding ca 85% of the East Adriatic coastlines. The obtained results will be presented by a coloured wall map in the medium scale with 9 degradation zones. It presents the very devastated shores including the azoical ones (zones 8 - 9) restricted in N Rijeka Bay, Zadar channel and Kaštela Bay. The other well degraded zones (6 - 7) include W and NE Istra Peninsula, SE Velebit coast, N Dalmatia (Zadar-Šibenik), interior Boka bays, NW Krk island, and Raša estuary. The most of the other E Adriatic coasts are medium-degraded (4 - 5). The semi-natural coasts (2 - 3) are in the islands Cres, SE Krk, NW Rab, Plavnik, SW Kornati, Vis, Lastovo, SW Mljet, NW Velebit, Zrmanja estuary, and middle Montenegrin coast. The very purest coasts with a richest vegetation (zone 1) are restricted to the remote Mid-Adriatic islets, the open mainlands of Konavli by Dubrovnik and Platamun cape by Budva, and also Prvić and Grgur isles in NE Adriatic channels. These distribution patterns offer some interesting conclusions. The purest natural sites may be in the remote isles and open mainlands, but also in the interior channels overexposed to perpetual strong winds and stormy surf e.g. isles by Senj. The most degraded ones are the sheltered closed bays with a coastal industry and major urbanizing.

The most effective degradation phytoindicators are: a general decrease in coastal species diversity, simplified communities and uniform vegetation; disappearing of perennials, calcified algae, woody halophytes, Plumbaginaceae, Rhodophyta and Phaeophyta, and the expansion of annuals, soft algae and halophytes, Chenopodiaceae, Chlorophyta and Cyanophyta. These changes if used isolated are not very informative, but if we put them together they give the certain pollution levels.

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Evolution à long terme (1974-1987) des peuplements benthiques sur substrats meubles du golfe d'Izmir soumis à de multiples pollutions

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INTRODUCTION : Les pollutions domestique, industrielle et maritime sont étroitement liées au développement économique de la région d'Izmir motrice pour le pays. Durant ces dernières années, l'augmentation du volume gagné sur la mer par remblai et surtout l'amélioration du drainage des effluents des différentes usines vers un ruisseau l'Halkapınar n'ont fait que contribuer à l'accroissement de la destruction générale de l'écosystème primitif malgré les différentes mesures, menées, pour controler les rejets industriels.

MATERIEL ET METHODE : Depuis 1974, les effets de la pollution sur les peuplements benthiques sont constatés par des prélèvements effectués dans différentes stations. Pour présenter les résultats évolutifs, 3 stations ont été sélectionnées (Fig.1).

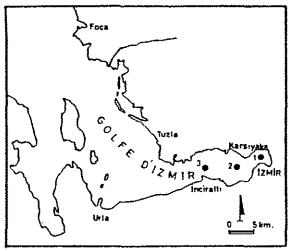

Figure 1: Stations.

Les prélèvements ont été réalisés à l'aide d'une benne "Orange-peel". Dans chaque station 9 à 10 l de sediment ont été tamisés. Pour pouvoir éffectuer des comparaisons, l'Indice de Margalef a continué à être utilisé.

RESULTATS : Depuis 1974 de nombreuses évolutions ont pu être observées au sein d'une même station et entre chacune d'entre elles.

-Station 1: Dans cette station, près de la source la plus importante de pollution, les résultats sont très déterminants quant à la conséquence que peut avoir les différents déchets sur le peuplement benthique. Pendant la période de 14 ans de 1974 à 1987; le nombre d'espèces varie de 3 à 16, le nombre d'individu de 28 à 1524, l'indice de diversité de 0,34 à 2,69. Dans cette stations, le plus bas indice de diversité a été observé en 1980 et le plus haut en 1987 (Fig.2). La cause de cette amélioration est liée à la modification du lieu de déversement des eaux de l'Halkapınar qui sont rejetées plus au large. Toutefois la faune nouvellement dévoloppée à la station 1 reste des espèces de polychète.

-Station 2: Se trouvant au milieu de la baie intérieure les changements observés dans cette station sont plus faible que ceux constatés dans le première station. Dans la même période de 74 à 87; le nombre d'espèces varie de 6 à 14, le nombre d'individus de 59 à 408, l'indice de diversité de 1,01 à 3,00. Le plus bas indice de diversité est constaté en 1980, le plus haut en 1987 (Fig.2).

-Station 3: Cette station à l'extrémité de labaie intérieure d'Izmir peut être considérée comme à la limite entre les eaux polluées et les eaux claires. Dans la même période que celle considérée jusque là, le peuplement benthiques a montré plus de modification que dans le autres stations. Le nombre d'espèces varie de 30 à 66, le nombre d'individu de 288 à 2072, l'indice de diversité de 5,12 à 11,05. Contrairement aux stations 1 et 2 l'indice de diversité continue à diminuer après 1980 (Fig.2).

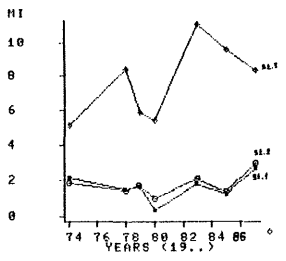

Figure 2

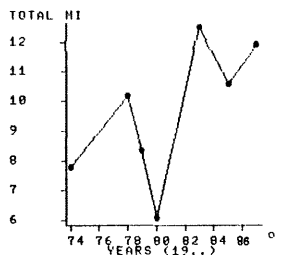

Figure 3

CONCLUSION : Les différentes observations sur les peuplements benthiques du Golfe d'Izmir depuis 1974, montrent des changements importants et en 1980 une pollution maximum (Fig.3). Après 1980, les mesures de traitement des rejets des usines et un drainage des boues du fond entrainant une réduction de la pollution dans les stations 1 et 2 apparait clairement dans le tableau présentant les résultats de 1985 et de 1987.

Tableau: Répartition par groupes systématiques des nombres d'espèces (NS) et d'individus (NI) ainsi que les indices de diversité (DI) entre 1985 et 1987.

		Polychaetes			Mollusces			Crustaceans			Echinoderms			Total		
		NS	NI	DI	NS	NI	DI	NS	NI	DI	NS	NI	DI	NS	NI	DI
	1	7	1452	0.82	2	71	0.23	1	1	-	-	-	-	10	1524	2.23
1985	2	7	386	1.00	1	16	-	1	6	-	-	-	-	9	408	1.50
	3	41	618	6.22	14	232	2.38	6	46	1.31	3	12	0.80	66	920	9.52
	1	13	77	2.76	2	54	0.25	-	-	-	-	-	-	15	131	2.87
1987	2	13	75	2.78	3	34	0.56	1	1	-	-	-	-	17	110	3.40
	3	26	167	4.89	13	121	2.50	5	5	2.50	2	41	0.27	46	334	7.74

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L-VI3

Le peuplement benthique du port d'Alger : évolution spatio-temporelle

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MATERIEL ET METHODES D'ETUDE

Le port d' Alger (superficie 180 hectares) comprend 3 bassins (Fig.1):le bassin de Mustapha (forte activité industrielle et commerciale), le bassin de l'Agha, le bassin du Vieux Port (pêche et plaisance).

La cartographie des peuplements benthiques du port d'Alger a été établie par Bakalem et al (1986) pour le mois de juin , selon la classification de Bellan(1967), par référence au port de Marseille.

Les auteurs distinguent: -la zone de pollution maximum où le macrobenthos (et le plus souvent le meiobenthos) a disparu; -la zone II polluée, interne, très polluée, avec un peuplement très peu diversifié, 2 à 3 espèces, essentiellement *Scolelepis fuliginosa* et *Capitella capitata*, des densités inférieures à 600 individus/m2 et une dominance d'espèces indicatrices de pollution (IP) supérieure à 94%; -la zone II polluée, externe, où la dominance des I.P. est supérieure à 80%, *S. fuliginosa* et *C. capitata* dominent, le nombre d'espèces est plus important que dans la zone précédente avec des densités plus élevées; -la zone III subnormale interne, encore sévèrement perturbée, le nombre d'espèces varie entre 15 et 23, les densités de 1500 à 2000 individus/m2, la dominance des I.P. diminue significativement, de l'ordre de 50%; -la zone III subnormale externe se caractérise par des densités plus élevées, un nombre d'espèces compris entre 24 et 50, alors que la dominance des I.P est faible (de l'ordre de 5%).

L'évolution des peuplements de ces zones a été plus spécialement étudiée au niveau de 7 stations parmi les 34 suivies au cours d'un cycle annuel par C. REBZANI-ZAHAF: stations 10 et 12 (Mustapha), 14 et 19 (Agha), 23, 29 et 31 (Vieux Port).

RESULTATS

La zone I, caractéristique du bassin de Mustapha, évolue considérablement dans le temps et dans l'espace. Au printemps et en été, les conditions sont si défavorables que l'extention de cette zone est maximale. Les conditions du milieu s'améliorant, la zone I évolue en zone II interne, durant la saison hivernale; le peuplement s'enrichit, quantitativement seulement (station 12: 8564 individus/m2) avec un équilibre entre les effectifs de *C. capitata* et de *S. fuliginosa*. Les régressions et transgressions de la zone I concernent uniquement le bassin d'évolution soumis aux influences des eaux de la baie d'Alger par la passe sud.

La zone II interne, localisée au niveau de la station 10 (passe sud) est présente toute l'année; elle est caractérisée par une fluctuation quantitativement élevée et qualitativement moindre du peuplement. Toute l'année les IP. y dominent. La densité est de 7672 individus/m2 en automne, maximale en hiver (25484 individus/m2) et mininale en été et surtout au printemps (40 individus/m2), en raison des conditions hydrodynamiques des eaux de la baie (houles, vagues). La zone II interne est instable dans le temps le temps et l'espace et est soumise simultanément aux eaux de la baie et aux conditions défavorables du bassin de Mustapha.

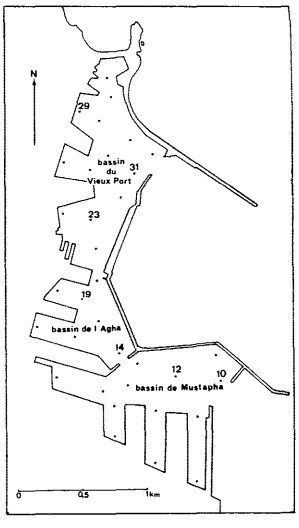
La zone II externe se caractérise par un accroissement de la richesse qualitative et quantitative du peuplement. On la retrouve dans le bassin de l'Agha, à proximité du bassin de Mustapha (station 14). Les fluctuations du peuplement y sont importantes: au printemps, le nombre d'espèces et les densités sont au maximum (30224 individus/m2), en hiver et en été cette zone devient azoique, en automne, le peuplement, pauvre qualitativement et quantitativement, est réferable à celui de la zone II interne. Par contre la zone proche du Vieux Port (station 19) présente un peuplement permanent avec des fluctuations qualitatives et quantitatives moindres, excepté en été; cette zone est alors réferable à la zone II interne fortement pertubée. Le reste de l'année, le peuplement est celui de la zone II externe avec une forte dominance des I.P. Le nombre d'espèces est minimum en été (3) et la densité maximale en hiver (3384 individus/m2)

L'ensemble du Vieux Port est occupé par la zone III, riche qualitativement, (23 à 48 espèces), et quantitativement (796 à 7388 individus/m2). La zone III externe (station 31) occupe tout le bassin d'évolution du Vieux Port lequel est soumis à l'influence des eaux du large par la passe nord; tandis que la zone III interne, pertubée, se localise au fond des darses (stations 23 et 29). La zone III externe s'enrichit qualitativement et quantitativement en hiver et au printemps où elle est maximale; la zone III interne est importante en automne et en hiver. Le bassin d'évolution du Vieux Port est soumis toute l'année simultanément à l'influence des eaux du large et à celle des fonds de darse. Ces régressions et transgressions dans le temps et dans l'espace de la zone III externe à la zone III interne, sont le résultat de cette double influence. Il est très difficile de délimiter nettement ces zones (peuplement en mozaïque, selon Bellan, 1967).

CONCLUSION

L'évolution spatio-temporelle des différentes zones du port d'Alger est liée simultanément à l'action des rejets d'eaux usées et à l'inflence bénéfique des eaux de la baie entrant par les passes nord et sud. La zone I occupe le bassin de Mustapha la majorité de l'année; quand les conditions deviennent favorables la zone II interne se met en place; la régression et transgression de la zone I dans le bassin de Mustapha est localisée au niveau du bassin d'évolution des navires. Dans le bassin du Vieux Port, sous l'influence des eaux de la baie les conditions du milieu sont beaucoup plus favorables. Le riche peuplement de ce bassin est réferable à un peuplement de zone III externe ou de zone III interne perturbée se succédant dans le temps et dans l'espace. Le bassin de l'Agha, soumis aux influences des rejets d'eaux usées subit une fluctuation complexe, les zones I, II et III interne se mettant en place dans le temps.

L'évolution spatio-temporelle du port d'Alger se fait de la zone I vers la zone III quand les conditions du milieu sont favorables et de la zone III vers la zone I quand ces conditions deviennent défavorables.



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L-VI4

Toxicité d'un alkylétain : oxyde de tributylétain sur l'Huître Crassostrea gigas Thunberg

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Des études réalisées par ALZIEU (1982) ayant relevé un impact possible des organostanniques sur le développement des huîtres Crassostrea gigas, le Ministère français de l'Environnement a pris en 1982 un arrêté interdisant l'utilisation des peintures marines antisalissures à base d'organostanniques pour les navires de moins de 25 tonneaux dans les régions de la Manche et de l'Atlantique. Cet arrêté d'une durée de trois mois a été reconduit en décret pour une période de deux ans et étendu à l'ensemble des côtes françaises.

Suite à cette décision, de nombreuses expériences ont été entreprises et des tests de toxicité de divers produits antisallissures réalisés sur l'huître Crassostrea gigas (GENDRON 1985).

I - EXPERIMENTATION

. Concentrations d'oxyde de Tributylétain testées
2 - 5 - 10 - 20 - 50 et 200 $\mu g.l^{-1}$ de TBTO

La solution mère à 1 gr/l est préparée dans l'acide acétique. Les dilutions se font dans l'eau de mer.

Les concentrations sont régulièrement surveillées par des analyses réalisées selon la méthode de génération d'hydrures (PINEL et al. 1984).

II - RESULTATS

1/ La mortalité est fonction de l'augmentation en TBTO. La CL50 96 h pour l'huître Crassostrer gigas de un an est de l'ordre de 120 µg/l de TBTO dans des conditions expérimentales précises (température : 17,5 à 19° C, salinité 37 ‰).

2/ Comportement des huîtres

Il est différent suivant la concentration testée. Aux faibles concentrations (2 et 5 $\mu g.l^{-1}$) les huîtres ont une activité en apparence normale et leurs valves sont entr'ouvertes. A des concentrations plus élevées (10-20 et 50 $\mu g.l^{-1}$), les huîtres ont une activité réduite et sont en majeure partie fermées. A 200 $\mu g.l^{-1}$, les animaux ont un réflexe immédiat de protection et ferment leurs valves. Après 2 à 3 jours leur comportement est rapidement perturbé. Le réflexe de fermeture des valves est diminué jusqu'à devenir quasiment nul 4 à 5 jours après selon les individus. L'huître présente un affaiblissement général et maintient ses valves largement ouvertes. Le retrait du manteau dans la cavité palléale est supérieur au centimètre. L'animal survit pendant 1 à 3 jours.

3/ Observation des coquilles

L'ensemble des résultats est regroupé dans la figure 1 exceptée la série de 200 $\mu g.l^{-1}$, afin de ne pas surcharger les courbes. Les données L/e (Longueur/épaisseur de la coquille) de cette série sont extrêmement variables en raison de la toxicité du TBTO.

La figure 1 met en évidence les effets toxiques du TBTO. Le rapport L/e est significativement inférieur à celui du témoin pour toutes les concentrations testées (2 - 5 - 10 - 20 - 50 $\mu g.l^{-1}$).

Le rapport de la série 2 $\mu g.l^{-1}$ décroit régulièrement pour atteindre une moyenne de 17,5 après 100 jours.

Les séries 5 et 10 $\mu g.l^{-1}$ présentent des courbes nettement inférieures aux autres séries. Aux concentrations de 20 et 50 $\mu g.l^{-1}$ de plus larges variations se manifestent, en raison de l'action du TBTO sur la physiologie de l'animal qui ralentit son processus de calcification.

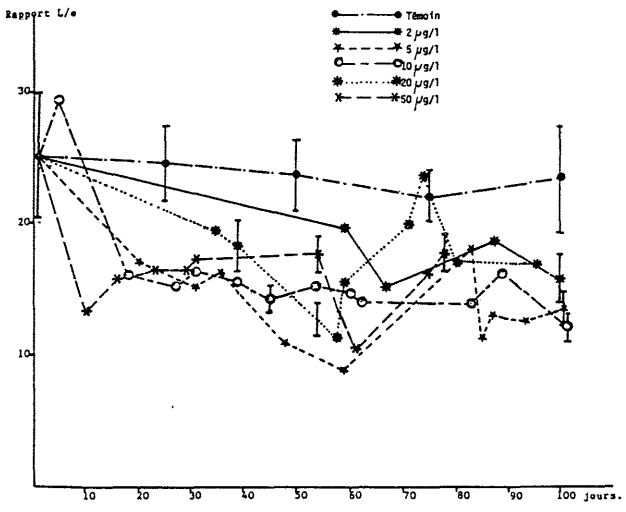

Fig. 1 : Evolution du rapport L/e des valves supérieures des huîtres des séries expérimentales : 2 - 5 - 10 - 20 et 50 µg/l.

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Toxicity of Egyptian crude oil to Tilapia zillii Gerv. and fat change through subacute oil exposure

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Abstract

In acute toxicity bioassay on Tilapia zillii Gerv., the concentration of crude oil fatal to 50% of the organisms in 96 hr was 6683.4 ppm. Survival and behaviour were the responses used for measuring toxicant effects. The highest concentrations of oil ($\geq$ 8000 ppm) had marked adverse effects on survival and behaviour. Survival and behaviour of fishes in low oil concentrations ($\leq$ 5600 ppm) did not differ from the control. In order to get an impression about fish production under subacute oil exposure, fat content in muscles were determined in fishes subacutely exposed to oil in the time interval between June and Aug. This time is well known to lie between the two spawnings of Tilapia zillii Gerv. The exposed fishes have less fat content than the unexposed ones.

Table 1 : A summary of survival data for populations of Tilapia zillii Gerv. submitted to acute exposure of Egyptian crude oil

Days of exposure	Number of fishes surviving at test concentrations							
	Control	5600 ppm	6000 ppm	6400 ppm	6800 ppm	7200 ppm	7600 ppm	8000 ppm
0	10	10	10	10	10	10	10	10
1	10	10	10	9	8	5	3	0
2	10	10	10	9	6	4	1	0
3	10	10	10	9	5	2	0	0
4	10	10	9	6	2	2	0	0

Table 2 : Fat content of muscles of oil chronically exposed Tilapia zillii Gerv.

Oil exposure	Fat content (% body wt) after time interval		
	0 (June)	30 days (July)	60 days (Aug)
Unexposed	1.6 $\pm$ 0.4	2.7 $\pm$ 0.10[a]	3.6 $\pm$ 0.30[ab]
Exposed		1.3 $\pm$ 0.09	1.5 $\pm$ 0.50

a represents significance of difference between fat contents in the muscles of exposed and unexposed fishes. (P values Based on Student's t-test)

b represents significance of difference between fat contents in the muscles of unexposed fishes at 0 days and after 60 days. (P values Based on Student's t-test)

Les enzymes de détoxification de la Moule utilisées comme tests biochimiques pour la surveillance des pollutions chimiques

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Par leur répartition géographique, leur sédentarité et leur capacité à accumuler les xénobiotiques, les moules ont servi d'organisme test dans des programmes internationaux (EARTH WATCH, MUSSEL WATCH) visant à mesurer la contamination chimique dans le milieu marin (Dunn et Stich, 1975; Fossato et Canzonnier, 1976; Phillips, 1976; Goldberg et al., 1978).

Cependant, pour déterminer des niveaux de pollution, pour quantifier et identifier les polluants, de nombreux dosages chimiques sont nécessaires. Ceux-ci entraînent un coût élevé de ces programmes et ne permettent pas une surveillance permanente de la qualité des eaux.

Il apparait donc indispensable de développer un test biologique prédictif, rapide et peu coûteux qui orientera, si nécessaire, l'analyse chimique. C'est dans ce cadre que nous proposons le test "MUSSEL WARNING".

Chez les bivalves marins, Lee et al. (1972), Neff et al. (1976) et Mc Leeze et Burridge (1983) ont montré une capacité d'accumulation des Hydrocarbures Aromatiques Polycycliques (HAP). L'existence de systèmes enzymatiques de métabolisation des HAP a été établie par la suite (Livingstone et Farrar, 1984; Stegeman, 1985; Suteau et Narbonne,1987).

Dans un premier temps, des études concernant la mise au point de la méthode de dosage, ou l'étude des variations naturelles et induites des systèmes de biotransformation des HAP, ont été réalisées au laboratoire (Suteau,1986; Suteau et al.,1987).

Ces travaux font apparaître que les activités Benzo(a)Pyrène Mono-Oxygénases (BaPMO) sont inductibles par les composés plans, alors que les composés non plans induisent les activités Epoxyde-Hydrolases (EH); parallélement, les métaux lourds (type Cadmium) inhibent ces activités.

L'étude de la sensibilité du test montre, par le calcul des relations doses/effets, une différence significative à partir d'un niveau de contamination de 0,4 ppb d'hydrocarbures lourds (PM >200).

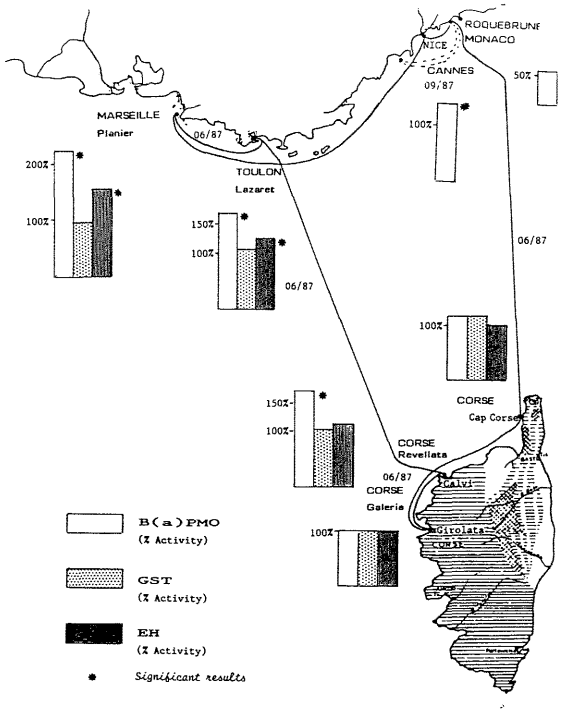
La dernière étape est une étude de terrain par prélèvement des organismes dans une zone contaminée.

Dans le cadre du GICBEM, deux missions préliminaires ont été effectuées, avec le navire le "Winnaretta Singer" de l'Institut Océanographique de Monaco, pour vérifier la validité du projet.

Les résultats rapportés ici sont exprimés en pourcentage par rapport aux mesures réalisées dans une zone non polluée : Golfe de Galeria (Corse). Cette méthode nous permet de ne pas tenir compte des variations saisonnières et donc, de réaliser ce test tout au long de l'année.

Comme le montre la figure, les activités B(a)PMO et EH sont significativement supérieures dans les zones supposées polluées (Marseille, Toulon).

Pour une surveillance continue du milieu marin, ce test biochimique, rapide et peu coûteux, semble fiable et suffisant. Toutefois, des missions ultérieures permettront de confirmer ces résultats et de les corréler avec des analyses chimiques et géochimiques.



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L-VI7

Presence of Cd-binding proteins in freshwater Crayfish Procambarus clarkii and Brine Shrimp Artemia

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Metallothioneins, a metal binding proteins, have a high affinity for various toxic metals, particulary cadmium and mercury. Metal binding proteins have been observed in mammals [1] and a variety of marine invertebrates [2], however, there is very little information available on metal binding proteins in freshwater invertebrates, and particulary in frehwater crustaceans [3]. The presence of such proteins has been variosly suggested as indicating involvement in uptake, storage, transport and elimination of toxic metals [4] and in the routine metabolism of metals [2]. Cadmium binding proteins observed in invertebrates have similar characteristics to mammalian metallothionein: low molecular weight, stable to acid and heat treatment, inducible by metal exposure, low ultraviolet absorption at 280 nm and high absorption at 254 nm, a characteristic absorbance dissapeared on acidification and reappeared with neutralization [1]. This report describes results on the characterization of Cd-BPs obtained from very euryhaline brine shrimp *Artemia* exposed to cadmium. For metodological purposes these results have been compared with those of the freshwater crayfish *Procambarus clarkii* . Induction of Cd-BP was achieved by water exposure at a concentration of 0.1 ppm and 3.0 ppm for *P. clarkii* and *Artemia* , respectively. In accordance with followed method by Engel and Brouwer [4] two midgut glands of *P. clarkii* or 0.5 gr of *Artemia* body were minced and homogenized in Tris-HCl (0.06 M) and NaCl (0.01 M) at pH=8.6 with 0.1 mM PMSF to prevent protease activity and 1 mM DTT to maintain reducing conditions. The homogenate was centrifuged at 30000 g for 45 min at 4°C. The supernatant was heat treated and 60°C for 10 min and centrifuged again at 30000 g for 45 min at 4°C. A portion of the 2 mL supernatant was then applied to a column of Sephadex G-75 (2.6 x 60 cm) and eluted with the same buffer (pH=8.6). Absorbances of the fractions collected were measure at 254 and 280 nm. Spectral changes on acidification and neutralization proteins fractions were determined. Cadmium concentrations was determined by flame (*P. clarkii*) in a Perkin-Elmer model 5000 atomic absorption spectrofotometer a deuterium background corrector. In *Artemia* samples cadmium was determined by graphite furnace with Zeeman background corrector.

Figure 1A is a Sephadex G-75 elution profile derived from midgut gland tissue pooled from two crayfish. Low levels of cadmium occur in the void volume. One cadmium peak is cleary resolved. Cadmium was accumulated in the low molecular weight range of 18000-20000. This fraction had high ultraviolet absorption at 254 nm and a higher 254/280 ratio. Figure 1B show a Sephadex G-75 elution profile derived from *Artemia* sample. In this case a important amount of cadmium was present in the void volume. Two peaks were resolved at the low molecular weight. The first one corresponded to 18000-20000 range and the second one to 8000-11000 range.In both *P. clarkii* and *Artemia* Cd-BP fractions were scanned on a U.V. absorbance spectrophotometer and found a maximal absorbance at about 254 nm with minimal absorbance at 280 nm. This maximal absorbance disappeared on acidification and reappeared with neutralization, indicating the presence of a mercaptide-metal bound (peculiar Cd-BP) [1].

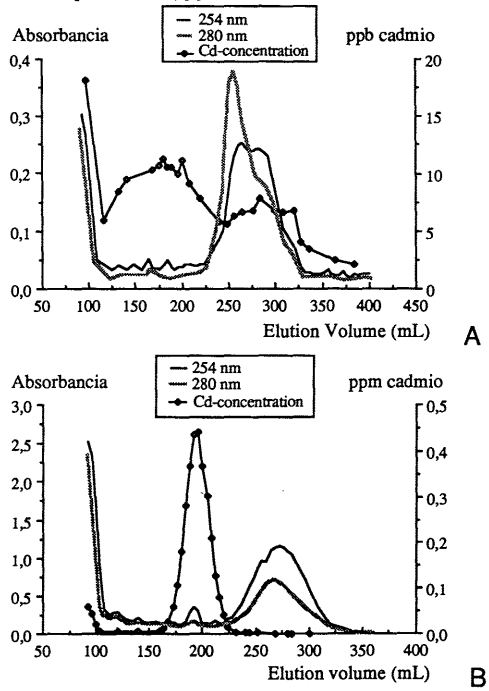

Figure 1. A) Sephadex G-75 elution profile for *Artemia* sample. B) Sephadex G-75 elution profile for midgut gland (*P. clarkii*). In both absorbance at 254 and 280 in arbitrary units, flow rate=50 mL/hr.

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L-VI8

Estimation of nutrients (N and P) along the Romanian Black Sea Coast

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Along the Romanian Black Sea coast (246 Km) several landbased sources are acting. Their importance is different depending on the volume and chemical composition.

The organic and mineral load determined some physico-chemical and biological modifications in the marine environment from influenced areas. In the last decades significant changes especially massive phytoplankton blooms,ocurred in biological cycle. They were induced by the enriching of sea water with nutrients. Owing to this situations it became important to evaluate the N and P input in the marine shallow waters, to identify the sources and to establish each contribution.

The quality of marine waters along the Romanian coast is mainly under the influence both of Danube river and waste water discharges. Because of flow and chemical composition variations; periodical estimations should be performed in order to quantify the source contributions and to establish adequate measures for preventing the environment degradation (DRAGASANU,VASILESCU and STOINA,1960; RUDESCU NICULESCU and CHIVU, 1965; PECHEANU, MIHNEA, SERBANESCU and CUINGIOGLU, 1977).

The paper analyses 1983-1986 data for Danube influence and 1987 for the southern sources. Concerning the Danube water the mean values for $N-NO_2$, $N-NO_3$, $N-NH_4$ during 1983-1986 and $P-PO_4$ during 1985-1986 were calculated. They were presented in the table.

Nutrients were determined by spectrophotometry. 1983 UNESCO method was utilised for $P-PO_4$. $N-NO_2$, $N-NO_3$ and $N-NH_4$ were measured by Murphy & Riley and Koroleff methods.

From the table it can be concluded the importance of the Danube in enriching marine waters along the Romanian coast with nutrients (N and P). Its share consists in more than 99% for N ($NO_2 + NO_3 + NH_4$) and 86.65% as $P-PO_4$ from the total quantities introduced in Romanian Black Sea waters/year.

However because of the distance as well as dilution and dispersion phenomena in the southern part of the coast the Danube contribution is diminished.The local sources acting in this well developed from industrial and tourist's point of view area are determining in biological processes especially in the shallow waters (till 20 m isobate). The 5378 t/year $P-PO_4$,although represent only 13.26% from the total input, are in such a quantity that phosphorus is no more a limitative factor for phytoplankton blooms in this zone.

Parametere	$N-NO_2$	$N-NO_3$	$N-NH_4$	$N-(NO_2+NO_3+NH_4)$	$P-PO_4$
A. Average input of the Danube water tons/year	6 848	189 181	33 050	229 080	34 924
B. Average input of southern sources tons/year	21	236	727	1002	5 378
Total input tons/year	6 869	189 417	33 777	230 082	40 302
B/A % ratio	99.69	99.87	97.84	99.56	86.65

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Levels and trends of the pollution of chlorinated hydrocarbons in sediments from the Mediterranean Sea

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The Mediterranean Sea, as a semienclosed body of water is of special interest and there are many monitoring activities that estimate the existing levels of chlorinated hydrocarbons in various components of the ecosystem, in order to gauge the magnitude of future pollution by these or other similar chemicals. Sediment is very suitable for monitoring purposes because of its stability and relatively simple sampling. Besides that, sediment analysis is significant also because sediments play an important role in the distribution of chlorinated hydrocarbons in the aquatic ecosystem. The levels of these pollutants in the water environment are regulated by adsorption and desorption processes and by the sediment--water interface (DUINKER and BOON, 1985; OLSEN et al., 1982). Figure 1 presents summarized data of such baseline monitoring activities of DDTs, BHCs, and PCBs pollution of sediments from the Mediterranean Sea, published in the literature or available in other ways. The presented averages were calculated as arithmetic means by using separate data. When such data were not available for the investigated area, averages were calculated by combining available arithmetic means ("weighted" arithmetic means if the number of samples was known) and arithmetic means obtained from single data. It means that for some averages are presented as arithmetic means obtained from arithmetic means available in previously published papers. Data are presented as concentrations on a dry weight basis. In the case when the data in literature were published only on a wet weight basis, concentrations on dry weight basis were calculated by multiplying concentrations on a wet weight basis by a factor of 2.0. Variations in the chlorinated hydrocarbons residue concentrations in the sediment from the Mediterranean Sea, their trends and various methodological difficulties encountered in the comparison of the obtained results are discussed.

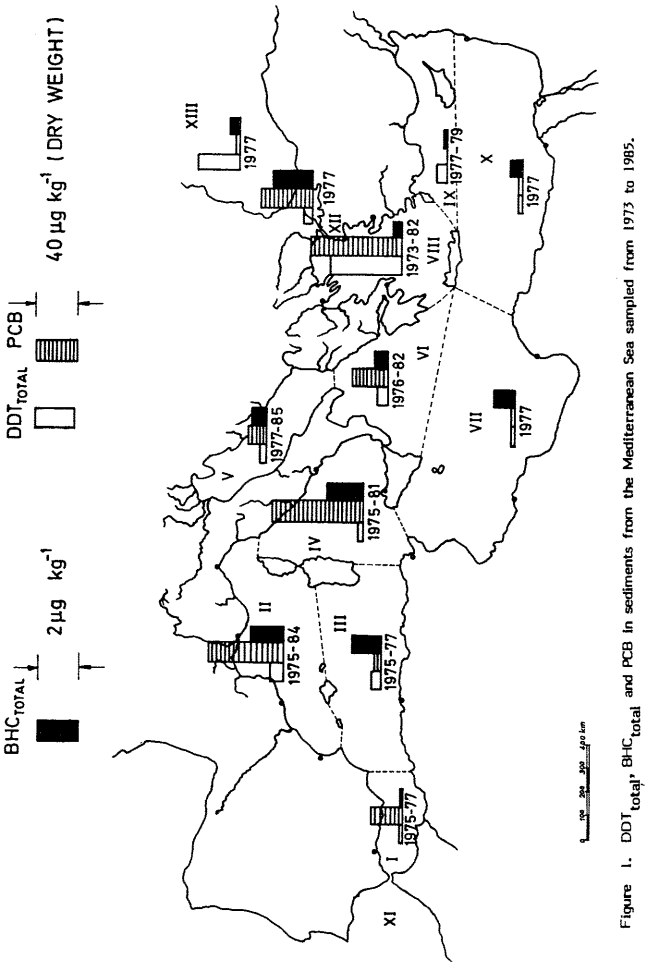

Figure 1. DDT_{total}, BHC_{total} and PCB in sediments from the Mediterranean Sea sampled from 1973 to 1985.

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Levels of chlorinated hydrocarbons and metals in demersal Fishes

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INTRODUCTION Past work on marine organisms for Greek waters in relation to the level of organochlorines concerns the Saronikos gulf (1). (2) and the Thermaikos, Strymonikos and Kavala gulfs (3). As regards the concentration of heavy metals, the studied areas were the Saronikos gulf (4) and other coastal areas of the Aegean Sea(5).

MATERIALS AND METHODS Samples of a large number of fishes, almost always Mullus barbatus (red mullet), once only Mullus surmuletus (striped mullet) were collected from various parts of the Aegean Sea between October 1986 to February 1987.

The determination of chlorinated hydrocarbons was performed on composite samples according to the procedure by Satsmadjis et al (6) and heavy metals analysis on pooled samples according to UNEP procedure (7).

TABLE 1. Organochlorine concentrations (ng/g dry weight)

	Tissue	lipids %	EPCBs	EPDTs	EBHCs	Etest
Alexandroupolis	Flesh	4.94	9.6	20.6	20.1	1.9
Chios	Flesh	11.07	39.9	55.2	15.4	1.3
Canea	Flesh	8.01	42.3	66.8	11.1	1.3
Saronikos	Flesh	16.75	84.3	47.8	65.1	4.7

RESULTS AND DISCUSSION Table 1 gives figures for organochlorines after grouping them into four categories. All the levels are far below what could be considered dangerous for human consumption by the strictest standard. As a rule, the concentration of organochlorines in organisms rises more or less in direct proportion to the lipids contents, since they dissolve in them. Thus, the Alexandroupolis sample, holding less lipids displays the lowest levels of chlorinated hydrocarbons. The opposite occurs in the case of the Saronikos sample. When taking into consideration the percentage of lipids, there is no substantial difference between studied areas.

TABLE 2. Trace metal concentrations in mg/Kg

STATION	TISSUE	Cd Average	Cd SD	Ni Average	Ni SD	Cu Average	Cu SD
Alexandroupolis	Flesh	0.84	0.22	5.59	1.61	16.33	13.16
	Gills	2.97	0.81	17.09	4.30	44.31	31.99
	(Liver)*	4.55	-	18.18	-	31.82	-
Chios	Flesh	0.66	0.33	3.50	0.55	17.67	14.17
	Gills	2.98	0.85	14.73	1.49	36.60	20.60
	(Liver)*	1.57	-	4.13	-	23.01	-
Canea	Flesh	0.70	0.24	4.04	0.34	18.47	14.04
	Gills	2.95	0.66	16.77	4.08	33.47	23.61
	(Liver)*	0.80	-	5.37	-	9.76	-
Saronikos	Flesh	0.78	0.15	2.66	0.58	2.26	0.50
	Gills	2.85	0.59	10.95	1.59	4.79	0.89
	(Liver)*	4.26	2.27	12.86	11.12	10.71	10.43

* Composite samples

Table 2 shows the concentrations of Cadmium, Nickel and Copper. The results are similar to those observed in other Mediterranean areas. Flesh samples exhibit lower concentrations than the other samples, fact due to the lower metabolic activity of the tissue in comparison with the others: gills, liver. We can also observe a relation between the increase of the metabolic itensity (e.g. in gills) and the elevation of the variation of the metal content. As the collection of fish samples was realised from October to February, during the reproduction repose of the studied species, the different sampling period did not play any important role in metal bioaccumulation results. When taking into consideration the Standard Deviation of the metal concentration in samples, there is no substantial difference between studied areas, although north samples seem to be a little more polluted. This hypothesis requires further investigation.

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L-VII3

Distribution et origine des hydrocarbures aromatiques et aliphatiques dans le néphéloïde et le sédiment, dans le Delta du Rhône, 1987

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L'alimentation des sédiments du bassin méditerranéen nord-occidental en matériel terrigène se fait essentiellement par une couche néphéloide, au contact du fond, se développant à partir du delta du Rhône (ALOISI et al.,1982). Deux origines de la matière organique de la couche néphéloide sont actuellement envisagées: la remise en suspension des sédiments superficiels et la floculation et/ou précipitation d'une partie de la matière organique présente dans le fleuve, à l'interface eau douce/eau salée. Afin d'évaluer l'importance de ce type d'apports, une analyse détaillée de différents marqueurs d'origine de la matière organique a été effectuée, sur les particules en suspension et le sédiment superficiel prélevés à différentes stations dans le fleuve et son delta, en Mai 1987.

Les hydrocarbures ont été extraits par le méthanol et le dichlorométhane et isolés après saponification. La séparation des hydrocarbures aromatiques a été effectuée par chromatographie liquide haute performance (HPLC) avec un détecteur UV. L'identification et la quantification ont été faites par couplage chromatographie en phase gazeuse/spectrométrie de masse.

L'étude d'un échantillon du néphéloide prélevé à 7 milles de la côte, dans l'axe de l'écoulement du Rhône, montre que la teneur en hydrocarbures totaux de la matière en suspension est de 2622 ng l^{-1} (654 ng g^{-1} de matière en suspension), dont 540 ng l^{-1} pour les hydrocarbures aliphatiques résolus, 2071 ng l^{-1} pour les composés non résolus (UCM) et 11 ng l^{-1} pour les hydrocarbures aromatiques polycycliques (HAP). L'analyse des n-alcanes révèle une distribution régulière de ces composés (Carbon Preference Index ≈ 1) en présentant un maximum en C_{31}. La valeur du rapport U/R (composés non résolus/composés résolus) proche de 4 indique une prédominance de la composante anthropique (MAZUREK et SIMONEIT,1984). L'examen des abondances relatives entre les HAP parents et leurs dérivés alkylés (LAFLAMME et HITES,1977), la présence de composés aromatiques pentacycliques (SIMONEIT,1985) et les valeurs des rapports fluoranthène/fluoranthène + pyrène et benzo(a)anthracène/benzo(a)-anthracène + chrysène + triphénylène indiquent une prépondérance de la composante pyrolytique sur la composante pétrolière. Cette empreinte pyrolytique des HAP particulaires a été également observée plus en amont, dans l'embouchure et dans le fleuve où elle est plus importante. On remarque une diminution des concentrations en HAP de 33 à 19 ng l^{-1} et en hydrocarbures totaux de 10885 à 4770 ng l^{-1} depuis les eaux fluviales vers l'embouchure. Des prélèvements réalisés au large du delta indiquent des changements significatifs de la composition en hydrocarbures dans le néphéloide probablement influencés par les courants de fond, la proximité du Golfe de Fos et la nature du sédiment à proximité de l'extrémité du plateau continental. On assiste par ailleurs à une diminution des concentrations en hydrocarbures totaux dans les sédiments superficiels, du fleuve vers le large (MILLE et al.,1981). On note des similitudes de répartition des n-alcanes entre le sédiment et les particules du néphéloide ainsi que des valeurs proches pour les rapports U/R et les rapports des HAP, fluo/fluo + pyr et b(a)A/b(a)A + chry + try.

On remarque également la présence de dérivés benzéniques alkylés ayant une chaîne de 10 à 14 atomes de carbone, marqueurs de pollution d'origine domestique (TAKADA et al.,1987), qui présentent la même distribution dans le sédiment du delta et les particules du fleuve.

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L-VII4

Dissolved and particulate hydrocarbons in the Rhone Delta, France

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A study of lipid indicators was undertaken in the Rhone delta, France,in order to assess contributions from different biological and anthropic sources, as well as to investigate processes controlling the transport and the fate of organic matter and organic pollutants in the marine environment. Both dissolved and particulate hydrocarbons were analyzed for saturated and aromatic compounds.

Water samples were collected (February 1985-September 1986) in the main river, in and off the river mouth and separated into dissolved and particulate fractions by filtration on glass fibre filter (0.7 µm pore size). After solvent extraction of the lipid fraction, hydrocarbons were isolated by high performance liquid chromatography (WISE et al.,1977) and analyzed by gas chromatography and gas chromatography/mass spectrometry (TRONCZYNSKI et al.,1986).

Surface waters show concentrations of particulate non-aromatic hydrocarbons (NAH) and n-alkanes varying from 15 µg/l (riverine station) to 1.0 µg/l (offshore) and from 0.9 µg/l to 0.1 µg/l respectively, whereas intermediate and deep waters concentrations are lower, varying from 5.1 µg/l to 0.4 µg/l for NAH, and from 0.4 µg/l to 0.04 µg/l for n-alkanes. Winter samples show higher hydrocarbon concentrations than those encountered in automn, with the exception of the unresolved complex mixture (UCM) which is more important in automn samples. Dissolved hydrocarbon concentrations vary in a close range, although no relationship is observed between particulate and dissolved hydrocarbons.

n-Alkane distribution patterns reveal high natural continental inputs ($n\text{-}C_{27}$ - $n\text{-}C_{31}$, odd carbon number alkanes), relatively low planktonic inputs ($n\text{-}C_{17}$), as the samples were collected during low productivity period. Bacterial activity is evidenced by the predominance of even carbon number n-alkanes in the low molecular weight range, and by the presence of 17β,21β(H)-hopanes and hopenes. Surprising maxima at $n\text{-}C_{20}$ in some winter samples indicate probably a microbiological origin as well. In addition to the alkanes little amounts of mono- and poly- unsaturated hydrocarbons are identified in some samples reflecting a biological origin; squalene (C_{30}:6) is ubiquitous in high abundance.

Anthropogenic pollutant inputs are evidenced by the presence of a smooth distribution of high molecular **weight n-**alkanes (Carbon Preference Index,$CPI_{25-35} \sim 1$). Such profiles are assumed to be derived from petroleum or petroleum-products pollution; this is supported by the simultaneous presence of an important unresolved complex mixture (UCM) and of the series of petrogenic 17α,21β(H)-hopanes and steranes (MAZUREK and SIMONEIT,1984). Furthermore the analysis of aromatic hydrocarbons and their distribution patterns allow the recognition of a variety of pollutant inputs, such as from pyrolytic processes, domestic and industrial waste waters, urban runoff, oil spills (WAKEHAM et al.,1980; SPORSTOL et al.,1983).

Results are discussed in terms of fractionation of hydrocarbons between the dissolved and particulate compartments in order to assess the role of sources and environmental conditions on the fractionation. Seasonal and spatial variations are considered and comparison is attempted with data from other estuarine systems (ALBAIGES et al.,1984; TRONCZYNSKI et al.,1986; QIU et al.,1988).

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The contamination of Shellfish (Lithophaga lithophaga) from the Eastern Coast of the Adriatic Sea with polycyclic aromatic hydrocarbons

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The number of organic compounds which enters in marine environment with industrial and domestic waste waters has been growing in the last ten years. From the ecological point of view special attention is given to polycylic aromatic compounds (PAH), because of their great toxicity as to marine organisms as to human health and danger which may be caused by consuming these organisms (Anderson et al.1974; Blumer et al. 1970) The results of the investigations of the pollution levels with PAH in dateshell (Lithophaga lithophaga) from the various localities on the Eastern coast of the Adriatic Sea are carried out in this paper. They have been detected in the tissue of marine shellfish from polluted and unpolluted area (Figure 1.)

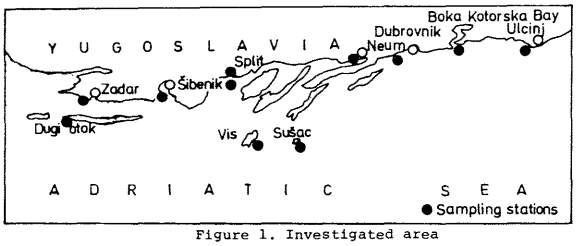

Figure 1. Investigated area

Two extraction fractions were collected lower and higher and continued emission spectra were scanned at the wavelenghts from 330 to 510 nm. From the contour diagram it is possible to identify the sort and the origin of pollutants of each locality. From our contour diagrams it is evident that the dateshell acumulate most aromatic compounds with 2-4 rings and that one which belongs to benzo (a) pyren type. The dominant origin of contaminants in organisms is of petroleum products. The results of levels of PAH in shellfish Lithophaga lithophaga are presented in Table 1, and are in connection with land-based sources contamination of the Adriatic sea.

Minimum value determined in ivestigated area was 0,41 µg/g d.w.in locality of island Dugi otok and the maximum was 29,41 µg/g d.w. determined in locality near port town Šibenik in chrysene equivalents. For the stations in which the contents of PAH in dateshell are about 1,µg/g, the background contents are of global origin (North Italian rivers).

The contents of PAH in the world seas are well documented (Ehrhardt, 1972; Fazio, 1971) but for the Adriatic Sea there is a little information (Sccaccini et Scaccini-Cicatelli, 1969; Picer, 1987.)

Table 1. Contents of PAH in dateshell(Lithophaga lithophaga)from **various** localities in the Eastern coast of the Adriatic Sea.The **values** are given in µg/g d.w.in chrysene and Kuwait oil equivalents

Investigated area (Locality)	Date	Content of PAH chrysene	Content of PAH kuwait oil	WW / DW
Dugi otok(Sakarun)	7. 87.	0.41	5.46	-
Zadar(Borik)	7. 87.	2.89	34.15	5.9
(Punta Mika)	9. 87.	2.01	36.60	3.9
Šibenik(Solaris)	7. 87.	20.41	239.46	2.3
(Zlarin)	9. 87.	5.33	62.86	4.5
Split(Kašjuni)	6. 87.	6.57	77.32	3.7
Vis (Rukavac)	7. 87.	1.53	18.35	6.0
Neum Klek (Klek)	7. 87.	1.06	12.70	4.4
(Duboka)	8. 87.	1.26	15.20	5.0
Sušac(Gradiška)	7. 87.	1.00	12.59	4.1
Dubrovnik (Gruž)	9. 87	1.71	20.48	6.0
Boka Kotorska (Trašće)	7. 87.	5.63	66.26	-
Ulcinj (Valdanos)	7. 87.	2.63	31.25	4.0

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Métabolisme du Benzo(a)Pyrène chez le Loup, Dicentrarchus labrax

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Le benzo(a)pyrène (BaP) est bien connu pour ses propriétés toxiques et cancérigènes (Gelboin 1969, Gelboin et al., 1972; Lu et al., 1979). Des quantités de benzo(a)pyrène, essentiellement d'origine anthropogénique, allant de 4 à 10 ng/g de poids sec ont été retrouvées dans les sédiments côtiers de la Méditerranée (Mille et al., 1982).

Il nous a paru intéressant d'étudier, d'une part, l'accumulation et la répartition de cet hydrocarbure aromatique polycyclique dans les différents compartiments d'un poisson marin, le loup (*Dicentrarchus labrax*). D'autre part, la répartition des métabolites résultant des activités enzymatiques cytochrome P-450 dépendantes permet de comprendre l'importance relative des voies métaboliques du benzo(a)pyrène.

Les loups, *Dicentrarchus labrax* , d'environ 80g, proviennent d'entreprises aquacoles. Chaque individu reçoit, par injection intrapéritonéale, 1,17 µci de benzo(a) pyrène marqués au ^{14} C.

Les animaux sont autopsiés 1, 2, 3, 5, 7 et 17 jours après injection. Les organes suivants sont prélevés : encéphale, foie, vésicule biliaire, rate, intestin, branchie, rein, muscle, graisse, gonade et sang.

L'extraction des métabolites et du BaP natif est réalisée selon la méthode décrite par Roubal et coll. (1977) modifié par Varanasi (1978). Environ 200 mg sont digérés dans 3 ml de soude 4N pendant 48 heures à température ambiante.

Aprés digestion complète, les métabolites sont extraits par 3 ml d'hexane, passer au Vortex 2 min et centrifuger 5 min à 5000 tours/ min.

Trois aliquots de 500 µl de la phase aqueuse et hexanique sont prélevés et passés au scintillateur. Le scintillant utilisé est du Hionic-Fluor qui permet une homogénisation parfaite de chacune des phases.

RESULTATS

a/ Le BaP

Le coeur, l'encéphale, la branchie, le muscle sont les organes incorporant les plus faibles quantités de BaP.

Les graisses et la rate présentent des taux de Bap importants et relativement constants.

La vésicule biliaire, l'intestin, le rein, les gonades et le foie ont aussi des quantités importantes de BaP mais variant avec le temps.

Les volumes de sang prélevés se sont révélés trop faibles pour détecter le BaP marqué.

b/ Métabolites du BaP

La vésicule biliaire montre un taux impressionant de métabolites qui présente de fortes variations avec le temps.

La radioactivité du rein lié aux métabolites reste constante tout au long de l'expérience.

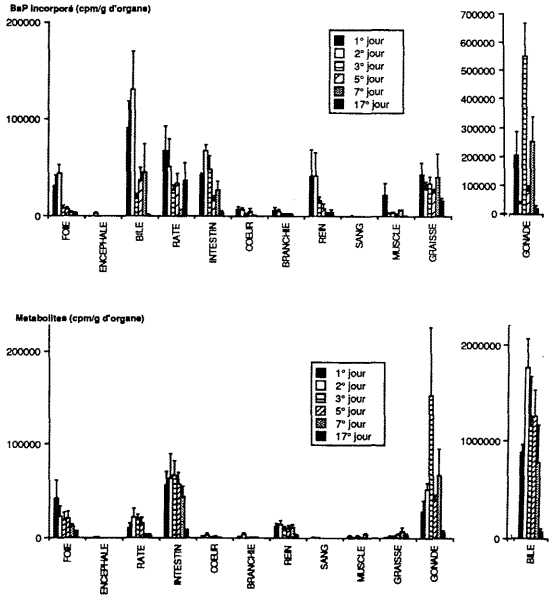
Les gonades, l'intestin, la rate et le foie ont des valeurs importantes qui varient avec le temps.

L'encéphale, le coeur, les branchies, le sang, les muscles et les graisses présentent des quantités relativement faibles.

CONCLUSION

Une partie importante du BaP injecté se retrouve solubilisée et piégée dans les graisses de la cavité péritonéale. Le reste est distribué dans les différents organes à des concentrations variées qui passent par un maximum quarante huit heures après l'injection pour baisser fortement au 17ème jour.

Chez le poisson, le BaP est métabolisé en hydroxyles essentiellement par les M.F.O. (Mixed Function Oxidases) hépatiques. La partie la plus hydrosoluble de ces métabolites est éliminée par voie rénale. La plus grande partie des produits s'associe à diverses macromolécules (glucose, sulfate, glutathion...) par les enzymes de la phase II afin d'être éliminée par voie biliaire via le tractus intestinal.



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L-VII7

Analyse spectrophotométrique des surfactants sur la côte Egéenne

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RESUME

Cette étude porte sur l'action nocive des surfactants sur la côte Egéenne. Les prélèvements trimestriels proviennent de 10 stations.

Les résultats obtenus ont montré que les concentrations varient de 0.20 à 3.30 mg/l en fonction des saisons et des rejets domestiques.

INTRODUCTION

Les recherches précédentes (1, 2) portaient sur les effets nocifs sur l'écosystème marin et les variations des paramètres physico-chimiques et des sels nutritifs.

La pollution par les détergents anioniques était nocive chez certains organismes au niveau des activités biologiques et des transports d'oxygène (3).

MATERIEL ET METHODES

Les prélèvements ont été effectués trimestriellement en surface et à une distance de 5 m de la côte, de mars 1985 à décembre 1985. Le dosage quantitatif a été effectué par la spectrophotométrie et qualitatif par la méthode de la chromatographie TLC et le solvant Chloroforme : Méthanol : Eau pour 8 cm de Silicagel (4, 5). Les teneurs moyennes apparaissent sur la Figure 1.

Selon nos travaux, les teneurs en détergents sont indicatrices pour les déchets domestiques et liées à celles des PO_4-P dans les eaux côtières. A la station 5, choisie dans le golfe intérieur d'Izmir, en saison hivernale, nous avons trouvé 1.35 mg/l pour les détergents contre 4.00 µg.at/l pour les PO_4-P. D'après les analyses qualitatives, les détergents principaux sont le Dodésyl Benzène Sodium Sulfanate et, en plus faible quantité, le Sodium Lauril Ether Sulfate.

Sur les 72 prélèvements effectués autour de l'île Karantina, dans le golfe d'Izmir, il a été trouvé une teneur moyenne en détergents de 2.76 mg/l contre une valeur de 7.10 µg.at/l PO_4-P aux sorties d'émissaires d'eaux domestiques. Au même endroit, à la sortie des rejets de blanchisserie : 4.53 mg/l de détergents et 5.00 µg. at/l PO_4-P.

D'après les statistiques concernant ces résultats, il existe une forte corrélation significative (99 %) entre les détergents et les PO_4-P : de 0.60 à 0.84 (1).

Cependant, ne négligeons pas l'effet sur les larves, à des taux très bas (entre 100 ppb), et sur la fertilité et la reproduction, chez les adultes, dans l'écosystème benthique et pélagique (6).

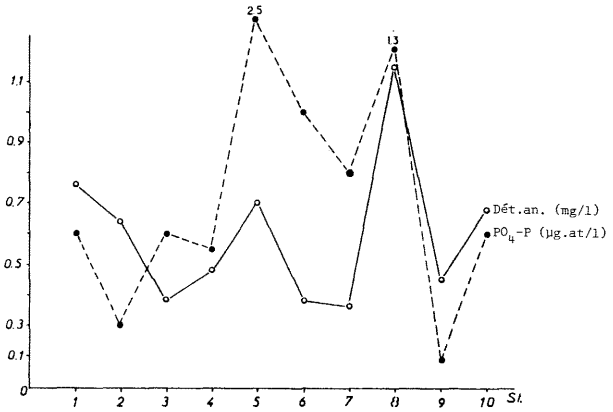

Fig.1.Teneurs moyennes en détergents anioniques et PO_4-P.

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L-VII8

Experimental model for testing the action of LAS on osmoregulation activity of Carcinus mediterraneus

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The first aim of this work is to find an experimental model for keeping crabs in laboratory under polluted conditions for prolonged periods. Crabs, of course, must be fed, and water continuously filtered: but, while filter removes organic matter, it removes the pollutant as well. The pollutant chosen in the present work is LAS (linear-alkilbenzenesulphonate), which is the major anionic surfactant used in laundry products. Once solved the question of obtaining a concentration as constant as possible of LAS in aquaria equipped with powerful filters, it is possible to use the treated crabs for the most varied physiological determinations, e.g. survival, osmolality and protein content of serum, oxygen consumption, transepithelial potential difference, Na-K-ATPase activity and ^{22}Na flux in gills. The analysis by High Performance Liquid Chromatography allowed to know the actual concentration of LAS in sea water of aquaria, while the crabs were living in the water and the filter was working. For the analysis, water was purified through a small scale preparative C18 reversed phase silica column. The column was rinsed with a methanol/water solution followed by elution with pure methanol. The analysis of LAS in the eluate was by HPLC with UV(224 nm) detection of the benzene chromophore group. The various LAS homologs were separated by a water acetonitrile/sodium perchlorate system, and the concentration of LAS quantified by the use of a commercial standard. Three experiments have been performed by using natural sea water at 17‰S, dosed with LAS. The aquaria were equipped with powerful biological filters made up by a layer of shell fragments through which water flowed, by means of an aerator set under the layer.

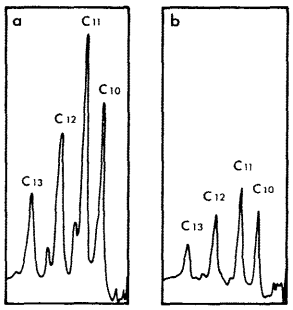

Fig.1. Chromatograms of a nominal 3mg/l LAS sea water solution, taken from 18 l aquaria, equipped with biological filters and each containing 5 crabs. a) first day; b) third day.

(Nominal)	Concentration (mg/l) Actual 1st day	Actual 3rd day
(3.00)	2.29	0.99
(6.00)	n.d.	2.48
(9.00)	n.d.	4.04

Table 1. Values of concentrations of LAS calculated on the basis of chromatograms reported on the left.

Time (days)	Nominal conc. mg/l	% Composition of LAS C_{10}	C_{11}	C_{12}	C_{13}
1st	3.00	28.6	37.2	21.4	12.8
3rd	3.00	28.6	34.9	23.8	12.7
3rd	6.00	29.0	35.4	21.7	14.0
3rd	9.00	31.6	36.3	21.5	10.5
-	pure LAS	20.1	32.0	26.0	21.9

Table 2. Percentage composition of LAS in sea water solution (in the above described conditions), in comparison with the percentage composition of pure LAS, dissolved in distilled water.

Groups of five crabs, randomly chosen from an acclimation aquarium, were transferred into as many as 18 l aquaria. In the first experiment an amount of 6 mg/l LAS was added only at the start; in the second and third experiment, the quantities of 3 mg/l, 6 mg/l and 9 mg/l were initially added; then, every second day, half of the initial quantity was added to the water, on the basis of the results reported in table 1. In such a way the actual concentration of LAS fluctuated, with a period of two days, between the nominal concentration and half of it. In fig. 2 it is reported only the second experiment, because it is the most significant. The other two experiments confirm this trend. The abscissa represents the level of water osmolality, during the experiment (that is 0.5 Osm/kg) and reports LAS concentrations. In the ordinate it is reported the average elevation - on medium osmolality - of serum osmolality (± s.e.), which represents the osmoregulation capability, of the groups of experimental crabs. In all three experiments the elevation of serum osmolality in crabs, kept for one week in LAS treatment, is higher than in controls. This unexpected result could be explained assuming that these organisms react to this pollutant either by activation of Na pump, or by production of low molecular products, such as amino acids, sugars, and organic acids, all contributing to the osmotic pressure. In both cases we plan to make investigations in the next future.

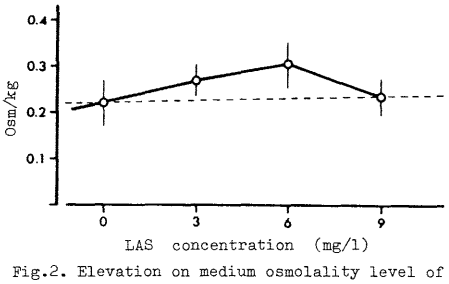

Fig.2. Elevation on medium osmolality level of serum osmolality of groups of five crabs, kept for one week in LAS solution. Bars are s.e.

L

Heavy metal concentrations in different tissues of some marine organisms from the Mediterranean (Castellon, Spain)

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Samples of *Sardina pilchardus, Mullus barbatus, Mullus surmuletus, Mytilus galloprovincialis, Carcinus mediterraneus and Thunnus thynnus* were collected in three points of the Castellón coast (Vinaroz, Castellón, Burriana) during the months of April, July & October, 1986, and July & October,1987. These were analysed for total Hg, Cd, Pb and Cr.

Samples identification and preparation were carried out according to the method recommended by the FAO Fisheries Technical Paper nº 158 (Bernhard,1978).

Different tissues were analysed in order to know the degree of accumulation of heavy metals: the whole body for *M. galloprovincialis* and *C. mediterraneus*; and muscle, digestive, liver, gills, kidney and gonads for *S. pilchardus, M. barbatus, M. surmuletus* and *T. thynnus*.

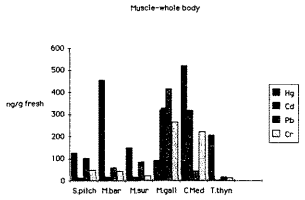
The high number samples makes the digestion procedure in teflon reactors under pressure very tedious. However, the use of open flasks allows one to work comfortably with a large number of samples. For this reason, a digestion procedure with HNO_3 conc. in erlenmeyer flasks covered with a glass was applied. This procedure was as follows: 0.05-0.9 g of lyophilised tissue were introduced into a 100-ml erlenmeyer flask and 10-ml HNO_3 conc. (65%) were added. Samples were digested on a hot plate at a temperature of 70-80 ºC during approximately 24 h. After cooling solutions were quantitatively transferred to a 25-ml beaker and diluted with water to the mark.

Due to the risk of losses of metals by applying this procedure of digestion (specially for Hg and Cd), we have carefully obtained the recoveries for five replicates of two standards of Hg, Cd, Pb and Cr, and also the accuracy of the procedure (ten replicates) using a sample of *M. galloprovincialis* for intercalibration (IAEA, MA-M-2/TM). The results indicated in the Table show that no losses of metals occurred during the digestion of samples.

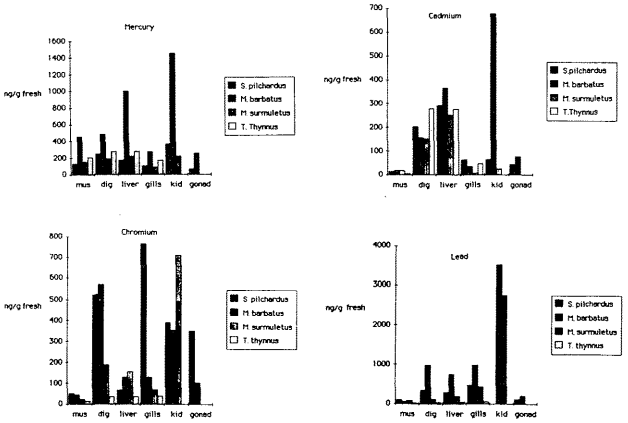
Analyses of total Hg were carried by the Cold Vapour Tehnique AAS; Cd and Cr were determined by graphite furnace AAS with deuterium background and by standard adittions method; Pb was analysed by graphite furnace in the presence of 0.5% $(NH_4)_2HPO_4$ as matrix modifier.

	Hg		Cd		Pb		Cr	
standard (µg/ml)	0.2	0.5	0.1	0.2	1.0	2.0	0.5	1.0
recovery (%)	108	108	107	103	102	104	115	103
std. deviation (%)	20	14	7.2	4.5	6.2	3.7	13	4.1
Accuracy	1.00 ± 0.13		1.83 ± 0.24		1.68 ± 0.26		1.36 ± 0.35	
Reference Values (µg/g dry weight)	0.93 ± 0.16 0.95(0.85-1.06)		1.50 ± 0.12 1.32(1.16-1.54)		1.79 ± 0.54 1.92(1.53-2.5)		1.64 ± 0.36 1.25(0.95-1.62)	

In the figure are shown the mean concentrations of each metal found in muscle (*S. pilchardus, M. barbatus, M. surmuletus, T. Tynnus*) and in whole body (*M.galloprovincialis, C.mediterraneus*). As can be seen, moluscs and crustaceans are generally the most contaminated organisms, whereas fishes present a minor metallic content, except for Hg (especially in *M. barbatus* and *T. Thynnus*)



In next figures the degree of accumulation of each metal in different tissues is shown.
A one-way analysis of variance (ANOVA) indicate significative differences of metal levels in the different tissues analysed. The order of accumulation for Hg and Cd were as follows: muscle < digestive < liver < kidney; the content of these two metals in gills and gonads is not high, and similar to that of muscle. A different order is observed for Cr, the order being: muscle < liver < digestive < kidney, with high levels in gills and gonads in *S. pilchardus*. For Pb, similar concentrations are found in digestive, liver and gills, and lower that those found in kidney; gills and kidney seem to be the tissues where a major accumulation of Pb is produced. For all the organisms analysed, the muscle is the tissue which clearly presents a minor content of heavy metals



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Study of toxicity and bioaccumulation of Mercury, Cadmium, Chromium and Lead in the Crayfish Procambarus clarkii

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In the present study, adult intermolt speciments of the crayfish *Procambarus clarkii* were collected in Lake Albufera (Valencia, Spain) and taken immediately to the laboratory where they were maintained in 300-l aquaria and for 15 days, at 20ºC with a daily diet of pork liver.

Groups of 10 crayfish were kept in tap water at several metal concentrations, each group in a 15-l experimental aquarium. Ten more crayfish used as a control were kept in 15-l tap water, without adding any metal. Only crayfish weighing between 15 and 20 g were used. The degree of toxicity of Hg, Cd and Cr on crayfish at various temperatures has been studied. All tests have been conducted under static conditions. The LC50 96 h values were calculated using the method of Litchfiel and Wilcoxon (1949). The results show the Hg is the most toxic of metals tested, while Cr presented very low toxicity (0.5 g Cr(VI)/l caused the death of only 40% of the population)

It has been proved that the toxic effects of Hg and Cd increased with increasing temperature. The effect of temperature on the Hg toxicity was more marked than in the cadmium toxicity. The responses of crayfish to Hg and Cd was further investigated with respect to different exposure times. In general, the increase in percent mortality was related to both time and metal concentration, with the highest mortality occurring after 48 h of metal exposure. However, in the case of Hg, the highest mortality occurred between 24 and 72 h for 24 ºC, and between 24 and 48 h for 28ºC.

Table 1 shows the 96-h LC50 values (mg/l) and the 95% confidence limits for Hg and Cd at 20, 24 and 28ºC with *Procambarus clarkii* Each 96-h LC50 value represents the mean of three replicates.

In conclusion, the *Procambarus clarkii* from Albufera Lake present a high resistence to heavy metals pollution. The importance of metallothioneins in the detoxification events of heavy metals is already known. These kinds of mechanisms are probably related to the resistence and accumulation ability of heavy metals in this crayfish.

Temperature (ºC)	mercury	cadmium
20	0.79 (0.58 - 1.08)	58.5 (41.8 - 81.9)
24	0.35 (0.21 - 0.56)	34.8 (28.1 - 43.2)
28	0.14 (0.08 - 0.23)	18.4 (10.7 - 31.6)

For experiments on metal accumulation, crayfishes from Albufera Lake were divided in groups of 10 animals each. These were kept in 15-l experimental aquaria containing increasing concentrations of Hg, Cd, Cr, and Pb. Ten more crayfish served as control and were kept in 15-l of clear water. After 96 h of metal exposure at 20ºC, the animals were transferred to clean water, free of any contamination, and kept there for an additional 5 h. Gills, midgut gland, antennal glands and muscle of each crayfish were disected, lyophilised and homogenised. Sample digestion was carried out with HNO_3. The content of heavy metal on each tissue was determined by flameless AAS, by using the standard additions method for Cr and Cd, or in the presence of $(NH_4)_2HPO_4$ as matrix modifier for Pb. Analyses of Hg were carried out by AAS Could Vapour Technique, by using NaBH4 as reductor agent and argon as purging gas.

Next tables show the metal levels (µg/g dry weight) in some tissues of the crayfish after 96 h of metal exposure at several concentrations:

µgHg(II)/l	gills	midgut gland	ant glands	muscle	TOTAL
0	0.93 ± 0.51	0.08 ± 0.06	----	0.02 ± 0.01	1,03
50	69.8 ± 24.1	1.09 ± 0.61	40.1 ± 9.2	1.29 ± 0.10	112
100	83.7 ± 18.8	2.60 ± 1.40	122 ± 153	0.80 ± 0.08	209
250	249 ± 66	13.6 ± 5.8	697 ± 194	3.59 ± 0.52	963
µg Cd(II)/l					
0	1.24 ± 0.40	0.50 ± 0.13	3.08 ± 0.82	0.02 ± 0.01	4,84
3.2	1.58 ± 0.42	0.41 ± 0.15	2.75 ± 2.19	0.03 ± 0.01	4,77
10	3.98 ± 1.00	0.49 ± 0.21	1.33 ± 0.51	0.10 ± 0.04	5,90
32	12.8 ± 5.2	0.72 ± 0.46	1.94 ± 0.95	0.60 ± 0.28	16,1
100	37.3 ± 10.5	2.41 ± 1.74	5.17 ± 3.87	0.98 ± 0.43	45,9
mg Cr(VI)/l					
0	13.1 ± 1.6	1.00 ± 0.40	38.2 ± 5.0	0.41 ± 0.22	52,7
10	67.2 ± 17.0	20.3 ± 3.5	37.5 ± 9.2	1.80 ± 0.41	127
37	89.4 ± 13.3	55.9 ± 25.0	147 ± 42	3.93 ± 1.20	296
136	230 ± 69	189 ± 99	286 ± 88	7.32 ± 1.51	712
500	541 ± 125	462 ± 102	1170 ± 202	32.1 ± 3.4	2250
mg Pb(II)/l	(*)	(*)	(*)	(*)	(*)
0	0.22 ± 0.11	0.007 ± 0.003	0.11 ± 0.04	0.02 ± 0.01	0,36
10	3.11 ± 1.96	0.24 ± 0.13	3.25 ± 1.42	0.03 ± 0.02	6,63
50	30.4 ± 21.3	0.38 ± 0.35	2.97 ± 2.66	0.11 ± 0.08	33,9
100	35.2 ± 16.5	0.52 ± 0.50	3.54 ± 3.43	0.24 ± 0.23	39,5

(*) Concentrations expressed in mg/g dry weight

It can be concluded that: 1)After sublethal heavy metal exposure, *Procambarus clarkii* accumulate important amounts of Hg, Cd, Cr and Pb. 2)The heavy metal distribution among several tissues of the crayfish is function of the heavy metal concentration used. Commonly, the gills and antennal glands present a high content, whereas the muscle is the organ which accumulates lowest amounts of metals. 3)This crayfish presents both high resistence and high capacity for heavy metal accumulation. Since these animals are consumed directly by man a potential human health hazard exists.

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L-VIII3

Heavy metals levels in marine organisms from the Mediterranean Sea (Spanish Coast)

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Within the framework of MED POL from 1984 to 1987 we carried out a systematic monitoring of heavy metals in marine organisms. Samples of organisms (Mullus barbatus, MB, Mytilus galloprovincialis, MG, and Aristeus antennatus, AA) collected from 13 western Mediterranean sites (Alicante, Guardamar, Cartagena, Mazarrón, Aguilas, Villaricos, Carboneras, Garrucha, Almería, Portman, Algeciras, Málaga and Palma de Mallorca), were analysed for heavy metals (Hg, Cd, Pb and Se).

Mytilus galloprovincialis was collected by us; the rest of organisms were collected through commercial fisheries. All the samples were deep frozen until used. Every three months samples of organisms were collected. Soft tissues were lyophilized and digested following Bernard (1976).

Analysis of samples and blanks were carried out in a graphyte furnace AAS (Perkin Elmer 603/76B) and background correction for Cd and Pb. Hg and Se were determined by hydride generation AAS (Perkin Elmer 2380).

Heavy metals average concentrations for each organism are shown on Table I.

The general heavy metal levels tendency in the different species is: Hg: AA > MB > MG; Pb: MG > MB > AA; Cd: MG > AA > MB; Se: MG > AA > MB.

Organisms from Portman and Cartagena are exposed to the influence of industrial effluents; in Portman, the discarge from the exploitation of a lead-zinc mine has heavyly polluted the sediment, seawater and organisms (R. de León et al., 1984a; R. de León et al., 1984b).

The maximum values observed were: 1.23 ppm for Hg in AA from Palma de Mallorca; MG did not accumulate Hg (0.01 - 0.13 ppm). 125 ppm in MG collected from Portman and 26.68 ppm in MG from Cartagena were determined for Pb. 1.5 ppm for Cd were observed in MG collected from Almería, and 1.45 ppm for the same metal in MG collected from Portman. The maximum level concentration for Se was observed in MG from Portman.

No significant seasonal variation in the levels of heavy metals in the organisms was observed nor correlation between body burden of heavy metals and length or weight of organisms.

Table I.- Concentrations of heavy metals in organisms (µg/kg F.W.)

METAL	SPECIES	n	Mean	Maximum (Sampling site)
Hg	MB	1187	94.73	1110 (Palma Mallorca)
	MG	2508	41.43	130 (Algeciras)
	AA	1019	354.12	1230 (Palma Mallorca)
Pb	MB	1187	227.73	19000 (Cartagena)
	MG	2508	12357.14	125000 (Portman) 26680 (Cartagena)
	AA	1019	67.50	760 (Aguilas)
Cd	MB	1187	9.45	1000 (Aguilas)
	MG	2508	265.43	1500 (Almería) 1450 (Portman)
	AA	1019	45.12	390 (Garrucha)
Se	MB	1187	285.64	830 (Almería)
	MG	2508	584.29	2500 (Portman)
	AA	1019	466.25	1050 (Garrucha)

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L-VIII4

Comparaison des concentrations métalliques (Cd, Cu, Fe, Mn, Zn) de Venus verrucosa provenant de l'Atlantique et de la Méditerranée

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Les concentrations en métaux traces (Cd, Cu, Fe, Mn et Zn) ont été recherchées dans les Praires Venus verrucosa prélevées en Atlantique Nord-Est (20°15'N-17°10'W), le long de la côte mauritanienne (en février 1987) et en Méditerranée Nord-Occidentale à Port-Vendres sur la côte française du Roussillon (en juin 1987). Ces Praires sont très abondantes en Mauritanie. Pour l'analyse par absorption atomique, les parties molles des animaux sont séparées de la coquille et certains échantillons sont disséqués de façon à isoler les branchies de la masse viscérale et du reste (manteau, muscles et gonades).

Les tableaux 1 et 2 donnent les concentrations en métaux exprimées en µg g^{-1} (poids sec) dans les Praires in toto et disséquées.

Tableau 1 : Cd, Cu, Fe, Mn et Zn dans V. verrucosa in toto

Métal (µg g^{-1} sec)	Cd	Cu	Fe	Mn	Zn
Atlantique (n = 10)	2.2. ± 0.9	4.1 ± 0.8	245 ± 63	6.4 ± 1.8	58 ± 8
Méditerranée (n = 8)	0.4 ± 0.1	6.9 ± 1.7	263 ± 45	4.5 ± 1.4	65 ± 20

Le tableau 1 montre que les Praires de l'Atlantique présentent des concentrations plus élevées en Cd et moins en Cu que celles de la Méditerranée. Medina et al. (1986) trouvent aussi des valeurs faibles en Cd pour une espèce proche : Venus gallina prélevée en Méditerranée.

Tableau 2 : Cd, Cu, Fe, Mn et Zn dans les organes de V. verrucosa

Atlantique		Cd	Cu	Fe	Mn	Zn
Branchies	(n = 8)	7.5 ± 1.1	6.0 ± 2.0	918 ± 238	9.7 ± 1.3	278 ± 45
Masse visc.	(n = 8)	1.4 ± 0.5	4.4 ± 0.4	214 ± 62	4.4 ± 0.9	54 ± 12
"Reste"	(n = 8)	1.8 ± 1.0	1.8 ± 0.2	235 ± 82	2.8 ± 0.5	76 ± 14
Méditerranée						
Branchies	(n = 5)	3.4 ± 0.6.	9.0 ± 2.0	724 ± 200	7.1 ± 1.1	81 ± 12
Masse visc.	(n = 5)	0.2 ± 0.03	8.0 ± 2.0	249 ± 25	6.2 ± 2.1	57 ± 1
"Reste"	(n = 5)	0.9 ± 0.3	7.0 ± 1.0	227 ± 42	6.2 ± 2.1	93 ± 34

Le tableau 2 montre que les branchies concentrent particulièrement les métaux par rapport aux autres organes. Cependant, étant donné leur faible poids env. 2 % du poids de l'animal, elles contribuent peu à la concentration globale. Les concentrations en métaux dans les branchies - organe en contact avec le milieu extérieur - peuvent refléter celles en métaux dissous ou particulaires dans l'eau de mer au moment de la prise de l'échantillon. Sauf pour Cu, les concentrations en métaux dans les branchies sont plus fortes pour les Praires de l'Atlantique que pour celles de la Méditerranée. Les masses viscérales (env. 52 % du poids de l'animal) sont des organes d'accumulation des réserves nutritives et reflètent le proche passé de l'animal. Les masses viscérales des praires de l'Atlantique et de la Méditerranée présentent des concentrations pratiquement identiques en Fe, Mn et Zn par contre ces concentrations sont plus fortes en Cd et plus faibles en Cu dans les Praires de l'Atlantique. Les concentrations dans les masses viscérales pourraient traduire les concentrations en métaux du milieu où ont vécu les Praires.

En conclusion, les Praires, qui sont des mollusques filtreurs, peuvent servir là où elles prédominent sur l'espèce Mytilus utilisée dans les programmes de "Mussel Watch" (Golberg 1986), d'espèces bioindicatrices de la qualité du milieu marin du point de vue des métaux traces.

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Mediterranean juvenile Bluefin Tuna : life patterns and Mercury body burden

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Mercury concentrations in Bluefin tuna caught in the Mediterranean sea are significantly higher than in Bluefin tunas caught in the Atlantic Ocean (Cumont et al. 1972). As yet the available information from the Mediterranean and neighbouring seas does not give a plausible explanation of the higher mercury levels reported in the Mediterranean tuna. Renzoni et al (1978) hypothesized the existence of two bluefin tuna populations in the Mediterranean Sea, one resident with higher mercury body burden and other migrating to the Mediterranean to spawn. The purpose of the present study is to gather information to facilitate identification of both tuna stocks using the morphological and chemical characteristics of their otoliths as an indicator of their physiological and habitat characteristics.

Table 1. Body meristics and pollutant levels of the bluefin tuna sampled along the Catalan coast.

fish length (cm)	fish weight (g)	Hg (µg)	date
53	3410	1040	18- 7-1986
53	3350	1590	18- 7-1986
39	1250	870	14-10-1986
39	1300	585	14-10-1986
39	1100	415	24-10-1986
40	1280	545	5-11-1986
41	1200	595	5-11-1986

Juvenile Bluefin tuna ranging 34-53 cm total length were collected along the Catalan Coast from July to October 1986 (Table 1). The sagittae from 4 specimens were documented for morphometric shape, and then observed under scanning electron microscope and analyzed with electron microprobe. This method provides accurate data at the microscopic scale. The samples and standards were analyzed by a CAMBAX X-ray electron microprobe with the electron beam focused on a five square micron area. Analyses of strontium and calcium concentrations were executed at five micron intervals across the longest axis of the otolith and the ratios calculated for each area analyzed. Apatite and strontium fluoride were used as standards. The mercury levels in the muscle samples were determined with standard procedures.

Inspection of juvenile sagittae at the SEM reveal clearly defined daily increments which disclose size differences of individual increments, ranging from 1.5 to 2 µm.

From the Bluefin tuna otolith microstructural observations it seems that fishes sampled in July 1986 were born in 1985 since they were around 14 months old at the time of fishing, while fishes sampled in fall were only around 6 months old.

The concentration ratios of Sr and Ca across a section of the otolith increase with distance from the core (Fig.1). The Sr/Ca ratio increases in the otolith edge of all the analyzed samples independently of the time of capture and consequently, of the water temperature cycles.

The Sr/Ca profiles show two types of variation of a short and a longer period. The periodicity of the longer trends appears to be seasonal. Thus, the changes in the Sr/Ca ratios in Bluefin tuna otoliths may be caused by changes in water temperature. Nevertheless, there is no agreement between the profiles of fishes caught in the same year period. This may be due to the high thermal regulatory capability of Bluefin tuna (Carey and Teal 1969), also capable of mantaining a body temperature well above the water temperature (Radtke et al. 1987).

Fig.1. Sr/Ca profile for a Bluefin tuna caugth in July, otolith core left, otolith edge right.

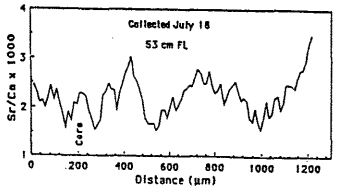
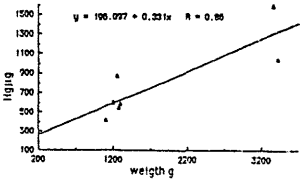


Fig.2. Mercury content vs. body weigth



The mercury level determined in the samples is shown in Table 1. The correlation coefficients between mercury level and body length or weight are high and significant (Fig.2), showing the dependence of mercury level on fish size. Pending further studies including adult fishes to compare the fish sampled off Catalonia with Bluefin from different Mediterranean areas, it seems that the studied fishes may correspond to the low mercury level population proposed by Renzoni et al (1979).

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Etude de la contamination mercurielle de la Phanérogame marine Posidonia oceanica (L.) Delile dans la zone d'épandage des eaux usées de l'émissaire de Giens (Var, Méditerranée, France)

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ABSTRACT :

The analysis of 33 samples of leaves of surviving Posidonia oceanica bed in the sewage area of the urban emissary of the gulf of Giens (Var) has shown low rates of mercury ranging from 0,03 to 0,14 ppm. The modalities of territorial distribution of rates from the emissary mouth has been studied as vell as its spacial variability at micro-local level.

INTRODUCTION :

Connaissant les effets néfastes du mercure sur les posidonies (CRISTIANI et al. 1980), nous avons entrepris, depuis plusieurs années, des recherches sur la contamination mercurielle de cette plante utilisée comme indicateur biologico-biochimique (Cf. AUGIER 1985 et 1987, AUGIER et al. 1984). Les fonds placés sous l'influence de l'émissaire de Giens (1400 m de long, 15 m de profondeur), et occupés par un herbier de posidonies plus ou moins dégradé, recoivent des eaux traitées de niveau E. Le branchement de plusieurs hopitaux sur le réseau a motivé notre choix.

METHODE :

Les posidonies sont récoltées dans 11 stations disposées sur 3 radiales partant de l'orifice de l'émissaire (Fig. 1) ; chaque station est subdivisée en 3 sous-stations (Fig. 2) où 15 faisceaux foliaires sont récoltés. Seules les feuilles intermédiaires sont retenues, puis lyophilisées et minéralisées selon la méthode de MALAIYANDI et BARETTE (1970). Le mercure est dosé par spectrophotométrie d'absorption atomique sans flamme (CUMONT et al. 1974).

RESULTAT ET DISCUSSION :

La contamination mercurielle des posidonies de Giens est plus élevée que celle de la zone de référence du Parc National de Port-Cros, mais plus faible que celle de plusieurs secteurs de notre littoral (AUGIER et al. 1984) ; au plan général, elle peut être considérée comme relativement faible puisque les taux de mercure s'échelonnent de 0,03 à 0,14 ppm (Tableau I). Celà signifie soit que les eaux brutes sont peu chargées en mercure, soit que les traitements de la station d'épuration sont efficaces pour l'élimination de ce métal.

Au plan toxicologique les taux de mercure sont bien en dessous des seuils critiques induisant chez les feuilles des désordres physiologiques graves (CRISTIANI et al. 1980) ; ce qui n'exclue pas cependant des effets synergiques avec d'autres polluants (métaux, détergents, etc...), qui restent à démontrer.

Les valeurs obtenues pour les 3 échantillons d'une même station sont cohérentes. Dans les investigations de routine, on pourra par conséquent se contenter de réaliser un seul prélèvement de feuilles par station, à condition que le nombre de faisceaux foliaires soit au moins égal à 15.

On peut observer une différence territoriale de contamination des posidonies : les taux les plus élevés ne sont pas trouvés au voisinage du rejet, mais à une distance de l'ordre de 280 m et la pollution marque un léger fléchissement vers le Sud.

Les données cohérentes obtenues en fonction de l'échantillonnage, confirme ainsi l'intérêt d'utiliser Posidonia oceanica comme indicateur biologique de la pollution mercurielle.

St.	D (m)	P (m)	MLF (cm) SSt.	MLF (cm) St.	TAUX (ppm) SSt.	TAUX (ppm) St.
A1	0	-15	27	26	0,09	0,07
A2			23		0,07	
A3			29		0,06	
B1	140	-16	27	33	0,09	0,08
B2			37		0,08	
B3			35		0,08	
C1	280	-17	25	28	0,12	0,11
C2			26		0,12	
C3			33		0,10	
D1	420	-19	23	22	0,10	0,07
D2			18		0,07	
D3			25		0,04	
E1	560	-21	15	20	0,05	0,04
E2			18		0,04	
E3			28		0,03	
F1	140	-15	29	29	0,09	0,08
F2			31		0,08	
F3			27		0,08	
G1	280	-16	30	29	0,10	0,10
G2			31		0,11	
G3			27		0,09	
H1	420	-17	26	22	0,06	0,06
H2			19		0,07	
H3			22		0,05	
I1	140	-15,5	28	28	0,09	0,09
I2			30		0,10	
I3			26		0,08	
J1	280	-16,5	32	30	0,12	0,13
J2			28		0,14	
J3			29		0,13	
K1	420	-17,5	22	20	0,10	0,10
K2			19		0,11	
K3			18		0,09	

Tableau I : Taux de mercure total dans les lyophilisats des feuilles intermédiaires de Posidonia oceanica récoltées à différentes profondeurs (P), à des distances différentes du débouché de l'émissaire de Giens (D) (MLF = Moyenne Longueur Feuilles, SSt. = Sous-Stations, St. = Stations).

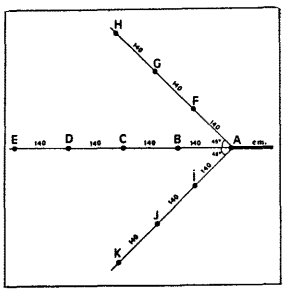

Fig. 1 : Emplacement des stations (distances en m.)

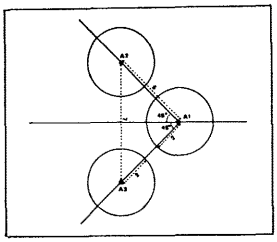

Fig. 2 : Localisation des sous-stations (distances en m.)

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L-VIII7

Etude in vitro de l'influence d'une peinture anti-fouling à base de Cuivre sur la Phanérogame marine Posidonia oceanica (L.) Delile

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ABSTRACT.

Artificial contamination of Posidonia oceanica Delile were carried out in a climatic aquatic cultural chamber with various quantities of anti-fouling paints of a new production, with copper. The results show that the sampling progressively concentrate the biocids of painting released by lixiviation into water of breeding boxes. The contaminated leaves show some phenomenons of growth as well as pigmentation disturbances of leaves, the severity of which grow with time and the rate applied which may result in death of the plant. The physiological disturbances affect not only the phenomenons of cellular elongation and partition, but also the inductive mechanisms of the birth of the new tissues of the leaves from the lower meristem. The consequences of these phenomenons on Posidonia bed are then examined.

INTRODUCTION.

L'herbier à Posidonia oceanica constitue l'écosystème le plus fondamental du littoral méditerranéen au quadruple point de vue biologique, écologique, géologique et économique (Cf. AUGIER 1985). Malheureusement les herbiers sont en régression depuis de nombreuses années et les causes de ce phénomène semblent en grande partie liées à la pollution croissante de la mer. Aprés avoir examiné la part de responsabilité revenant au mercure, aux tensio-actifs et aux borates (CRISTIANI et al. 1980, AUGIER et al. 1984,1987), nous avons étendu notre investigation aux peintures anti-foulings de la nouvelle génération à base de cuivre.

METHODE.

La peinture "International leader", de grande diffusion, a été utilisée. Elle contient 340 g/Kg de cuivre, 104 g de TiO_2, 1,7 g de CN, 175 ppm de Cd, 170 ppm de Pb et 0,03 ppm de Hg pour un liant de 156 g, des solvants de 233 g, avec 61,10 % de pigments totaux (poids frais). Pour simuler ce qui se passe en mer à proximité des coques de bateau, des plaques de PVC enduites d'une quantité connue de peinture (tabl. I) ont été suspendues dans les bacs de culture.

AQUARIUMS	1	2	3	4
Surface des plaques (cm^2)	40	200	600	2000
Quantité de peinture en g. de matiére sèche	0,73	4,58	19,94	60,84
Quantité de cuivre sur chaque plaque en g.	0,32	2,03	8,83	26,95

Tableau I : Caractéristiques des plaques de contamination et gamme des concentrations en cuivre.

Les expériences ont été réalisées dans une pièce climatique régulée par un climatiseur reproduisant les thermo.(17/15°C) et photopériodismes (8/16 E) nécessaires. Les plants de posidonies isolés et stabulés sont plantés dans le sédiment au fond des bacs (4 par bac). Cinq bacs en verre sont utilisés : 1'un pour les témoins, les autres pour l'expérience d'intoxication, avec des taux croissants en cuivre.

La mesure de la croissance des feuilles est effectuée par marquage au poinçon au dessus de la ligule, au début, puis à la fin de l'expérience (66 jours). Le cuivre est dosé dans les feuilles par spectrophotométrie d'absorption atomique, aprés minéralisation (MALAIYANDI et BARETTE 1970, CUMMONT et al. 1974).

RESULTATS - DISCUSSION.

Les croissances obtenues en milieu naturel sur des plants marqués et dans les bacs témoins sont comparables.

Dans les bacs contaminés, les plants montrent une inhibition progressive de la croissance des feuilles avec la concentration croissante en produits toxiques dans l'eau (tabl. II). Les perturbations de croissance se portent non seulement sur les phénomènes de l'élongation et de la division cellulaires, mais également sur les mécanismes inducteurs de la génèse des nouveaux tissus foliaires dans le méristème basal. On note, en effet, une inhibition progressive de la formation des feuilles juvéniles qui est totale dans le bac 4 le plus contaminé. On note aussi une modification pigmentaire des tissus foliaires par l'apparition de taches sombres dont le nombre et la surface sont proportionnels à la concentration en produits toxiques. L'analyse des plants en fin d'expérience montre enfin que le facteur de concentration du cuivre, déjà important pour les rhizomes et les écailles (58 et 557) est particulièrement élevé pour les feuilles, avec un maximum de 3 200 pour celles qui sont en pleine croissance.

D'autres études devront corroborer ces premiers résultats avant d'extrapoler au milieu naturel les données expérimentales obtenues en laboratoire. On peut cependant dire, dès à présent, que les peintures à base de cuivre constituent une menace potentielle dont il faudra tenir compte dans les mesures de sauvegarde des herbiers de posidonies.

Témoin	NF	CT	CM/F
FA	12/2*	39,9	3,32
FI	5	39,0	7,80
FJ	8	106,6	13,3
Total	25	185,5	

Bac 1	NF	CT	CM/F
FA	13/5*	30,4	2,33
FI	7	38,3	5,47
FJ	5	27,4	5,48
Total	25	96,1	

Bac 2	NF	CT	CM/F
FA	13/6*	27,7	2,13
FI	6	24,1	4,01
FJ	2	11,0	5,50
Total	21	62,8	

Bac 3	NF	CT	CM/F
FA	13/6*	27,3	2,10
FI	5	17,8	3,56
FJ	3	8,2	2,73
Total	21	53,3	

Bac 4	NF	CT	CM/F
FA	14/5*	29,5	2,10
FI	5	12,7	2,54
FJ	0	0	0
Total	19	42,2	

TABLEAU II : Synthèse des résultats de la mesure de la croissance des feuilles de Posidonia oceanica (en cm) en culture, en fin d'expérience (66 jours). (Bacs 1, 2, 3, 4 = Bacs contaminés par la peinture anti-fouling, FA, FI et FJ = Feuilles Adultes, Intermédiaires, Juvéniles, NF = Nombre de Feuilles, CT = Croissance Totale des feuilles des 4 faisceaux, CM/F = Croissance Moyenne par Feuille en tenant compte des feuilles adultes qui n'ont pas poussé, 2* = 2 feuilles adultes qui n'ont pas poussé).

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L-VIII8

Variation et teneurs des métaux lourds chez certaines Algues sur la côte Egéenne Turque

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Résumé:

Dans ces travaux nous avons dosé les teneurs en métaux lourds chez U.lactuca, U.rigida, Enteremorpha linza, Codium bursa, C.dichotomum, Halimeda tuna, Padina pavonia, Dichyhotoma dichotoma, Zostera marina et Posidonia oceanica récoltées dans les différents secteurs du littoral turc.

D'après les résultats, les teneurs ne sont pas excessives sauf à Karaburun (baie extérieure d'Izmir) où nous avons trouvé chez certaines espéces des teneurs en Hg variant de 0.17 à 11.80 µg/g P.H.

Introduction:

Aprés avoir étudié la distribution des métaux dans la zone littorale, sur les organismes, nous présentons quelques résultats sur les teneurs chez les algues dans 17 stations(1,2,3).

Materiel et Methode:

Les algues ont été récoltées par dragage et plongée autonome sur une periode de trois ans(1982 à 1985).

La détermination de la teneur en métaux a été fait par l'AAS avec flamme et le mercure sans flamme à l'aide du kit Modèle 64 As/Se/Hg (4).

Resultats and Discussion:

Dans le tableau I les teneurs chez les espèces varient de l'une à l'autre, l'accumulation en Fe est maximale et minimale en Hg (en dehors des espèces provenent de Karaburun).

Les prélèvements de U.lactuca pendant l'année 1985 sur la côte Egeenne montrent une valeur minimale à Çanakkale en Hg(0.03 µg/g P.H) puis à Bodrum en Cd(0.1 µg/g P.H).

D'après les résultats il a été trouvé une progression parmi les teneurs:

$$Fe > Zn > Pb > Cu > Cd > Hg$$

et une valeur moyenne en Zn 72 µg/gP.S et en Fe(0.99 µg/g P.S) chez U.lactuca. Ces résultats coincident avec ceux de Ozsöz,Erdin(1983) et GÜner et coll.,(1987) pour U.rigida prélevé dans le Golfe intérieur. Chez Z.marina il y a une tendance à l'accumulation en Fe(7).

Si les résulttats de ces recherches sur la côte turque chez les espèces étudiées, sont tolérables, il n'est pas de même avec le cas de Karaburun qui est situé dans la baie extérieure d'Izmir. En effet chez P.pavonia, D.dichotoma, E.linza, C.dichotomum, P.oceanica et Z.marina l'accumulation de Hg varie de 11.80 a 0.17 µg/g P.H.

Tableau I. Concentrations des métaux chez certaines algues sur la côte Egeenne Turque.
* Conc. au-dessous du seuil de détermination.

	Fe	Zn	Cu	Pb	Cd	Hg
U.lactuca G.Inter.	79.0	77.0	0.60	0.50	0.04	*
E.linza G.Inter.	124.0	12.50	4.50	5.80	0.09	*
U.lactuca Narlıdere	136.0	8.30	2.00	1.20	0.05	*
E.linza Narlıdere	56.0	11.40	1.25	1.80	0.10	0.02
U.lactuca Urla	63.0	14.30	1.40	1.00	0.24	0.005
H.tuna Urla	193.0	9.20	1.60	7.40	0.50	*
U.rigida Foça	24.0	9.60	0.60	0.45	1.00	*
E.linza Karaburun	90.0	6.00	0.50	0.90	0.05	1.38
C.dichot. Karaburun	90.6	3.50	0.35	0.75	0.08	0.82
C.bursa Çeşme	82.6	1.10	0.60	1.00	0.09	0.004
H.tuna Çeşme	66.5	6.00	2.15	7.70	0.60	*
E.linza Gümüldür	2.8	5.00	0.20	1.15	1.00	*
C.bursa Gümüldür	16.0	1.10	0.30	1.20	0.06	*
P.pavonia Urla	295.0	22.40	0.75	3.20	0.13	*
D.dichotoma Urla	178.0	70.00	3.65	16.30	2.50	*
P.pavonia Karaburun	280.0	7.50	1.00	1.65	0.20	11.80
D.dichotoma Karaburun	165.0	18.00	0.70	0.60	0.08	1.40
P.pavonia Gümüldür	360.0	14.40	1.20	4.10	0.37	*
Z.marina Narlıdere	111.0	2.30	0.83	2.00	0.28	*
Z.marina Urla	125.0	8.10	1.00	3.20	0.30	*
P.oceanica Urla	54.0	18.00	2.40	3.00	0.85	0.03
Z.marina Karaburun	-	-	-	5.00	0.17	0.17
P.oceanica Karaburun	186.0	42.50	7.20	10.00	0.40	0.45

Il faudrait faire une étude plus complete pour établir l'accumulation du Hg chez les espéces précédentes et d'autres existant dans cette même localité.

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Mercury distribution in the Aegean coast of Turkey

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ABSTRACT

The surface sea water and sediment samples collected from Aegean Sea were analyzed for their total mercury content. In total four cruises have been carried out in the Aegean Sea during 1987 with the research vessel R/V BILIM which belongs to Middle East Technical University Institute of Marine Sciences. The overall avarage concentration is found to be 19±11 ng/l with a range of 4 to 57 ng/l. The possible land based sources were also searched and found that the rivers draining the extensively cultivated and mercury mining area of the Western Anatolia are primary source of the mercury input, *i.e.* mercury concentrations up to 73 ng/l were measured in the regions receiving river discharges.

Sediment samples collected from different locations of the Aegean Sea were analyzed for their total mercury content. Analysis results shows that the sea water quality is reflected in the underlying sediment. Biota analysed were *Mytilus galloprovincialis* and *Mullus barbatus* and the later one showed significantly higher mercury levels.

Sublethal effects of Zinc on the survival and the fertility of four successive generations of Tisbe Holothuriae

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In this study we determined the survival and fertility of succesive generations of the harpacticoid copepod Tisbe holothuriae, after exposure to three sublethal concentrations of zinc (0.07 0.01 and 0.007ppm Zn).

The experiments carried out in the laboratory, under a set of controlled conditions : temperature 18±0.5 C, 38‰ salinity and a photoperiod of 12h light, 12h darkness.

Statistical analysis of the results was performed by the paired t-test and the linear regression analysis.

Concentrations

Generations	0.07 ppm Zn	0.01 ppm Zn	0.007 ppm Zn	0.00 ppm Zn
	%	%	%	%
F1	7.61±2.71 → 79.20 N, 20.80 C	1.18±1.02 → 85.70 N, 14.30 C	1.75±0.89 → 72.90 N, 27.10 C	0.81±0.56 → 51.66 N, 48.34 C
F2		0.97±0.50 → 81.80 N, 18.20 C	0.84±0.63 → 67.50 N, 32.50 C	0.74±0.21 → 40.08 N, 59.92 C
F3		1.29±0.79 → 88.80 N, 11.20 C	1.51±0.70 → 52.17 N, 47.83 C	0.58±0.25 → 41.50 N, 58.50 C
F4		6.46±2.43 → 85.40 N, 14.60 C	1.04±0.45 → 64.28 N, 35.72 C	0.53± 0.24 → 49.95 N, 50.05 C

Table 1. Percentage mortality for each generation of **T.holothuriae** at different concentrations of zinc. Percentage contribution to mortality of nauplii (N) and copepodits (C).

For the 0.07ppm Zn, concentration equal to 1/10 of the LC50 (48h), population size is reduced to zero after the first generation , whereas population size of the fourth generation is not affected for a concentration of 0.007ppm Zn. The highest mortalities were noticed at a concentration of 0.07ppm Zn for the first generation and at a concentration of 0.01ppm Zn for the fourth, while nauplii proved to be more sensitive than copepodits (Tab. 1.)

Generation - Concentration	Egg-sacs 1	2	3	4	5	6	
F1 0.070	3.6+0.5	2.1+0.6	0.4+0.1				
F1 0.010	25.3+5.8	19.5+4.0	18.8+4.5	11.7+3.1	4.5+1.0	1.3+0.5	
F2 0.010	19.6+4.8	5.6+2.5	3.4+2.5	2.1+0.8	0.7+0.3		
F3 0,010	6.6+2.7	4.7+1.8	2.8+1.5	1.1+0.5			
F1 0.007	35.2+8.5	35.0+5.1	31.2+7.1	25.6+6.2	14.8+3.4	3.7+1.5	
F2 0.007	15.4+4.7	10.9+3.0	6.4+2.7	4.4+1.6	2.1+0.6	1.4+0.4	
F3 0.007	24.2+5.6	16.9+3.5	12.1+3.7	5.6+0.8			
F1 0.000	41.9+8.0	36.6+6.1	28.5+7.1	26.8+5.6	14.3+3.5	8.9+5.4	
F2 0.000	21.5+7.0	20.6+5.6	19.4+4.1	15.3+2.1	8.7+2.0	6.3+1.0	
F3 0.000	21.9+2.0	21.9+3.5	20.7+5.1	16.5+4.0	12.2+2.1	10.9+3.5	

Table 2. Percentage of the population producing egg-sacs for each generation at the different concentrations.

Increasing the metal concentration from 0.000 to 0.07ppm Zn the percentage of animals with egg-sacs were decreased.(Tab.2.)

At 0.07ppm Zn concentration, only the 0.38% of the population produced a third egg-sac whereas of the other concentrations, greater numbers of animals produce up to 5 egg-sacs.

Furthermore the percentage of the population producing egg-sacs decreases from generation to generation at the 0.01ppm Zn dose, something that is not observed for the 0.007ppm Zn dose and for the control dose (0.00ppm Zn.)

The results of this study show that zinc continues to be toxic not only at high concentrations (3), but also at certain sublethal concentrations and especially after prolonged exposure of the population to the pollutant.

The basic effect of heavy metals on marine animals probably involves the inhibition of different enzyme systems.(2).

Furthermore laboratory studies have demonstrated that larval stages of marine invertebrates are more sensitive to metals than the adults.(1).

Knowledge about the possibility of Tisbe to grow normally at different sublethal concentrations is very important, because it allows a deeper understanding of the disturbance caused by heavy metals in the ecosystem.

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L-VIII11

Some heavy metal contents in the marine environment along the Romanian Black Sea Coast

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Between 1982-1987 a rather large quantity of data on the presence and content of heavy metals in the three major components of marine environment-- water, sediments and organisms - was accumulated (PECHEANU, 1982; PECHEANU and MIHNEA, 1986; PECHEANU and VELESCU, 1986).

The aim of this paper is to shortly present the variation range, spatial distribution as well as the determining factors on heavy metal dynamics along the Romanian coastal waters.

Water, sediments and organisms samples were collected from different areas in the shallow zones under the anthropic influence along the Romanian Black Sea coast. In order to avoid contamination they were preserved in plastic bags or bottles.

Metallic ions in sea water were determined after a previous concentration and extraction with APDC and MBIK.

Surface sediments were collected by means of a Van Veen sampler and organisms by fishing nets. After preliminary processing operations samples were digested in HNO_3 acid.

Heavy metal content was determined in air-acetylene flame by an atomic absorption spectrophotometer PYE-UNICAM 2900 with double beam.

In the table the lower and the upper limits for each metal in the three components between 1982-1987 are presented.

As can be notices from the table there are relatively low values for marine water in comparison with those published concerning other areas.

In the sediments the highest content was determined in samples collected in front of the Danube Delta (IV), followed by those inside the Constantza harbour (III) where different impurification sources are present. Industrial waste waters contain heavy metal quantities which are found in the nearby sediments (II). The lowest values were found in the samples taken from domestic waste water influenced area (I) because of the their origin and composition.

Concentrating ability of sessile organisms (mussels) in comparison to migratory ones was proved.

A comparison of our data even the higher ones (IV, III sediments and mussels) with those mentioned by other authors from different areas of world ocean points out that there is not a heavy metal pollution in the Romanian marine waters yet.

		Cu	Pb	Zn	Cd
Marine water			µg/l		
1982 - 1985		ND - 7	ND - 13	1 - 91	ND - 2
			µg/g		
Surface sediments 1982 - 1984	I	2 - 12	4 - 13	12 - 35	ND - 0.4
	II	3 - 69	6 - 44	22 - 171	-
	III	32 - 47	48 - 51	109 - 120	1.8 - 2
	IV	108	78	154	3
			µg/g W.W. / µg/g D.W.		
Mussels	30-50 mm	1 - 2	0.3 - 0.7	31 - 47	0.6 - 98
	50-70 mm	7 - 10	-	208 - 308	3 - 5
			µg/g W.W.		
Organisms* 1982-1987	Sprat				
	Anchovy	1 - 2	0.3 - 0.5	15 - 28	0.04 - 0.13
	Horse makerel				
	Whiting				

ND - not detected

I, II, III, IV - areas under anthropic influences

* G.Munteanu and I.Pecheanu personal communications

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Chlorophyll a in the Romanian inshore Black Sea area

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ABSTRACT: Chlorophyll a concentration as an eutrophication degree indicator, in the Southern part of the Romanian inshore is presented.

One of the most important effect produced by pollution was the high eutrophication (in µg at l^{-1}: $P\text{-}PO_4$ = 0.03-125; $N\text{-}NO_2$ = 0.01-4.5; $N\text{-}NO_3$ = 0.47-90; $N\text{-}NH_4$ = 0.2-19; $Si\text{-}SiO_3$ = 0.55-305) that permitted mass algal growth or heavy blooms (up to 422×10^6 cell l^{-1}). The phytoplankton density is not a complete indicator of the eutrophication as the community can be represented by micro- or ultrananoplankton and thus, the biomass could be different for the same number of cells. We need useful information to describe not only the number of cells but the photosynthetic capacity, too. Rather few data on chlorophyll a concentration for the Black Sea were available (BOLOGA and cowork., 1985). The present paper is based on 1,126 samples, employing SCOR UNESCO standards for chlorophyll a analyse (Table 1).

Table 1: Chlorophyll a concentration in the nearshore area (in µg l^{-1})

Year	Size range	Min. and max.	n	$\bar{x}$	σ^2	SD (σ)
1983	0 - 1	0.03 - 0.88	57	0.50	0.08	0.28
	1 - 5	1.02 - 4.86	86	2.41	1.01	1.01
	5 - 10	5.13 - 9.77	23	6.99	1.80	1.34
	> 10	10.35 - 185.32	55	34.61	1285.30	35.85
1984	0 - 1	0.10 - 1.00	68	0.55	0.06	0.24
	1 - 5	1.01 - 4.78	90	2.14	1.09	1.04
	5 - 10	5.08 - 9.99	24	6.96	2.39	1.54
	> 10	10.33 - 49.68	34	21.10	105.71	10.28
1985	0 - 1	> 0 - 1.00	182	0.43	0.07	0.26
	1 - 5	1.03 - 4.82	155	2.03	0.94	0.97
	5 - 10	5.02 - 9.45	21	6.56	1.57	1.25
	> 10	10.33 - 62.50	30	20.79	168.68	12.99
1986	0 - 1	0.12 - 1.00	35	0.57	0.06	0.24
	1 - 5	1.02 - 4.70	39	2.45	1.22	1.11
	5 - 10	5.17 - 9.94	21	7.55	2.84	1.69
	> 10	10.06 - 59.34	105	25.47	154.14	12.41
1987	0 - 1	0.09 - 0.99	14	0.48	0.09	0.31
	1 - 5	1.02 - 4.88	33	2.61	1.49	1.22
	5 - 10	5.21 - 9.35	11	7.32	1.65	1.28
	> 10	10.32 - 86.91	43	23.72	375.09	19.37

During 1983-1987 thirteen hydro-biological stations were sampled monthly intervals from February to October, at the surface, 5, 10, 20m depth, on the 5, 10, 20 m isobathes as well as a control area 10, 20, 30 Nm from the coast, at the surface, 5, 10, 20, 30, 40 and 50 m depth.

The minimum and maximum determined values ranged between more than zero and 185.32 µg l^{-1}. The distribution of values was (in µg l^{-1}): 31.61% = 0-1; 35.79% = 1-5; 8.88% = 5-10; 26.38% = 10-185.32. According to MARCHETTI (1984) the mentioned concentration limits of this pigment fit to the oligo, mezo, eutrophic and hypertrophic waters. The values from more than zero to 5 were characteristically for deeper or offshore zones as well as for all studied area after strong winds that removed inshore sea water and brought instead of it clean and poor one. In 35.26% of samples chlorophyll a concentrations was bigger than 10 µg l^{-1}; they usually were found in nearshore, surface (0-10 m), or during blooms phenomena. No strong positive correlations between phytoplankton density and chlorophyll a levels were observed but there is a tight relation between this pigment concentration and both taxonomical structure and physiological state of the community.

It follows therefrom that: 1) chlorophyll a concentration could be considered a good global indicator of the trophic potential of a zone; 2) the nearshore area exhibit the tendency to eutrophic and hypertrophic conditions in comparison to the offshore which evolved to mezo and eutrophic ones.

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Trace elements in Mytilus galloprovincialis LMK from Sozopol area (Bulgarian Black Sea Coast)

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Introduction

During the period I985-I987 trace elements (Cu, Zn, Cd, Pb, Hg) were determined in Mytilus galloprovincialis Lmk from Sozopol aarea. The study was carried out to determine the good sanitary condition of the experimental mussel culture and in accordance with a programme for biological monitiring. Modern high sensitive analytical methods were applied.

Materials and methods

The study included both cultivated (suspended culture) and bottom mussels from the same area. After preliminary processing (I) a definite quantity of the soft tissues was dried at I05°C. Then it was digested with $HNO_3/H_2SO_4/HClO_4$ or trace metals were extracted from the sulfate ash (heated at 500°C), in addition of HCl. The dilutions obtained were analysed through AAS - for Zn, Cu and Hg (cold vapour method) and anodic stripping voltammetry, ASV (2) - for Cu, Cd and Pb. Means of some determinations obtained are given in Table I.

Table I. Trace elements in Mytilus galloprovincialis Lmk, Sozopol area, I985 - I987

Date	Average concentrations /$\mu g.g^{-1}$ dry weight/ Pb	Cu	Zn	Cd	Hg
I985/III	4.9	3.8	32.I	0.25	0.0I5
IV	2.9	4.3	40.3	0.I7	0.0I7
V	2.8	I.5	35.7	0.38	0.0I7
X	2.6	2.6	42.0	0.22	0.0I8
I986/III	3.8	I0.6	27.2	0.3I	0.0I9
V	2.I	7.9	22.3	0.39	0.022
XI	2.I	8.4	I2.8	-	0.020
I987/ I	2.4	I.3	22.2	0.65	0.0I9
IV	2.5	I.4	27.6	0.77	0.022
V	2.3	0.5	28.4	0.90	0.020
X	2.I	I.0	2I.3	0.7I	-

Results and discussion

AAS-determination of Cu- and Zn-concentrations in both dry ash and wet mineralized samples of Mytilus galloprovincialis Lmk showed good agreement with error of each determination within the method limitations. The ASV-method allows quantifying 0.I-I0 ppm Cd, Pb and Cu in hydrobionts, with relative standard deviation of 8-I0% (n=5).

The average values for trace elements in the cultivated mussels coincide with those for the bottom mussels. In spring (March and April) higher concentrations of Pb and Cu were determined related to the specific physiological condition and increased metabolism of mussels following the increase of sea water temperature.

Increased Cu-concentrations were determined in I986, and Cd- in I987, most probably due to further coastal pollution. Nevertheless the values obtained are less than those cited for similar studies along the Italian and French Mediterranean coast (3). Hg- concentrations are constant during the whole period of investigation and less than the standard Bulgarian sanitary requirements.

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ANTIMONY IN SEAWATER AND SEDIMENTS FROM SARONIKOS AND ELEFSIS GULFS, GREECE

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Antimony was determined in seawater and sediments from Saronikos and Elefsis Gulfs, Greece, by Instrumental Neutron Activation Analysis . In Saronikos Gulf, elevated concentrations of total, dissolved and particulate Sb in seawater and total Sb in the silt-clay fraction of sediment cores, were found near the Athens Sewage Outfall (ASO) and close to a Fertiliser Plant (FP) outside Piraeus Harbor if compared with those found from stations several miles offshore. In Elefsis Gulf, slightly increased levels of dissolved Sb in seawater and total Sb in sediment cores were observed. In general, at a distance of 3-5 Km from the pollution sources, Sb concentrations reach those of the unpolluted pelagic waters and sediments. The predominant form of Sb in seawater is dissolved Sb (85-90% of total). The Sb vertical distribution in polluted sediment cores -very similar to that of arsenic- is evidence that redissolution and upward migration of these elements may take place in organic rich anoxic sediments.

INTRODUCTION

Antimony is one of the less studied trace elements in the Mediterranean although it is known to be solubilized from the sediments under reducing conditions and it has biological significance since it forms organometallic compounds.

Saronikos and Elefsis Gulfs receive wastes from the most industrialised and heavily populated Greek regions. These wastes contain, among other pollutants, big quantities of heavy metals.

The objective of this study was to investigate the distribution of Sb in seawater and sediment cores in polluted and unpolluted areas of N. Saronikos and Elefsis Gulfs and to establish typical background values of this element in seawater and sediments of the specific marine environment.

MATERIALS AND METHODS

Sampling: Seawater samples were collected from 35 stations (Fig. 1) during March, July, October 1984, November 1986, and February 1987. Sediment cores were collected from 18 stations (Fig. 1). Details about sampling and pretreatment of samples prior to analysis are given elsewhere (Grimanis et al. 1985).
Methodology: Antimony was determined in all samples by Instrumental Neutron Activation Analysis (Grimanis et al. 1985).

RESULTS AND DISCUSSION

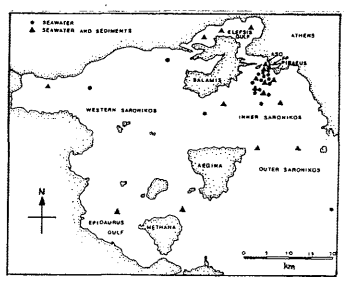
Seawater: Higher concentrations of antimony were found in the visinity of ASO and FP (Tab.1). The Sb concentrations decreased with distance, reaching values that are comparable with those reported for clean coastal waters, at a distance of 3 km (Tab.1). Typical Sb concentrations for open Saronikos waters (results from the analysis of 70 samples) are: 0.29±0.11 µg/l for total, 0.26±0.10 µg/l for dissolved and 0.03±0.01 µg/l for particulate Sb. In the water Sb was found to remain constant or to decrease with depth in most cases. A slight increase in Sb levels was observed in Elefsis Gulf's waters (see Tab.1).

Sediments: Highest concentrations of Sb were found in sediments affected by the FP wastes (14-102 µg/g , 30-208 times higher than the background values). Elevated concentrations of Sb were found in the visinity of ASO (6.6-32 µg/g, 15-65 times higher). At a distance of 3-5 km from the pollution sources, Sb concentrations reach values between 0.48-0.90 µg/g (average 0.73±0.12 µg/g), which seem to represent the inner Saronikos gulf's background values.

TABLE 1. Antimony concentrations (µg/l) in seawater. Numbers in parentheses indicate average values.

AREA	TOTAL	DISSOLVED	PARTICULATE	REFERENCE
ASO, FP	0.60-1.40 (1.0)	0.50-1.0 (0.75)	0.11-0.40 (0.25)	This work
Inner Saronikos	0.16-0.55 (0.29)	0.15-0.48 (0.26)	0.01-0.08 (0.03)	This work
Outer Saronikos	0.11-0.31 (0.23)	0.10-0.28 (0.21)	0.01-0.03 (0.02)	This work
Western Saronikos	0.15-0.44 (0.28)	0.14-0.40 (0.26)	0.01-0.03 (0.02)	This work
Elefsis Gulf	0.13-0.85 (0.37)	0.12-0.80 (0.35)	0.01-0.05 (0.02)	This work
Coastal,Japan	0.16-0.60		0.01-0.03	Gohda (1975)
Saanich Inlet	0.11-0.16		negligible	Bertine & Lee (1983)
N.Adriatic	0.26-5.6			Grancini et al. (1975)

FIGURE 1. Sampling stations.



For the open Saronikos Gulf the Sb levels were found to range from 0.30-0.60 µg/g (average 0.43±0.13 µg/g). Sb concentrations were slightly increased in sediments from the Elefsis gulf (0.53-0.96 µg/g, average 0.74±0.15 µg/g) if compared with the open Saronikos background values. In general, the antimony content of the offshore sediments was, in all cases, comparable with the values of 0.43 -1.5 µg/g that have been reported for the open Aegean sea sediments (Angelidis, 1986). In contrast with other trace elements' distribution, Sb concentrations were found to increase with depth in the most polluted cores. The same distribution pattern was found only for arsenic in the same cores (Grimanis et al.,1984) and could be attributed to a redissolution and upward migration of these elements in these organic rich, anoxic sediments.

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L-VIII15

Heavy metal concentrations contained on the sediment's surface of Algiers Bay

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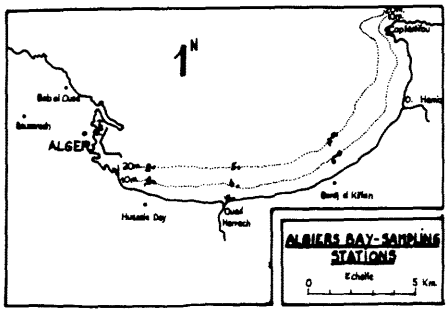
INTRODUCTION : The aim of this study was, to settle the level of the metals traces of the sediments surface of a zone put under influencial anthropical activities.

I/ Area-studied : The area observed as well as the stations taken are shown below.



II/ MATERIALS AND METHODS : Sediments' samples were collected with VAN VEEN Grab in seven stations of Algiers' bay. They had been put into plastic bottles and stored at - 4C until ready for diagnosis. Moreover, after had been dried by sublimation (at - 40°C, 0.1 BARS) for two days ; the sediments' samples were crushed into a porcelain mortar. One gramme of that was taken and put into solution per attack to the aqua-regia water (3v. HCl at 35% + 1v. HNO3 at 65%) during two hours at 80°C under a flowing-back column. The atomic absorption spectrophotometry is used to determine the metals.

III/ RESULTS AND DISCUSSION : High concentration of heavy metals (table 1) where observed near river-mouth of El-Harrach. These concentrations fall to a lower level to up to a distance of one kilometer. Lead and mercury gradient from the river-mouth of El-Harrach up to then part's plants showed a considerable increase. These high sedimentary levels are probably dues, in a part, to the pollution xaused by the factories implanted in Algiers and its serrounding, to the intense activity of motors finally to then pourring of impurs waters.

METALS / STATIONS	Zn	Cu	Hg	Cd	Pb
1	105.50	32.6	5.35	3.42	10.62
2	107.95	33.0	5.48	3.70	10.17
3	137.55	37.4	8.67	7.36	12.38
4	115.95	40.1	8.55	4.28	11.07
5	108.95	36.7	4.48	5.33	8.16
6	156.95	38.2	3.40	6.40	13.69
7	139.85	39.1	3.56	7.20	15.51

TABLE 1 : Trace metals on surface sediments' of Algiers'bay (ug/g)

The data obtained indicate that the average pollution level of the Algiers' Bay sediment, by the heavy metals studies is relatively low to compared to other areas in the mediterranean sea. (Table 2).

Compared to the results obtained in the western mediterranean, the extents of pollution are approximatively half lower however they start to present critical aspects.

METALS / STATIONS	Zn	Cu	Hg	Cd	Pb	REFERENCES
Coast of Romania	4-44	0.48-9.72	-	-	1.6-23.4	PECHEANU 1983
Abu-Kir Bay Alexandria	9-760	0.8-91		14.1	-	SAAD et al. 1981
Golf of Veneta	48-450	34-37	-	0.3-5.3	5-5.54	ANGELA et al. 1981
Ebro	32.8-180	7.9-21.5	-	0.16-0.37	22-48	LEON et al. 1983
Occidental Mediterranean	257	51.5	0.57-16	-	32.8	ARNOUX et al. 1982

Table 2 : Trace metals on surface sediments (ug/g)

REFERENCE

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L-IX1

Metal pollution in the Argostoli Bay, Cephallonia Island, Greece

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INTRODUCTION

Surface sediments from Argostoli bay have been analysed in bulk by Inductively coupled Plasma for Pb, Mo, Zn, Cu, Ni, Cd, Cr, V, Mn, Fe and Al. The samples have been subjected to an $HF-HNO_3-HClO_4$ attack prior to analysis. Carbonates were determined using acetic acid leach and organic carbon by titrations (Method $K_2Cr_2O_7Fe(NH_4)_2\cdot(SO_4)_2\cdot 6H_2O$).

RESULTS AND DISCUSION

Of the metals examined Mo, Pb, Cr, Ni, Co and Zn were found to be enriched relative to normal shallow water sediments their degree of enrichment being decreased in the following order : Mo>Pb>Cr>Ni>Co>Zn.

Manganese, V, Ni and Co follow Al and Fe in their areal distribution suggesting their association with the clays. However, V/Al, Ni/Al and Co/Al ratios at a number of stations are much higher than the average ratio given for near shore sediments. It is therefore concluded that a portion of V, Ni, and Co is held at adsorbed sites in the clays. On average the concentrations of V, Ni, and Co are lower than those reported for other Greek semi-enclosed embayments (1).

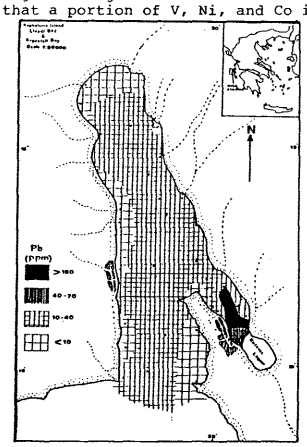

Fig. 1

Lead varies between a few ppm and 206 ppm.The latter value was found in the Argostoli embayment and is close to the maximum concentration of Pb reported for the Thermaicos bay(2).The location of the highest values of Pb would suggest that they should be related to the dissemination of oil in sea from the oil tanks occuring at the eastern coast (Fig. 1). Elevated values of Pb (68 ppm) are also found at the eastern coastal zone of the embayment and they should be due to the discharge of domestic sewage from the town of Argostoli. At the port of Lixouri Pb is 32 ppm while in the rest of the bay is below 30 ppm.

Molybdenum varies between 1 ppm and 43 ppm. Its highest values were found at the inner part of the Argostoli embayment and they decrease toward the outer and deeper parts. Its areal distribution is generally similar to that of organic carbon with which it shows a strong positive correlation (r = 0.80). The highest value of Mo found here is greater than the average value given for near-shore sediemnts (3).However it is lower than that found in the Navarino and Ithaki bays (4,5).

The highest values of Cu and Zn are found at the outfalls of domestic sewage of Argostoli and Lixouri and generally follow organic carbon. In the rest of the bay Cu and Zn tend to increase in the deeper zones and they show an inverse relationship with the mean grain size of the sediments. The highest concentrations of Zn found in the Argostoli bay is greater than its average concentration in near-shore sediments and is similar to those reported for the Messolongi lagoon.

Cadmium in most of the sediments is below o.5 ppm except for 3 stations where it reaches the value of 1 ppm. One of these stations is also characterized by high concentrations of Pb and organic carbon.

The areal distribution of Cr, is similar to that of Pb except that elevated concentrations of Cr are also found in the deeper parts of the bay.

Organic carbon varies between 0.04% and 6.20%. Its highest concentration are found in the inner part of the Argostoli embayment and the port of Lixouri, where the domestic sewage of the two towns are discharged. Elevated values of Corganic also occur near the oil tanks existing on the easter coast of Argostoli embayment. Very low values occur along the western coasts of the area studied.

A negative correlation exists between the concentration of organic carbon and the mean grain size of the sediments, probably as a result at its oxidation in the coarser sediments dued to the greater porosity. The greatest values of Corganic are of the same level with those reported for the Navarino and Ithaki bays.

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Teneurs métalliques de sédiments marins superficiels de la zone septentrionale du canal de Corse

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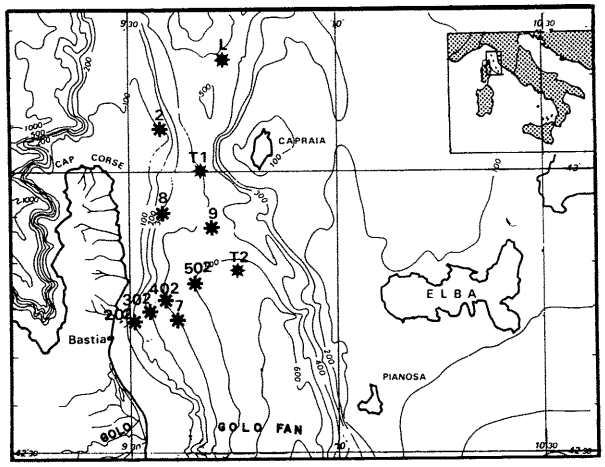
Des sédiments marins superficiels ont été prélevés de 1984 à 1987 dans onze stations (L, T1, T2, 2, 7, 8, 9, 202, 302, 402, 502) de la zone septentrionale du canal de Corse, situées de part et d'autre de l'axe cap Corse-île de Capraia entre -100 m et -500 m (figure), pour déterminer les teneurs en cadmium, mercure, cuivre, plomb, zinc et la granulométrie.

Les dosages des métaux ont été effectués par spectrométrie d'absorption atomique sur des niveaux régulièrement espacés des carottes (après séchage à 50°C et digestion des sédiments bruts dans l'acide nitrique concentré).



Position des stations

Les sédiments issus de -100 m (station 2) très carbonatés, constitués de 92 % de fractions granulométriques > 63µm ont les teneurs les plus faibles de la série. Elles sont en moyenne, par gramme de sédiment sec, égales à O,O4 µg de Cd, 0,06 µg de Hg, 5 µg de Cu, 14 µg de Pb, 46 µg de Zn.

Pour les sédiments vaso-sableux prélevés à -300 m, composés de 55 à 65 % de fractions granulométriques > 63 µm, les teneurs sont de l'ordre de 0,11 µg pour le Cd et le Hg, 16 µg pour le Cu, 17 µg pour le Pb, 62 µg pour le Zn.

A -400 m et -500 m, les teneurs des sédiments oscillent de 0,13 à 0,21 µg pour le Cd, 0,16 à 0,26 µg pour le Hg, 20 à 32 µg pour le Cu, 16 à 26 µg pour le Pb, 75 à 95 µg pour le Zn.

La répartition verticale des métaux dans les sédiments prélevés dans cette partie de la Méditerranée, éloignée des zones d'apports d'origine anthropique est relativement uniforme le long des colonnes sédimentaires, les teneurs les plus faibles se rapportant aux sédiments de -100 m et -200 m. Les niveaux supérieurs des sédiments n'ont pas révélé d'augmentation marquée des teneurs métalliques. Aucune variation temporelle significative des teneurs métalliques n'a été mise en évidence dans les sédiments de trois stations (L,T1 et T2) prélevés de 1984 à 1986.

Pour l'ensemble des sédiments de la zone septentrionale du canal de Corse analysés, les teneurs métalliques (par gramme de sédiment sec) toutes granulométries confondues varient de 0,04 à 0,27 µg pour le Cd, 0,04 à 0,29 µg pour le Hg d'une part, de 5 à 32 µg pour le Cu, 6 à 31 µg pour le Pb d'autre part, et de 40 à 102 µg pour le Zn. Ces teneurs correspondent aux valeurs trouvées par différents auteurs et considérées comme bruit de fond géochimique du milieu naturel. Elles indiquent que ces sédiments du canal de Corse ont une origine biolithogénique et ne sont pas affectés par des apports anthropiques récents.

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Total and methyl-mercury in some commercial Fish species from wider region of Middle Adriatic

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A B S T R A C T

It is well known that mercury is an accumulative trace element, i.e. the body concentrations of mercury increase with age of the specimen. There are large numbers of total mercury levels in edible marine organisms in Mediterranean (ref.1). Despite its great importance for better understanding of the distribution of mercury concentrations in seafood, a few data exist on organic mercury in sea organisms (in which tissues mercury appears to exist largely as methyl mercury).

Lack of age or size data for specimens made impossible an accurate comparison of the mercury levels in individual species from different locations and a prediction of the possible mercury levels to be expected in various seafood, respectively.

In this work, for mercury analysis we have chosen three commercial fish species (striped mullet-Mullus barbatus, hake-Merluccius merluccius,sea bream-Pagellus erythrinus) caught during 1987 on the wider region of open waters of middle Adriatic (Fig.1).

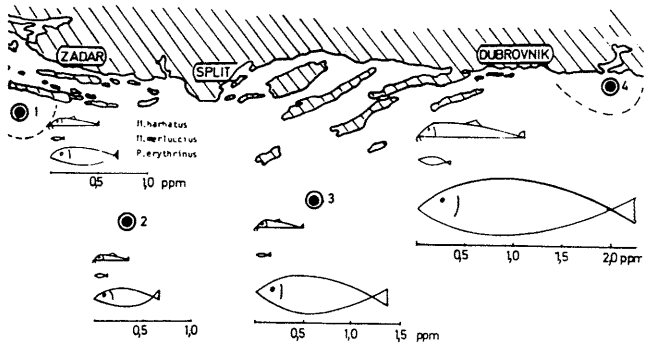

Fig.1 Sampling locations with shematic presentation of total mercury in some fish species

Along with basic morphometric parameters (length and weight) concentrations of total and methyl mercury in homogenate of the fish fillets were determined (by CV AAS and GC-ref.2) and percentages of methylation were calculated.

Apart from the relative distance of all investigating stations from obvious pollution sources, surprasingly high mercury concentrations in sea bream and striped mullet were detected in the southeastern part of Adriatic (Table 1 and Fig.1).

Probable reasons for such high contents of mercury in mentioned species and relationships between Hg concentrations and morphometric parameters are discussed. Although there are some indications that this unexpected high level could be a consequence of higher background mercury concentration in southern part of Adriatic (natural mercury anomaly) or terrestrial influence from the coast, due to high percentage of methylation for the most of the analysed species, consumption of the above mention species from the investigated area could be health hazard (especially for critical groups-fishermen and their families).

Species name	Station	Average Length (cm)	Average Weight (g)	Mean ± SD (ug/kg wet weight) Hg-Tot	Mean ± SD (ug/kg wet weight) Me-Hg	%
Striped mullet	1	19.5	125.0	490 ± 30	470 ± 50	96
(Mullus barbatus)	2	13.3	31.3	350 ± 20	320 ± 10	91
	3	12.4	26.8	490 ± 20	400 ± 20	82
	4	14.4	47.8	1090 ± 20	1070 ± 0	98
Hake	1	29.5	240.0	120 ± 20	120 ± 0	100
(Merluccius	2	26.0	130.0	110 ± 20	110 ± 0	100
merluccius)	3	27.6	150.0	130 ± 20	110 ± 10	85
	4	24.0	95.3	330 ± 40	260 ± 0	79
Sea bream	1	17.9	100.0	700 ± 10	700 ± 0	100
(Pagellus	2	18.0	105.0	650 ± 20	600 ± 10	92
erythrinus)	3	17.0	87.4	1380 ± 10	1290 ± 20	93
	4	17.0	87.4	2270 ±190	2130 ±280	94

Table 1 : Total and methyl mercury contents (with a percentage of methylation) in the flesh of some fish species caught in 1987 in the middle Adriatic.

Acknowledgement: We are grateful to the UNEP-MAP Co-ordinating Unit in Athens for financial contributions from the MED Trust Fund.

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L-IX4

Accumulation and distribution of Mercury in Solea vulgaris and Lepidorhombus boscii of the Northern Tyrrhenian Sea

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The northern Tyrrhenian sea is affected by the geological anomaly of Monte Amiata, resulting in the presence of Hg in the superficial marine sediments along the coast (1).

Hg concentrations of marine organisms in this area are generally high (2), and in specimens of Citharus linguatula the methylmercury content was 2-16 times higher than the maximum limit of 0.2 ug.g-1 w.w. indicated for the edible parts of fish by the EEC directives (3). Recently it was found that Solea vulgaris has lower Hg contents than other flat fish studied (4). The difference in Hg concentration between S. vulgaris and Lepidorhombus boscii was attributed to the different feeding behavior (5).

Hg concentrations were determined in muscle, liver and stomac contents of specimens of S. vulgaris and L. boscii collected in the northern Tyrrhenian sea in spring 1986. Analyses were performed with flameless atomic absorption spectrometry on samples digested with nitric acid in a pressurized digestion system (6).

Hg content in muscle of L. boscii is higher than in S. vulgaris (Fig. 1a) and increases with length in both organisms . As regards liver, the metal content is higher in L. boscii and increases with length, while in S. vulgaris it remains almost constant (Fig. 1b).

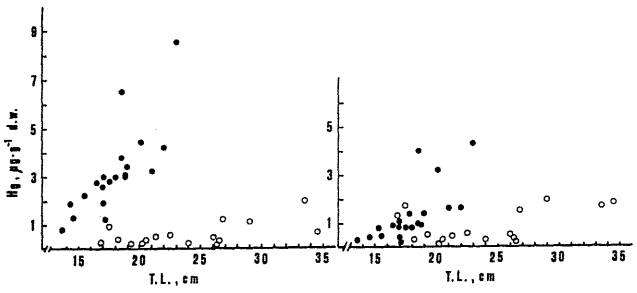

Fig. 1 - Hg concentration in muscle (a) and in liver (b) of L. boscii (●) and S. vulgaris (○) versus total length (T.L.) of the organisms.

In L. boscii, the percentage Hg liver/Hg muscle is in the range of 20 to 70 and increases slowly versus Hg content in muscle tissue (Fig. 2a). In S. vulgaris the range is 40 to 600, and the values are less homogeneous, especially at lower Hg concentrations.

Furthermore, in L. boscii the Hg Concentration Factor (CF) of muscle with respect to the stomach content is 22.7, higher than that of liver (9.3). On the contrary, in S. vulgaris the FC of muscle is lower (9.6) than in liver (13.9).

These results show that in S. vulgaris liver accumulates Hg more than muscle does, while for L. boscii it is the opposit. This cannot be attributed to the different percentage of lipids observed in the liver of the studied organisms, since the percentage of fat in S. vulgaris is 27.5 d.w. as compared with the 61 % in L. boscii, while the percentage of fat in muscle is equal in the two organisms (less than 3).

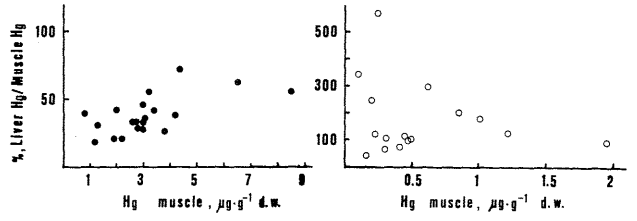

Fig. 2 - Ratio expressed in % between liver Hg and muscle Hg versus muscle Hg concentration, for L. boscii (a) and S. vulgaris (b).

We can conclude that the different Hg content in muscle of L. boscii and S. vulgaris can be attributed not only to the different feeding behavior as previously demonstrated (5), but also to the different physiology of the two species.

Research supported by funds from FAO, program MED POL-Phase II

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L-IX5

Petroleum hydrocarbons in sea water, marine organisms and sediments from Northeastern Mediterranean and Aegean Sea

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ABSTRACT

Northeastern Mediterranean (Northern Levantine) with a surface area of 1.1×10^6 km² was monitored for DDPH seasonally from November 1986 till December 1987. On the other hand in the Aegean Sea, seasonal monitoring was carried out during 1987 in the regions close to the Anatolian Peninsula. The DDPH concentrations varied from 0.1 to 6.9 μg/l for the Mediterranean and from 0.1 to 12.5 μg/l for the Aegean. High concentrations were found in the Bay of İskenderun in the N.Eastern Mediterranean and İzmir Bay in the Aegean. *Mullus barbatus*, caught in the Aegean Sea in December 1987, were analyzed for their PAH content and the concentrations ranged between 0.92 and 3.30 μg/g dry wt. Composite *Mytilus galloprovincialis* samples from the İzmir Bay, as expected, showed considerably high PAH levels than *Mullus barbatus*, *i.e.* PAH levels varied in between 10.78 and 13.30 μg/g dry wt. In the notheastern Mediterranean, *Mugil auratus* species caught in December 1987 from the Mersin Harbour (a heavily pooluted area) were also analyzed for their PAH and found to range from 9.98 to 14.48 μg/g dry wt. A composite sample of a bivalve (*Venerupis tabes decussata* surviving in the Mersin Bay showed up to 41.41 μg/g of PAH in terms of dry wt. PAH concentrations in the coastal shelf sediments of the N.Mediterranean was found to range from 0 01 to 0.55 ng/kg and in the Aegean Sea from 0.081 to 1.10 ng/kg on dry wt basis.

L

L-IX6

A preliminary study on the pollutional qualities of the Aegean deltaic zones of some Turkish Rivers*

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Study areas take place at the eastern coast of the Aegean Sea (Figure a) on the Turkish territorial waters. Study period covers the years 1983-1987 with regular seasonal visits to the river mouths and a number of marine stations located nearby Study cruises are carried out by R/V K.Piri Reis ship of the Institute. During the study visits standard oceanographic parameters such as salinity, temperature, dissolved oxygen, conductivity, pH, turbidity, redox potential recordings with depth are automatically recorded. A simultaneous sampling program is carried out with due care to precondition and preserve the aliquots as necessary. After the analytical results are obtained they are statistically treated to get the seasonal averages. Oil slicks and floatable material observations are made whenever possible. Study conditions such as meteorological factors during the sampling and in situ measurements are also recorded.

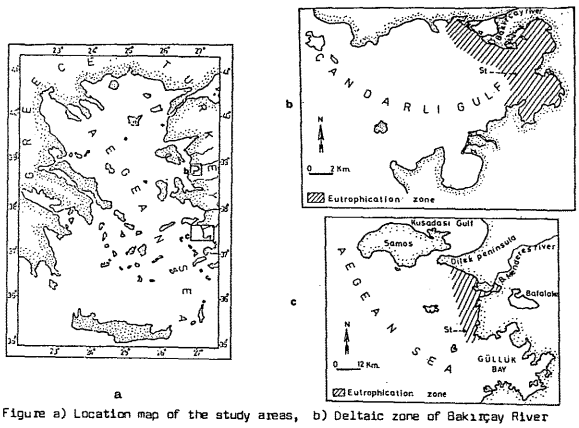

Figure a) Location map of the study areas, b) Deltaic zone of Bakırçay River
c) Deltaic zone of Büyük Menderes River

The study zones are shown in Figure b and c. Data generated from these two zones are treated wor discussion here by using the averaged values over 20 stations in Çandarlı (Fig.b) and 15 stations in B.Menderes delta (Fig.a). In Çandarlı the studyarea is wider than 20 in fact, there are 45 stations to cover all of the Bay. But the shaded area which covers the high eutrophication zone (shaded in figure) includes 20 stations only. In both figures b and c shaded eutrofied zones exhibit chlorophyl a concentrations of more than 1 mg/l in summer periods.

Study areas / Characteristics	ÇANDARLI BAY (Bakırçay River)	BÜYÜK MENDERES River
River (incl. seasonal variability)		
Flow rate, m3/sec	0.5 - 50	1 - 50
BOD5, tons/day	0.03 - 13.5	35
TSS,tons/day	0.3 - 764	5 - 450
Chlorophyl a,mg/l	4.60 - 13.02	-
Total Inorganic Nitrogen,tons/day	1 - 3	0.1 - 40
Sea (surface waters)		
Temperature, C	16.50 - 17.10	15.50 - 25.00
Salinity, ‰	38.60 - 38.70	36.00 - 39.60
Conductivity, mmho (avg)	47	48.5
Turbidity, TU	88.3 - 95.0	82.0 (avg)
Redox potential,mV	266 - 380	383 (avg)
Dissolved oxygen, mg/l	7.2 - 8.2	6.2 - 8.2
pH	8.50 - 8.70	7.92 - 8.50
Total Inorganic Nitrogen , mg/l	0.66 - 2.22	0.121 - 1.403
Total phosphorus, mg/l	0.016 - 0.159	0.012 - 0.450
Chlorophyl a mg/l	2.87 ∓ 0.82	0.10 - 1.38
Fecal coliforms per 100 ml	6 ∓ 5 (autumn)	0 - 53
Total petroleum mg/l	0.35 - 6.48	1.36 (avg)

Table 1 summarizes the river characteristics as well as the monitored sea water (surface) parameters. These quantities indicate that both zones have higher chlorophyl a values in comparison to the other zones at the Aegean Sea. According to the most recent measurements in summer 1987 which will be published soon, these values are in the range of 0.0145 to 1.0088 mg/l of pigment concentrations. This contrast is attributable to better nutritional conditions in the study regions. This conclusion is in parallel with the appreciably high total inorganic nitrogen, total orthophosphate phosphorus and turbidity values in these regions. These nutritional factors show rather sharp seasonal changes at the same stations which might be related with the seasonal changes in river water carry over of these substances and probably the discharging of surface runoff from the land. These seasonal variability has been notable during this study covering the period of 1983-1987.

* This presentation has been summarized from the final reports of two scientific projects MED TUR/8-H and TUR/9-K being carried out by the Institute.

L-IX7

Decline in tar pollution in the Mediterranean Sea

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The Mediterranean Sea is considered to be one of the most tar polluted seas in the world. Horn et al. (1970) reported concentrations of floating tar of up to 500,000 $\mu g/m^2$ in the Ionian Sea in 1969, and Golik (1982) reported on values of beach-stranded tar of up to 14 kg per frontal meter of beach in Israel in 1975. The reason for this high concentration of tar in the Mediterranean Sea was attributed to the fact that the Mediterranean is a land-locked sea, limited in its water exchange with other oceans. Though covering only 0.82% of the world ocean area, 21.4% of the global oil transport was carried on that sea in 1985.

In a recent investigation which was carried out in August-September 1987, by vessels and personnel from Cyprus, Germany, Israel and Turkey, pelagic tar was sampled from the surface water by means of neuston nets at 101 stations in the Mediterranean. Of these, 93 stations were east of the Straits of Sicily and 8 west of it. The distribution of the tar content indicates that the most tar contaminated areas in the Mediterranean are in the northeast between Cyprus and Turkey and in the Gulf of Sirte off the coast of Libya, where the mean tar content was 1847 and 6859 $\mu g/m^2$, respectively. The least polluted areas were the southwestern Mediterranean and the northern Ionian Sea as far east as halfway between Crete and Cyprus, with mean tar concentrations of 236 and 154 $\mu g/m^2$, respectively. Intermediate mean values of 1347 and 876 $\mu g/m^2$ were found in the Levantine Basin west and south of Cyprus, respectively.

With a few exceptions of coastal waters, pelagic tar was never measured in the eastern Mediterranean, so it is impossible to compare directly these findings to the past. However, several studies on tar pollution were conducted in the western and central Mediterranean in the past. A comparison between pelagic tar data collected in 1969 by Horn et al. (1970), in 1974 by Morris et al. (1975) and our data shows a sharp decline in tar concentration with time:

year	1969	1974	1987
mean tar concentration ($\mu g/m^2$)	37,000	9,700	1,175

A rank sum test which was conducted on the 1974 and 1987 data yielded $p<0.001$, indicating that there is a significant difference between the two. As the difference between the old and new data is so sharp, it is reasonable to assume that it represents a difference in time and not in space. These results agree with other investigations which show that during the last decade a significant reduction in tar pollution occurred at some of the Mediterranean coastlines such as that of Paphos, Cyprus, where beach-stranded tar quantity declined from a mean of 268 g/m^2 in 1976-1978 (UNEP, 1980) to 67 g/m^2 in 1983 (Demetropoulos, 1985). A similar reduction in tar quantity on the beach was found in Israel: 3625 g/m in 1975-76 (Golik, 1982) in comparison to 12 g/m in 1984 (Golik,1985). Image processing of air photographs from the Israeli coastline also shows a continuous decline in tar quantity between 1975 and 1985 (Golik and Rosenberg, 1987).

From the data at hand, it is proposed that the sharp decline during the last decade in the activity of most of the oil terminals in Israel, Lebanon and Syria in the eastern coast of the Mediterranean has caused a reduction in tar pollution in the Levantine Basin. The construction of an oil terminal in Iskenderun Bay, Turkey, and its increasing activity of oil loading from 14 million tons/year in 1977 to 75 million tons/year in 1987 caused concentration of tar pollution in that part of the Mediterranean Sea. In the same way, high tar pollution is found in the Gulf of Sirte off Libya, where oil loading is very active. However, except for local foci of tar pollution, the Mediterranean Sea as a whole has undergone a process of reduction in its tar pollution. The reasons for that must be the adoption of international conventions on prevention of oil pollution in the Mediterranean, the harsh steps undertaken by various Mediterranean countries to administer anti pollution laws, the technological developments in the shipping industry that reduce oil leakage, and the installation of coastal facilities for reception of oil wastes.

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L-IX8

L'évolution géochimique de la Méditerranée

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Depuis quelques décennies, les apports anthropiques, résultant d'intenses activités industrielles, agricoles et urbaines sur le bassin versant, sont devenus nettement supérieurs aux apports naturels qui contribuaient à un état géochimique quasi-stationnaire. L'évolution géochimique de la Méditerranée dépend principalement de la dynamique de ces apports, elle concerne l'équilibre écologique de cette mer et également la géochimie des eaux profondes de l'Atlantique.

Une détermination expérimentale des apports atmosphériques a débuté dans le bassin Occidental (i.e. Bergametti, 1987; Migon et al., 1987). Les enquêtes UNEP (1984) précisent des apports telluriques suffisamments forts pour marquer géochimiquement la mer. Ces quelques données atmosphériques et telluriques ne permettent pas la connaissance quantitative de la répartition spatiale des apports, ni de leur variabilité temporelle, liés à des processus économiques et démographiques. D'après les estimations de Cousteau et Paccalet (1987), en l'an 2025, 545 millions de personnes vivront autour de la Méditerranée, ce qui correspond à une augmentation moyenne de 1,3% par an. Par ailleurs, la progression du niveau de vie est quasi-générale autour de la Méditerranée, et, en France, elle a atteint 5 à 6% par an entre 1950 et 1974. Ces deux progressions, du nombre de riverains et de leur niveau de vie, se traduisent certainement par celle des rejets anthropiques.

La dynamique de la Méditerranée, mer soumise à un climat continental, est caractéristique de deux bassins de concentration, séparés par les détroits et seuils peu profonds de Gibraltar et de Sicile. Elle induit des circulations horizontales et verticales intenses, tant dans les différents circuits cycloniques que dans les zones de formation d'eaux denses (Béthoux, 1980). Le devenir des apports extérieurs, en terme de concentration, dépend de la fonction d'entrée des apports, de la dynamique marine, du volume des bassins, ainsi que de la réactivité de l'élément considéré. Les plus longues séries géochimiques marines, hormis la salinité et l'oxygène, concernent les concentrations en phosphore dans le bassin Occidental (Béthoux et Copin-Montégut, 1987). Elles montrent une augmentation des concentrations profondes qui passent de 0,35 µmole/l en 1960 à 0,40 µmole/l en 1984-86. D'après un modèle dynamique (Béthoux et Copin-Montégut, 1984), cette augmentation correspond aux effets d'une augmentation des apports telluriques de 3% par an dans le bassin Occidental et de 1,5% par an dans le bassin Oriental, conséquences probables de l'augmentation tant du nombre de riverains que de leur niveau de vie.

Sur le bassin Occidental, une telle augmentation des apports en nutriments, sur la période 1960-85, revient à doubler les apports et la nouvelle production. Bien que restant une mer oligotrophe, les images satellitaires CZCS et les dernières campagnes océanographiques montrent des étendues productives et des teneurs en chlorophylle jusqu'à présent jamais relevées. Il en est ainsi, par exemple, du panache "biologique" du Rhône, directement lié à son apport fertilisant, dont l'extension en mer parait surprenante, et de la mer d'Alboran dont la productivité résulte essentiellement d'enrichissements liés à des transports verticaux.

La dynamique de la Méditerranée est caractérisée par la sortie en profondeur à Gibraltar, et donc par la formation hivernale de 50,5 $10^{12}m^3.an^{-1}$ d'eaux profondes (Béthoux, 1980). Dans l'hypothèse où toutes ces eaux (superficielles nord-occidentales et intermédiaires d'origine orientale) ont été oxygénées en surface dans le bassin Occidental, lors des processus de formation d'eau profonde, elles ont une concentration d'environ 6 ml O_2/l. La formation d'eaux profondes se traduit par l'envoi en profondeur d'un stock maximal de 3,03 $10^{11}m^3$ d'oxygène par an. Ce stock annuel permet, compte tenu d'un rapport C:O = 41:139 en poids, la reminéralisation d'environ 1,3 10^{14}g de carbone, soit l'équivalent d'une nouvelle production limite de 150 $gC.m^{-2}.an^{-1}$. Cette valeur correspond à environ 4 fois la nouvelle production calculée dans l'hypothèse d'un bilan stationnaire, soit 36 $gC.m^{-2}.an^{-1}$ (Béthoux, 1981). Cependant, compte tenu de l'augmentation constatée des concentrations profondes entre 1960 et 1985, et du doublement probable de production, la valeur limite ne correspondrait plus qu'à deux fois la productivité probable actuelle.

Si nos hypothèses d'augmentation des apports telluriques en Méditerranée se confirment, un état critique pour la Méditerranée pourrait être atteint dans moins de 40 ans. Le stock d'oxygène de la couche profonde, qui ne correspondrait alors qu'à environ 17 ans de réserve, pourrait être consommé plus ou moins rapidement en fonction de la progression des apports fertilisants. Dès la première moitié du 21 ième siècle, la Méditerranée prendrait alors certaines des caractéristiques de la Baltique et de la mer Noire, à savoir celles d'un milieu profond anoxyque, les effets de l'environnement ayant réussi à contrecarrer ceux de la dynamique climatique.

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L-IX9

Un exemple de l'utilisation des gamètes d'Oursin en tant que modèle biologique en écotoxicologie : rôle du calcium et des protons dans la toxicité du mercure ($HgCl_2$)

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Dans le cadre d'une recherche écotoxicologique, dont l'objectif essentiel est l'étude des mécanismes de contamination par les polluants d'un écosystème en vue de sa protection, l'approche expérimentale en laboratoire est indispensable pour permettre d'analyser grâce à une simplification des systèmes naturels, les mécanismes impliqués.

Dans ce but, nous avons développé depuis 1987, l'étude des gamètes d'oursins (spermatozoïdes et oeufs vierges ou fécondés), déjà très utilisés dans d'autres domaines de la biologie, comme modèle biologique en écotoxicologie.

Le présent exposé résume des résultats préliminaires permettant de comprendre le mécanisme d'action d'un polluant métallique hautement toxique, le chlorure de mercure ($HgCl_2$). Il fait suite à un article, (Allemand et al., 1988), dans lequel nous avions mis en évidence les différents mode d'action de ce métal sur les transports membranaires d'ions et de nutriments.

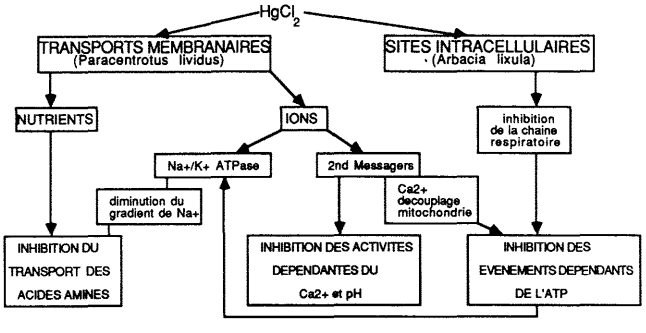
Grâce à une approche physiologique (la mesure de la consommation d'O_2 des gamètes), nous avons mis en évidence une des principales cibles intracellulaire du mercure. Nous avons en effet pu montrer que ce métal agissait au niveau mitochondrial soit en inhibant directement la chaîne respiratoire (spermatozoïdes, oeufs d'*Arbacia lixula*), soit en la découplant (oeufs de *Paracentrotus lividus*). Dans les deux cas le résultat est le même: le mercure induit une inhibition de la production énergétique de la cellule. L'action toxique du mercure dépend de l'espèce, mais aussi de l'état physiologique de la cellule cible: ainsi, une cellule quiescente (l'oeuf vierge) réagit différemment par rapport à une cellule très active (l'oeuf fécondé). Cette différence est liée aux grandes modifications des systèmes enzymatiques et des paramètres intracellulaires (pH, contenus en ions...) consécutives à l'activation cellulaire (Giudice, 1986)

De par leur nature, les polluants métalliques interfèrent avec les voies normales de transport ou les sites des liaisons des ions, dont le rôle physiologique est primordial puisqu'ils participent à la régulation de nombreuses activités cellulaires (Whitaker et Steinhardt, 1982). Pour tenter d'analyser plus en détail, les mécanismes impliqués dans la toxicité du mercure nous avons effectué des mesures de flux de Ca^{++} et de H^+ qui représentent les principaux signaux internes contrôlant l'activation, la croissance et les divisions cellulaires. Ils interviennent aussi bien dans des cas physiologiques (transduction hormonale, fécondation...) que pathologiques (cancérogénèse) (Berridge, 1985).

Chez l'oeuf vierge, le mercure stimule l'antiport membranaire Na^+/H^+, activant ainsi l'excrétion de protons. L'origine de ces protons demeure hypothétique: ils pourraient provenir de compartiments acides sous-membranaires, analogues à des lysosomes.

Nos résultats montrent que, chez l'oeuf fécondé, le mercure augmente l'entrée de Ca^{++}. Cet excès de calcium cytoplasmique est rapidement tamponné par la mitochondrie dont les systèmes de transport du Ca^{++} ont une plus faible affinité mais une plus grande capacité que les systèmes présents dans le réticulum (Carafoli, 1987). Ce transport est effectué à la place de la synthèse d'ATP et induit donc un découplage de la mitochondrie entre le transport des électrons et la phosphorylation oxydative (Carafoli, 1987).

L'ensemble de nos résultats permet d'élaborer le schéma suivant, montrant les différents mécanismes de l'homéostasie cellulaire qui sont affectés par le mercure:



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Effets de deux métaux lourds (Cu et Cd) sur la fonction de reproduction chez Idotea balthica basteri (Crustacé, Isopode)

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RESUME : Des Idotées femelles soumises aux effets chroniques de deux métaux lourds, présentent une importante baisse de la fécondité. Les résultats sont comparés à ceux obtenus avec des détergents.

ABSTRACT : Chronic toxicity test of two heavy metals on Idotea females fertility, shows an important decrease. This results are compared to those obtained with the detergent.

INTRODUCTION

Au cours des trente dernières années, l'aire de répartition de l'Isopode Idotea balthica basteri s'est considérablement réduite dans la région de Marseille. Pour expliquer ce phénomène, des études ont été entreprises sur un des facteurs susceptible d'être la cause de ce phénomène : les détergents (KAIM-MALKA 1980, 1983). Actuellement cette étude est réalisée avec des métaux lourds, pour voir si les effets provoqués sont de même type ou différent de ceux obtenus avec les détergents. Le présent travail est consacré aux effets de deux métaux lourds : le cuivre et le cadmium sur la fonction de reproduction de l'Idotée. Pour ces études, trois phénotypes ont été retenus : type uniformis pour les mâles, albafusca et flavafusca pour les femelles.

Au laboratoire, on peut obtenir l'appariemment et la fécondation en mettant des femelles au contact des mâles 12h à.24h après que la femelle ait effectué la mue de la région antérieure. Après s'être assuré que la femelle a bien pondu les oeufs dans la poche incubatrice, les animaux sont séparés et les femelles sont élevées isolément dans des bacs contenant 250 ml de solution de cuivre ou de cadmium, à la concentration de 0,1 mg/l. La solution est renouvelée tous les 3 jours. Les animaux sont nourris avec des morceaux de feuilles de posidonies. La salle d'expérience est maintenue à une température de 17° + 0,5° avec un éclairement de type journalier. Si tout se passe bien, les oeufs sont incubés pendant la période d'intermue, les juvéniles sont émis quelques jours avant la mue suivante (la gestation est d'environ 25-30 jours).

Les résultats obtenus ont été traités statistiquement : la comparaison des moyennes s'est faite en utilisant le test t de STUDENT pour les petits échantillons, les pourcentages ont été comparés par la méthode de l'écart réduit .

RESULTATS

L'ensemble des résultats obtenus sont résumés dans le tableau 1.

	% avortent	% réussite	Nb tot.Juv.	NbJuv/♀	% par rapport au témoin
Témoin	-	100	571	57,1 ± 28,55	-
0,1mg/l Cu	40	60	152	15,2 ± 22,58	26,61
0,1mg/l Cd	60	40	76	7,6 ± 12,03	13,30

Tableau 1 : Résultats obtenus pour des femelles d'Idotées soumises aux effets du Cu et du Cd.

Il apparait tout d'abord que toutes les femelles témoins ont donné une descendance : 571 individus au total, et sur lesquels aucune anomalie n'a été observée. Pour les animaux soumis à l'influence du cuivre, on observe qu'une proportion non négligeable de femelles perdent leur ponte (40 %). La proportion de juvéniles obtenus représente environ le quart de celui des témoins. On y trouve une très faible proportion d'individus malformés (environs 3 % des individus obtenus). Pour les animaux soumis à l'influence du cadmium, la proportion de femelles qui perdent leur ponte est augmentée (60 %) et le nombre de juvéniles obtenus représente la moitié seulement de ceux obtenus quand les femelles sont soumises au cuivre. Aucune anomalie n'a été observée sur les juvéniles ainsi obtenus.

DISCUSSION

Si on compare ces résultats avec ceux obtenus par KAIM-MALKA (1983) pour des Idotées soumises à un détergent (Tableau 2)

	% avortent	% réussite	Nb tot. Juv.	Nb Juv/♀	% par rapport au témoin
Témoin	-	100	550	55 ± 17,19	-
5mg/l dét.	70	30	21	2,1 ± 3,87	3,8
30mg/l dét.	70	30	39	3,9 ± 8,69	7,09

Tableau 2. Résultats obtenus pour des femelles d'Idotées soumises aux effets d'un détergent aux concentrations de 5 et 30 mg/l.

- un premier point remarquable est représenté par le nombre de juvéniles obtenus chez les témoins, et qui est très proche dans les deux expériences.
- Aussi bien dans le cas des métaux lourds que dans celui du détergent, on note qu'une proportion non négligeable des femelles perdent leur ponte, suite à cette exposition.
- De plus, le pourcentage de juvéniles obtenus à la suite d'une exposition au détergent, représente en fonction de la concentration, la moitié ou le quart de celui obtenu, suite à une exposition au cadmium.

Divers auteurs ont pu observer une baisse de fécondité chez certaines espèces soumises à l'action de métaux lourds. MARTIN (1975) indique que l'ovaire de Carcinus maenas peut concentrer le Cu et le Zn. TAHVILDARI-DAMOUI (1977) indique pour Paracentrotus lividus, que les oeufs fécondés qui atteignent le stade d'échinopluteus, quand ils sont soumis à une solution de $CdCl_2$, présentent une réussite inférieure de 23 à 55 % par rapport aux témoins. LIPINA et al (1987) indiquent que chez Strogylocentratus intermedius soumis à des concentrations élevées de Cd la plupart des oocytes dégénèrent, et les gamètes peuvent fixer le Cd directement dans l'espace intercellulaire. GOULD et al (1988) signalent que le Cu a un effet inhibiteur sur la production de gamètes et la maturation de Placopecten magellanicus. Des effets similaires ont été observés avec des altéragènes autres que les métaux lourds, tels pétroles et détergents.

CONCLUSIONS

L'exposition au cuivre et au cadmium, même à de très faibles concentrations, a des effets importants sur la fécondité des femelles d'Idotées, en abaissant d'une manière importante le nombre de juvéniles obtenus. Ceci peut avoir des conséquences importantes sur le maintien de l'espèce dans le milieu. Il pourra être intéressant d'étudier les effets provoqués par l'associations métaux + détergent, sur la reproduction.

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Increase of domestic sewage toxicity as a consequence of treatment by flocculating agents as determined by the sea Urchin bioassay

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The distribution, fate, and biological quality of domestic sewage in the Bay of Toulon, France, have been investigated in a multi-disciplinary study involving a number of physico-chemical, analytical, microbiological, and toxicological parameters. The present data refer to the results of testing developmental, genetic, and reproductive toxicity of seawater and sewage samples on sea urchin embryos and sperm.

1. Effluent from the sewage treatment plant (STP) at La Garde-Toulon Est was tested in its raw form (after primary treatment), or after flocculating by means of iron chlorosulfate and polyelectrolytes (PE) (resins Nos. 910 and 934), at dilutions ranging from 10^{-4} to $3x10^{-2}$.

2. Sewage treatment was simulated in the laboratory by stirring raw sewage with some flocculating agents [$FeClSO_4$, or $FeCl_3$, or $Al_2(SO_4)_3$] with or without PE.

3. Seawater samples were collected at different distances from the sewage outlet and tested for their effects on embryogenesis and fertilization success as a function of sewage dilution.

The above samples were tested on developing embryos or sperm from the sea urchins Paracentrotus lividus and Sphaerechinus granularis, according to the methods reported by Pagano et al. (1986). To summarize: a) developmental defects and larval mortality in exposed embryos, and b) cytogenetic abnormalities (both aberrations and changes in quantitative parameters) were determined according to Pagano et al. (1983;1986). The effects on sperm were determined by changes in: a) fertilizing capacity, and b) offspring quality (embryogenesis, mortality, and mitotic activity).

Our results show an increase in the developmental toxicity of sewage following treatment with $FeClSO_4$ and PE (at the STP or in the laboratory), or with $FeCl_3$ or $Al_2(SO_4)_3$ (with or without PE). Comparing the effects of the different agents, embryotoxicity may be ranked as follows:
[$Al_2(SO_4)_3$ ± PE] > [$FeCl_3$ + PE] > [$FeCl_3$ - PE] = [$FeClSO_4$ + PE] > raw sewage = [$FeClSO_4$ - PE].
These data were consistently obtained both with P. lividus and S. granularis, and showed an embryotoxic effect of $FeClSO_4$-treated sewage at realistic levels, e.g. $3x10^{-4}$ dilution. When developing embryos were reared in seawater samples collected at different distances from the sewage outlet, developmental defects displayed a dose-related trend as a function of sewage levels, with a significant increase of malformations in embryos reared in low-level sewage (~10^{-3} dilution).

Sperm pretreatment experiments resulted in a decrease in fertilization success in sperm suspended in realistic levels of treated (not raw) sewage (e.g. 10^{-4} dilution). It should be noted that high, non-realistic levels of treated sewage, as well as aged sewage (both raw and treated) resulted in an increase of fertilizing capacity, as compared to control seawater. When sperm were suspended in seawater samples collected at different distances from the seawage outlet, fertilization success was enhanced in plume samples (sewage dilution ≈10^{-2}), whereas diluted sewage (~10^{-4} to 10^{-3}) resulted in a decrease of fertilization success, as compared to offshore-collected seawater.

Present data point to the environmental hazards related to sewage treatment by using flocculation procedures and suggest that domestic effluents may contribute to developmental and reproductive imbalance in marine organisms. Developmental toxicity of sewage was exerted following treatment with each of the coagulants used. Due to the different potencies of the coagulants tested, it may be inferred that $FeCl_3$- or $Al_2(SO_4)_3$-treated sewage could exert a more severe embryotoxicity than $FeClSO_4$-treated sewage. Spermiotoxicity was exerted by treated sewage at environmental levels, thus suggesting a role for domestic sewage in affecting reproductive success of some externally-fertilizing marine organisms. Some results suggest that aged or high-level sewage may cause an enhancement of the fertilizing capacity of echinoid sperm, or hormesis (Pagano et al., 1986) which might result in excess echinoid population growth.

The present study shows a good agreement between laboratory-simulated and in-field data, thus providing further evidence for the reliability of sea urchin embryo and sperm bioassay in toxicity testing and in biological monitoring of marine pollution (Kobayashi, 1971; Muchmore & Epel, 1973; Stebbing et al., 1980; Oshida et al., 1981; Dinnel et al., 1982; Pagano et al., 1986).

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L-IX12

Evolution du peuplement des sables fins de la baie d'Alger : mise en évidence de perturbations

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MATERIEL ET METHODES : Il a été effectué au niveau de 3 stations (-10 m) : H, O et B des sables fins (SF) de la baie d'Alger des prélèvements quantitatifs (décembre 1985, mars, juin et septembre 1986). La surface prélevée à chaque fois est de 1 m2. La station H est située dans un secteur où débouchent un grand nombre d'égoûts de l'agglomération algéroise. La station O se trouve en face de l'embouchure de l'oued Harrach, véritable égoût à ciel ouvert quand il coule en mer. La station B, dans la partie Est de la baie, est la station la moins soumise aux perturbations d'origine terrigène.
Pour préciser l'évolution des peuplements de ces stations nous comparerons nos résultats à ceux de Bakalem (1979).

RESULTATS - DISCUSSION : Au niveau des 3 stations étudiées ce sont les mêmes indicatrices de pollution : Audouina tentaculata, Capitella capitata et Scolelepis fuliginosa que nous retrouvons, seule leur densité les différencie dans le temps et l'espace.
Les espèces opportunistes à la station O sont Venerupis aureus, Polydora antennata, P. ciliata, P. flava et Chaetozone setosa. A la station B nous retrouvons ces mêmes espèces auxquelles s'ajoutent : Abra alba, Heteromastus filiformis, Heterocirrus bioculatus et Nebalia bipes. La station H regroupe 7 espèces opportunistes : Corbula gibba, Abra alba, Venerupis aureus, Polydora antennata, Heteromastus filiformis, Chaetozone setosa et Nebalia bipes.
A la station H les indicatrices de pollution connaissent leur plus grand développement, excepté en juin où c'est à la station O que ces espèces atteignent les densité et dominance les plus fortes enregistrées. Les indicatrices de pollution sont très mal représentées tant en nombre d'espèces qu'en effectifs (O - 1 ind/m2 ; 0,073 - 0,082 %) en septembre aux 3 stations. Par contre, à la station H les indicatrices de pollution se classent parmi les principales espèces du peuplement en particulier en décembre où Audouinia tentaculata est l'espèce "leader".
Le nombre d'espèces opportunistes est plus élevé aux stations H et B qu'à la station O ; il en est de même pour leurs densités et dominances. C'est la station H qui est la plus riche quantitativement, et où les dominances des opportunistes sont fortes. Mais la dominance des opportunistes à la station O est bien supérieure à celle de la station H bien que les densités soient identiques.
Les principales opportunistes au niveau des 3 stations sont, par ordre d'importance, les mêmes : Chaetozone setosa, Venerupis aureus et Polydora antennata.
Les fluctuations quantitatives du stock des opportunistes sont grandes à la station H alors qu'elles sont moindres aux stations O et B. Mise à part en juin, où la station O présente la plus forte densité et aussi dominance des indicatrices de milieux perturbés, la station H est, le restant de l'année, la station où ces espèces ont des effectifs élevés et une forte représentativé au sein du peuplement.
Le classement des stations, en prenant comme critère les valeurs de l'abondance et de la dominance des espèces indicatrices de milieux perturbés, par ordre décroissant, est le suivant : en 1er la station H, suivie de la station O, et la station B en dernière position. Ce qui revient à dire que la station H est la plus perturbée, la station B le moins et la station O une station intermédiaire entre les deux.
Bakalem (1979) dans son étude du peuplement des SF de ces mêmes 3 stations signale la présence d'indicatrices de pollution : Audouinia tentaculata et Capitella capitata seulement à la station H.
Audouinia est présente en décembre 1977 dans le milieu avec seulement 7 individus soit une dominance de 0,24 % tandis que Capitella existe à la station H en juin 1978 (45 individus) soit une dominance de 3,98 %. Pour les opportunistes, cet auteur signale les espèces Chaetozone setosa, Abra alba et Corbula gibba.
Corbula gibba, absente à la station H, se retrouve très souvent au cours du temps dans les prélèvements des 2 autres stations.
Chaetozone setosa se trouve, mais de façon très ponctuelle, à toutes les stations ; il en est de même pour Abra alba. Les dominances de ces opportunistes sont très faibles. La dominance du stock des opportunistes la plus forte notée par cet auteur est de 2,04 % en juin à la station O, les autres dominances varient entre 0,12 et 0,64 %.
Comparés à ces données, nos résultats traduisent bien les modifications existantes en 1986 au niveau des SF de la baie, notamment l'apparition en force, en nombre d'espèces et en effectifs, des indicatrices de milieux perturbés.
Si nous nous référons aux études de Bakalem et Romano (1987) et Bakalem et al. (1986) qui ont mis en évidence une zonation des peuplements macrobenthiques dans les milieux perturbés nous pouvons dire que : - à la station H le milieu correspond à une zone III perturbée en décembre et juin. En mars le peuplement de cette station est référable à celui d'une zone III normale ; tandis qu'en septembre il correspond à un peuplement de sables fins typique ; - le peuplement de la station O présente les caractéristiques d'un peuplement de sables fins, excepté en juin où ce peuplement est référable à celui d'une zone III perturbée ; - la station B en décembre possède un peuplement présentant certaines similitudes avec celui d'une zone III, le reste du temps c'est un peuplement de sables fins.

CONCLUSION : L'étude qualitative et quantitative de la macrofaune du peuplement des sables fins de la baie d'Alger a permis de mettre en évidence : - l'existence en 1985 et 1986 d'un changement qualitatif et quantitatif significatif de ce peuplement par rapport aux données d'études antérieures (Bakalem, 1979) ; ce changement est du à la dégradation du milieu par les rejets d'eaux usées de la ville d'Alger qui s'est considérablement développée. Cette dégradation est très importante dans le secteur ouest de la baie et s'étend progressivement au reste de la baie ; - la mise en place en baie d'Alger d'un peuplement de milieux perturbés référable à celui d'une zone subnormale, caractérisé par la présence importante d'un certain nombre d'espèces indicatrices de pollution et d'espèces dites opportunistes.

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L-IX13

Evolution à long terme (1978-1986) des peuplements superficiels de substrats rocheux du secteur de l'émissaire de Marseille-Cortiou

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De 1978 à 1986, le rejet des émissaires d'eaux usées de Marseille-Cortiou a varié de 3 à 9 m3.s-1. C'est en effet en 1980 que le détournement estival, jusque-là temporaire de l'Huveaune, fleuve côtier pollué, dans l'émissaire, est devenu permanent, lui apportant un supplément de débit de 6m3.s-1.

Sept stations fixes de la côte sud du massif de Marseilleveyre, échelonnées entre l'anse de l'Escu (800m à l'Ouest du débouché de l'émissaire) et le cap Croisette (5500m à l'Ouest de ce débouché et à l'entrée de la rade de Marseille) ont été étudiées en 1978 (Bitar,1982), 1980 et 1986. Ces stations sont toutes situées dans la partie supérieure de l'étage infralittoral (faciès des Corallines, de la Moulière ou des Cystoseires). La partie centrale du secteur prospecté, ouverte vers le large, est moins polluée que les stations situées de part et d'autre (fig.1).

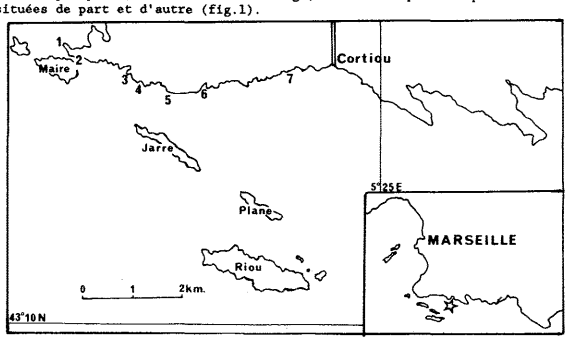

Figure 1. Carte des stations

Les prélèvements ont été effectués par grattage total de 1/25ème de m2 et étudiés selon la méthode de Bellan-Santini (1969). Les trois groupes majeurs, Polychètes, Mollusques et Crustacés Amphipodes sont, seuls, considérés ici. Les indices écologiques classiques ont été complétés par des Analyses Factorielles des Correspondances (AFC) et des Diagrammes Rang-Fréquence (DRF).

RESULTATS ET COMPARAISONS ENTRE LES TROIS CAMPAGNES

Les résultats généraux de 1986 (tabl.1) mettent surtout en évidence le petit nombre d'espèces présentes et la faiblesse des indices de diversité et d'équitabilité. Le tableau 2 montre l'évolution globale du peuplement à l'Ouest de l'émissaire. On y relève, en particulier, une diminution du nombre des espèces et des individus, ainsi que des indices de diversité et d'équitabilité, et une augmentation de l'indice annélidien de pollution (Bellan 1980).

Entre 1978 et 1980, les indices pris en compte s'étaient montrés relativement stables, notamment à la station 1 à la limite du golfe de Marseille. Ils pouvaient alors être corrélés avec le détournement de l'Huveaune dans le grand émissaire . En 1986, au contraire, tous ces indices traduisent une nette dégradation par rapport à 1978 et 1980 . Les AFC, et plus encore les DRF mettent clairement en évidence cette évolution régressive des peuplements des différentes stations au cours de la période 1978-1986 (fig.2). De plus, on a constaté en 1986, une régression particulièrement spectaculaire, d'une part, des populations de *Mytilus galloprovincialis* (nombre moyen par station: en 1978, 661±525; en 1980, 600±379; en 1986, 277±257) et d'autre part, du "concrétionnement de base" qui, en 1978, était riche en organismes à test calcaire: Polychètes Serpulidae, Mollusques Vermetidae , Balanes,qui ont pratiquement disparu en 1986, probablement "ennoyés" par l'accélération de la sédimentation liée à l'acroissement du volume de particules fines rejetées par l'émissaire (Arnaud 1986). On ne les rencontre plus qu'à l'état d'individus plus ou moins isolés , en épibiontes, notamment sur les moules.

Compte tenu de la mise en service en novembre 1987 d'une importante station d'épuration (traitement physico-chimique) ne laissant subsister qu'une teneur en matière en suspension inférieure à 100mg/l, une amélioration est attendue; elle devrait entraîner une diminution notable de l'extension de la tache polluée et une réduction de l'intensité de la pollution dans cette tache. Le suivi des 7 stations fixes devrait traduire ces effets spatio-temporels sur la reconquête d'une structure plus normale des communautés.

TABLEAU 1
Données par station pour 1986

St.	1	2	3	4	5	6	7
A	476	385	1147	841	780	853	1740
N	20	20	19	14	18	20	25
S	1,99	2,68	2,43	1,40	2,00	1,86	1,95
E	.46	.62	.57	.37	.48	.43	.42
M	3,08	3,19	2,55	1,93	2,55	2,81	3,22
P	1,35	2,05	2,51	1,50	2,31	16,18	22,63

TABLEAU 2
Données moyennes 1978-1980-1986

	1978	1980	1986
A	1877±608	1813±1139	889±453
N	31,1±7,3	26,6±4,6	19,4±3,2
S	2,6±0,2	2,4±0,5	2±0,4
E	0,54±0,04	0,51±0,12	0,48±0,09
M	4,02±0,93	3,46±0,48	2,76±0,46
P	4,33±5,26	3,58±4,04	6,93±8,73

Légende: A: Abondance. N: Nombre d'espèces. S: Indice de diversité de Shannon-Wieser. E: Equitabilité. M: Indice de diversité 2 de Margalef. P: Indice annélidien de pollution.

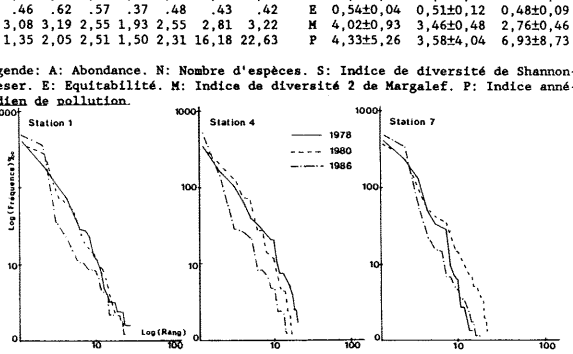

Figure 2. Diagrammes Rang-Fréquence

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Etude à long terme (1976-1986) des peuplements de substrats meubles au large de l'émissaire de Marseille-Cortiou

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Six stations choisies parmi les 40 prospectées en 1976, (BELLAN et al., 1980) ont été étudiées en 1980-1981 (BELLAN et BOURCIER, 1984) et 1986 (Fig. 1). Les prélèvements (40 dm3 de sédiment, sauf à la station H3, 20dm3) ont été étudiés selon les méthodes classiques. Des analyses chimiques ont été réalisées, prenant en compte les critères habituels de pollution (matières organiques, polluants minéraux et organiques).

Après détermination et décompte des individus présents, les calculs statistiques classiques ont été effectués ainsi que des Analyses Factorielles de Correspondance et des Diagrammes Rang-Fréquence.

1) CAMPAGNE 1986

Les données générales pour les prélèvements de la campagne 1986 sont fournies dans le tableau 1. Il convient d'insister sur: a) la faiblesse des Indices de diversité, la dominance considérable d'un petit nombre d'espèces (16 soit 4,6%) présentes dans la moitié des prélèvements et regroupant de 56 à 81% des individus, b) la dominance écrasante des espèces indicatrices des conditions générales de la zone subnormale qui regroupent de 80 à 95% des individus, c) le petit nombre d'individus représentatifs des biocoenoses (1 à 7,5%).

TABLEAU 1

Données pour la Campagne 1986

	3H3	3F2	3E1	3E6	3D2	3B2
A	970	444	423	268	281	121
N	43	48	45	45	45	32
S	3,69	4,31	3,70	4,17	3,89	3,52
E	.679	.772	.673	.759	.708	.477
M	6,11	7,71	7,27	7,87	7,80	6,46
50%	55,77	74,32	81,09	64,55	74,33	80,13
Sl	86,29	86,94	95,27	79,85	82,21	84,30
SB	0	1,35	1,18	1,49	1,07	7,4

TABLEAU 2

Données moyennes pour les campagnes:

	1976	1980	1986
A	497,67±357	196,33±164	417,83±295
N	75,33±34,4	42,33±14,1	43,00±5,6
S	4,77±1,1	4,21±0,8	3,88±0,3
E	.789±.521	.791±.129	.678±.107
M	12,05±4,75	8,21±2,32	7,20±0,75
50%	35,92±19,2	54,61±17,8	71,70±9,8
Sl	60,54±8,5	66,35±11,5	85,81±5,3
SB	2,75±1,7	4,99±6,5	2,09±3,7

A: Abondance. N: Nombre d'espèces. S: Indice de diversité de Shannon. E: Equitabilité. M: Indice de diversité de Margalef 2. 50%: Somme des dominances des espèces recueillies dans au moins la moitié des prélèvements. Sl: Somme des dominances des espèces indicatrices au sens large de la zone subnormale. SB: Somme des dominances des espèces caractéristiques de Biocoenoses.

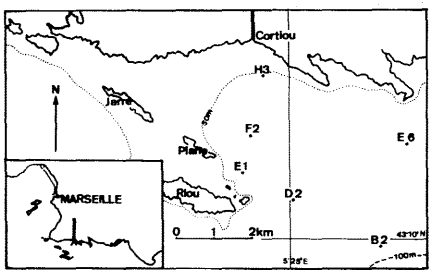
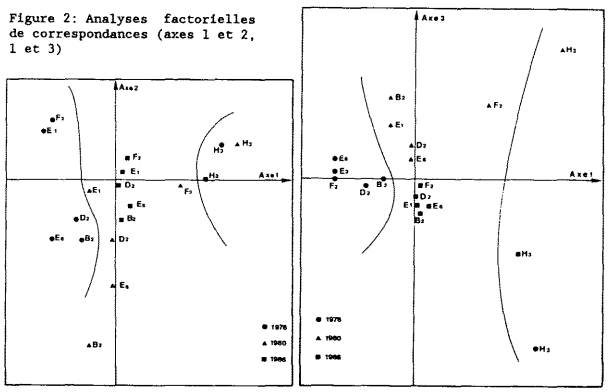


Figure 1: Localisation des stations fixes de prélèvement

2 COMPARAISONS ENTRE LES TROIS CAMPAGNES 1976, 1980 et 1986

Le tableau 2 fournit, d'une manière globale, l'évolution du peuplement au large de l'émissaire. On notera, en particulier: a) une diminution du nombre d'espèces présentes et des indices de diversité et d'équitabilité, b)un accroissement sensible de la dominance globale d'un petit nombre d'espèces présentes tant dans les 2/3 des prélèvements (9 espèces) que dans la moitié d'entre eux (16 espèces), témoignage irréfutable de la monotonisation et de la destructuration des peuplements, renforcée par l'accroissement de la présence des espèces indicatrices des conditions générales de la zone subnormale tandis que les espèces indicatrices de Biocoenoses se raréfient. Les AFC (Fig. 2) confirment amplement ces données et montrent: a) l'isolement, sur l'axe, 1 de la station H3, la plus proche de l'émissaire, qui s'oppose à l'ensemble des autres stations de la campagne 1976, tandis que les prélèvements de 1980 et de 1986 se regroupent, en position intermédiaire, le long de l'axe 2 (et de l'axe 3). On peut admettre qu'il y a un état 1976 précédant le détournement permanent de l'Huveaune, petit fleuve côtier très pollué, dans le système d'émissaires d'eaux usées, suivi d'un état 1980-1986. Il faut, cependant, garder en mémoire que de 1976 à 1986, la dégradation des peuplements a été continue .

Figure 2: Analyses factorielles de correspondances (axes 1 et 2, 1 et 3)



La réduction, très importante des rejets de particules fines véhiculant tout type de polluants, à la suite de la mise en route de la station d'épuration de Marseille (fin 1987) devrait permettre une amélioration très importante de la qualité des peuplements benthiques au large de Cortiou. On rapellera que cette réduction avait été proposée par toutes les équipes scientifiques ayant travaillé dans le secteur. On se réfèrera, à ce sujet, à la récente synthèse de ARNOUX et al. (1987).

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M-I1

Evaluation des différentes populations microbiennes dans deux zones de la Méditerranée

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L'étude du rôle que les micro-organismes ont dans les ecosystèmes aquatiques requiert la quantification des diverses composantes microbiennes présentes. Nonobstant la connaissance des densités microbiennes présentes dans la mer, on doit la considérer plutôt incomplète outre que de difficile interprétation, à cause de la diversité des méthodes d'étude utilisées. Genovese (1981) a affirmé que la distribution et la composition bactérienne d'un corps d'eau peuvent donner des indications relatives au trophisme, à la nature et à l'origine de l'eau.

Les connaissances relatives à la Mer Méditerranée semblent assez limitées et concernent plutôt des données obtenues par des méthodes culturales, ayant trait essentiellement aux bactéries hétérotrophes aérobies mises en évidence sur milieux contenant de l'eau de mer. (Monticelli, 1980, Genovese 1981, Genovese et al. 1984).

Les méthodes de comptage direct par microscopie en épifluorescence, proposées par Hobbie et al.(1977), permettent aujourd'hui, de compter toutes les cellules d'une grandeur déterminée (Total direct Count:TDC) en utilisant diverses longueurs d'ondes ou bien seulement la composante photosyntétique autofluorescente (picophytoplancton ou picoplancton photosynthétique).

Cette étude-ci se réfère à la distribution verticale des populations microbiennes, dénombrées à travers diverses méthodes, dans des échantillons d'eau de mer prélevés dans deux zones de la Mer Méditerranée ayant des caractéristiques hydrologiques différentes.

Les zones étudiées sont reportées dans les fig.1 et 2. Les échantillons d'eau, prélevés à la profondeur indiquée dans les fig.3 et 4, ont été examinés selon les techniques déjà décrites (Bruni et al.1987) au microscope à épifluorescence et pour le comptage cellulaire total, après coloration avec DAPI (Porter et Feig, 1980) et pour le comptage du picophytoplancton (Putt et Prézelin, 1985); et ensemencé (par étalement sur milieu gélosé Marine Agar 2216 (Difco) pour le comptage des colonies de bactéries hétérotrophes capables de se développer à 20°C.

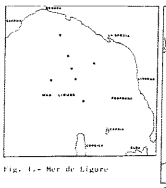

Fig. 1.- Mer de Ligure

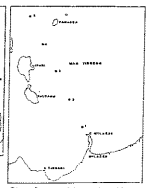

Fig. 2.- Archipel des Iles Eoliennes

Les données physiques et chimiques relatives aux échantillons examinés ont été fournies par le laboratoire de chimie du Département de Biologie Animale et Ecologie marine de l'Université de Messine.

La distribution verticale des densités microbiennes évaluées avec les différentes méthodes sont représentées dans les figures 3 et 4.

Pour la zone qui correspond à la Mer de Ligure, les comptages totaux obtenus par microscopie à épifluorescence ont donné des valeurs comprises entre $5,5x10^7$ cell.l^{-1} (500mètres) et $1,1x10^9$cell.l^{-1}(20mètres).

Les cellules autofluorescentes (fraction dimentionelle comprise entre 2 et 0,22µm ont fait enregistrer des valeurs comprises entre $7,7x10^6$cell.l^{-1}(100mètres) et $2,3x10^8$cell.l^{-1}.

Les comptages microbiens totaux effectués dans la zone des îles Eoliennes montrent une meilleure uniformité que ceux de la zone décrite auparavant. Ils présentent des valeurs comprises entre $4,3x10^7$cell.l^{-1}(500m) et $6,5x10^8$cell.l^{-1}(100m). La composante hétérotrophique aérobie a enregistré des valeurs qui oscillent entre $9,5x10^6$cell.l^{-1}et $2,85x10^8$cell.l^{-1}(0metri).

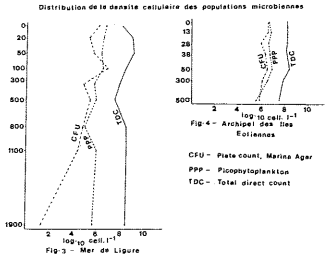

Fig.3 - Mer de Ligure

Fig.4 - Archipel des Iles Eoliennes

CFU - Plate count, Marina Agar
PPP - Picophytoplankton
TDC - Total direct count

Les données obtenues sur Marine Agar 2216 sont du même ordre de grandeur que celles qui ont été obtenues par Monticelli (1980) et par Genovese et al. (1984) dans des échantillons de la même mer.

L'utilisation des méthodes de comptage direct a permis d'apprécier des densités cellulaires plus élevées grâce à la possibilité de dépasser les limites représentées par les cultures sur des milieux artificiels.

La présence constante de la composante autofluorescente, indépendamment de la profondeur et de la lumière, semble d'un intérêt particulier.

Bien que les données fournies se réfèrent toujours à la population microbienne, elles sont à même de fournir des informations relatives à des composantes physiologiquement différentes (comptage de toutes les cellules d'une dimension déterminée, comptage des bactéries hétérotrophes aérobies, comptage des micro-organismes photoautotrophes).

Les corrélations relevées entre les densités microbiennes et les paramètres physico-chimiques d'intérêt océanographique sont discutées brièvement.

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M-I2

Distribution des Bacillus dans les eaux et les sédiments du golfe d'Aden et de la mer d'Oman

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Plusieurs études antérieures des eaux et des sédiments marins de la région Nord-Ouest de l'Océan Indien, ont été consacrées essentiellement à la distribution de la microflore hétérotrophe (Bensoussan et al.,1981a),aux grands groupes bactériens (Bensoussan et al.,1981b) et à l'origine de la matière organique des eaux et des sédiments marins de la région Sud-arabique (Boudabous et al.,1981).

La présente étude a été effectuée dans le même programme de recherche pour définir la répartition horizontale et verticale des bactéries du genre Bacillus ainsi que l'identification des groupes isolés et leur distribution dans le sédiment de la même région marine.

De l'étude de la microflore hétérotrophe des sédiments marins de 9 stations réparties entre Djibouti et le large de Mascate, il apparait que les Bacillus dominent l'interface (0-2 cm à 22 cm) et représentent 70 à 90 % de la microflore du sédiment superficiel à l'exception de la station 6 où les Pseudomonas atteignent 80 % des bactéries isolées.Ce dernier genre est surtout dominant (80 à 100 % de la microflore) dans les eaux proches du fond marin (Bensoussan 1982).

Les coques Gram+ et Gram- et les bacilles Gram+ cohabitent avec les Bacillus et représentent 10 à 30 % des bactéries selon les stations. Avec l'enfouissement les bactéries sporulées aérobies diminuent nettement dans les sédiments prélevés à 50 cm de l'interface et disparaissent dans les sédiments profonds.Dans les mêmes niveaux les coques qui ne représentent qu'un faible pourcent (0 à 4 %) dans le sédiment superficiel augmentent à 25 % en moyenne à 50 cm de profondeur (13 à 50%) et atteignent des taux de 75 à 100 % de la microflore hétérotrophe des sédiments profonds (100 à 400 cm).

Tous les Bacillus isolés (220 souches) des stations 7,8 (en face de Mascate) et 9 (au large des côtes Sud d'oman) ,ont été caractérisés par 149 tests morphologiques biochimiques et nutritionnels et les résultats ont été analysés selon le KHi2 et les souches associées selon la variance.Plusieurs analyses ont été effectuées et les réponses aux tests des Bacillus marins ont été comparées à celles de 39 souches de Bacillus de référence représentant la majorité des espèces connues et étudiées dans les mêmes conditions.

65 % des souches sauvages associées à des espèces de référence ont été identifiées à des espèces connues.Les taxons identifiés regroupent les espèces apparentées à B.subtilis,B.firmus,B.lentus,B.badius et B. licheniformis.Un autre groupe fréquent dans les sédiments Sud-arabiques s'identifie à B.sphaericus et B.cirroflagellosus.

Les souches marines non identifiées (35 % des Bacillus) forment quatre taxons stables dans les différentes analyses numériques et ne s'associant pas avec les espèces de référence apparaissent comme des espèces nouvelles de Bacillus d'origine marine.Cette hypothèse est confirmée en partie par des observations préliminaires des spores de ces groupes en microscopie à balayage.

La répartition verticale des différents groupes de Bacillus (identifiés et non identifiés),en fonction de la profondeur du sédiment,ne présente aucune relation avec la stratigraphie sédimentaire.Les Bacillus isolés des niveaux anciens s'associent étroitement,dans les mêmes phénons,avec ceux provenant des sédiments récents.Cette observation prouve que la décroissance des bactéries sporulées en fonction de l'enfouissement n'est pas qualitative mais seulement quantitative et reste liée essentiellement à la diminution de la matière organique dégradable dans les sédiments profonds.

La distribution des groupes de Bacillus actifs (hydrolyse des macromolécules.fermentation et oxydation des sucres) et des groupes inactifs ou de faible activité métabolique est homogène et les différents phénons coexistent dans les mêmes niveaux sédimentaires (répartition horizontale).Ces résultats suggèrent que dans les conditions in situ une complémentarité métabolique existe entre ces groupes dans la minéralisation et l'utilisation des composés minéraux et organiques.

Les Bacillus marins (identifiés ou non) tolèrent des salinités $\geq$ à 35 % de NaCl.Toutes les espèces de Bacillus terrestres,mêmes celles très actives sur les substrats carbonés et sur les macromolécules comme B.polymyxa,B.macerans et B.circulans ne tolérant pas les salinités élevées (supérieures à 10 à 15 g de NaCl /l),n'ont pas été retrouvées et aucun groupe apparenté à ces espèces n'a pu être isolé dans les eaux et les sédiments du Golfe d'Aden et Mer d'Oman.

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M-I3

Evolution de la dynamique des peuplements de Micromycètes de la zone littorale roumaine de la mer Noire

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Abstract

A big number of samples from the nearshore Romanian marine waters (1,300) have been analysed throughout 1981-1985 period. There had been identified 28 marine fungi belonging to the Phycomycetes class: Chytridiales, Saprolegniales, Peronosporales, Mucorales orders, and Deuteromycetes class: Blastomycetes, Coelomycetes orders are also presented. For the systematic account, criteria mentioned by Ainsworth and Sussmann (1968) and Kreger von Rij (1973) were used. For all five years,qualitative and quantitative analyses have been carried out, establishing also the frequency of either dominant and less representative species.

En poursuivant les recherches sur les peuplements de micromycètes du littoral roumain de la mer Noire (Apas, 1978; 1980 a,b), ce travail présente très succinctement des données concernant la dynamique des champignons accidentellement et rigoureusement marins de la zone mentionnée.

En vue des investigations, on a considéré un réseau de stations formé de 13 profils, perpendiculaires à la côte, chaque profil ayant trois stations à l'horizon 0 m des isobathes de 2, 5, 10 et 20 m. On a prélevé les échantillons mensuellement, pour mettre en évidence toutes les saisons biologiques. La méthode de prélèvement utilisée a été celle recommandée par Schlieper (1968). Pour isoler, cultiver et déterminer qualitativement les espèces de champignons des classes Deuteromycetes et Phycomycetes, on a employé la méthode de Gaertner (1965; 1968).

Nos recherches ont mis en relief quelques caractéristiques générales de l'évolution de ces organismes planctoniques. Le mycoplancton côtier a eu généralement des niveaux maximaux pendant les saisons biologiques de printemps et d'automne, ayant cependant des valeurs significatives au cours des mois d'été de la plupart des années de référence.

Durant les cinq années d'études (1981-1985), on a identifié 28 taxons (tableau 1). Parmi ceux-ci,les genres Cladosporium,Penicillium, Rhodotorula et Candida ont eu la domination quantitative, les espèces appartenant aux genres Rhodotorula et Candida ayant une fréquence élevée.

Le rapport entre les groupes taxonomiques a toujours été favorable aux champignons levuriformes, ainsi qu'on peut voir ci-dessous:

Groupe taxonomique	1981	1982	1983	1984	1985
Champignons filamenteux	25,85	25,83	33,77	21,66	27,45
Champignons levuriformes	74,15	74,17	66,23	78,34	72,55

De la moyenne totale de 246.225 spores par litre (pour les cinq années de recherche), environ 75 % revient aux champignons levuriformes. Le développement excessif des formes levuriformes atteste l'état de forte eutrophisation du milieu marin. Deux genres sont même responsables d'un phénomène de "floraison fongique", signalé au cours des années 1981 et 1984 - engendré par les espèces de Rhodotorula, et en 1985 - dû aux espèces de Candida.

La quantité moyenne totale de propagules oscillait, au cours des cinq ans, entre 6640 et 10.470 spores par litre, selon les stations.

Tableau 1

Structure qualitative de la mycoflore et fréquence (%) des espèces pendant la période 1981-1985

Espèces	1981	1982	1983	1984	1985
Penicillium chrysogenum	5,34	19,17	9,21	8,88	8,67
Cladosporium algarum	8,64	7,74	8,31	9,70	8,60
Fusarium moniliforme	0,29	0	0	0	0
Fusarium oxysporum	0	0,48	0,13	0,19	0,34
Aspergillus niger	0,09	0,28	0,07	0	0
Aspergillus fumigatus	0	0	0	0,12	0,26
Mucor racemosus	0,14	0	0	0	0
Mucor sp.	0	0,20	0,13	0,47	0,27
Rhizopus nigricans	0	0	0	0,07	0,09
Rhizopus sp.	0,12	0,28	0,22	0	0
Epicoccum maritimum	0,16	0,06	0,13	0,27	0,15
Alternaria maritima	0,09	0,09	0,01	0,05	0,05
Trichoderma viride	0,73	0,19	0,04	0,03	0,03
Cephalosporium acremonium	0,18	0,37	0,18	0,22	0,38
Pullularia pullulans	0,02	0	0	0	0
Verticillium tenerum	0	0,71	0,17	0	0
Verticillium lecanii	0	0	0	0,04	0,10
Trichophyton mentagrophytes	0	0	0	0,10	0,19
Trichophyton sp.	0	0	12,34	0	0
Botryotrichum piluliferum	0	0	0	0,14	0,09
Champignons filamenteux non-identifiés	4,03	0,47	0	0	0
Rhodotorula glutinis	40,18	20,33	20,12	48,45	23,16
Candida albicans + C.maritima	20,43	28,20	23,09	0	0
Cryptococcus neoformans	10,39	10,73	8,37	2,13	5,39
Geotrichum candidum	2,39	7,57	9,27	5,77	2,26
Champignons levuriformes non-identifiés	6,74	3,15	0,11	0,06	0,10

Les recherches seront continuées, qualitativement aussi bien que quantitativement, en divers biotopes et zones de la mer Noire, en les complétant en même temps avec certains aspects éco-physiologiques.

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M-I4

The role of marine Fungi in the degradation of sea grasses

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In marine coastal ecosystems, the production of macrophytes algae sea grasses, mangroves constitute the natural and most important food sources for marine invertebrates and vertebrates (Mann 1976). Approximately 5% of the macrophyte production is consumed directly by herbivores (Fenchel, 1972; Odum, Zieman and Heald, 1973) and the remainder must be converted to microbial biomass before it can be utilized by primary consumers (Hargrave, 1976; Yingst,1976;Heinle, Harris, Ustach and Flemer,1977,Tenore, 1977). Considerable information is available on the occurrence of marine fungi on wood and other cellulosic materials (Jones, 1976; Kohlmeyer and Kohlmeyer, 1979); however remarkably little is known about marine fungi growing on sea grasses such as Cymodocea, Posidonia, Thalassia and Zostera.
Few studies have been undertaken of the degradation of sea grasses in marine ecosystems.
Marsh plant degradation has been studied by Gessner (1976;1980),Crabtree and Gessner (1982), Torzilli and Andrykovitch (1980); seaweed by Tubaky (1969), Miller and Jones (1983) and Schatz (1984). Detailed studies of mangrove leaf breakdown had been reported by Fell and Newell (1981), and Cundell et al.(1979).
Breakdown and conversion of Posidonia oceanica leaf biomass had been reported by Cuomo (1986) and Cuomo et al. (1987a,1987b).
Detailed information is available on the colonization and enzymatic breakdown of lignicellulose material (Jones E.B.G. 1976; Leightley L.E. and Eaton R.A. 1977, Leightley L.E. 1980).
Marine lignicolous fungi have been shown to possess a wide range of enzymes capable of utilizing wood components: cellulose, xylan, glucomann and lignin (cellulases, hemicellulases, laccase, tyrosinase, laminarase), Tubaki (1969); Leightley L.E. (1980), Cuomo (1987a).
Degradation of sea grasses in marine ecosystems has been studied and the role of higher marine fungi in this process proves to be important. These studies have shown that a wide range of fungi is involved in the degradation.
Members of the Phycomycetes (Fell and Master; 1975) are early colonizers of mangrove leaves. These are later replaced by a wide variety of Ascomycotina and Deuteromycotina (Fell and Newell, 1981).
Similar cell wall degrading enzymes have been reported for a range of salt marsh fungi (Gessmer 1980; Torzilli and Andrykovitch 1980). The mechanical and biochemical breakdown of marine angiosperm leaves is a process that should be taken due note of and investigated further.

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M-II1

Antibiotic resistance of bacterial strains isolated from the marine environment

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Introduction.

The widespread use of antibiotics in agriculture and medicine is considered as the major responsible factor increasing the isolation frequencies of antibiotic-resistant microorganisms. It has been demonstrated that antibiotic-resistant microorganisms eventually may enter into the marine environment through land runoff and sewage discharges (2,4).

This study was undertaken to provide descriptive information about antibiotic resistance patterns of microorganisms (fecal pollution indicators and pathogens) isolated from marine environment (water, shellfishes, and sediments), and to explore whether this resistance ability is related with their respective taxonomic groups.

Material and Methods.

Samples were collected in the marine area near Guadalhorce river mouth and in beaches affected by sewage discharges in Málaga (Spain). The studied microorganisms belong to two groups: fecal pollution indicators (Coliforms and Fecal Streptococci), and pathogens (*Pseudomonas aeruginosa*, *Salmonella* spp, *Aeromonas hydrophila*, *Vibrio* spp, and *Staphylococcus* spp). The culture media employed for the microorganisms isolation were: Endo agar for Coliforms, KF agar for Fecal Streptococci, Cetrimide agar for *P. aeruginosa*, XLD agar for *Salmonella* spp, m-A medium for *A. hydrophila*, TCBS agar for *Vibrio* spp, and Mannitol Salt agar for *Staphylococcus* spp (1). The study of antibiotic resistance patterns of isolates were determined by the disk diffusion method (6). The relationship between resistance patterns of the different bacterial groups was studied by applying the formula proposed by Kelch & Lee (4).

Results and Discussion.

The results obtained from the antibiotic susceptibility study are shown in Table 1. They reveal the existence of high resistance frequencies to amoxycillin and tetracycline, and low resistance frequencies to carbenicillin, gentamicin, and colistin, among Gram-negative microorganisms. A higher resistance ability of *P. aeruginosa* strains is observed, according to the results obtained by other authors (3,5,6). For Gram-positive microorganisms, two different resistance profiles are observed, being the highest resistance pattern for Fecal Streptococci strains.

The study of the relation among resistance patterns of microbial groups is shown in Table 2, independently of the isolation environment (water, shellfishes, or sediments). In this Table, no correlation between *P. aeruginosa* and the other microorganisms is observed. Similar results are obtained for Fecal Streptococci. This shows the presence of specific antibiotic resistance patterns for these microorganisms, being possibly associated to their respective taxonomic groups. For the other microbial groups significant correlations among them are obtained, especially for Coliforms. This means that the microorganisms have similar resistance patterns, which can be explain by the exposure of microorganisms to these substances in their original environments, or because they have developed similar resistance mechanisms against antibiotics (4).

TABLE 1. Antibiotic resistance of bacterial strains isolated from marine environment.

Antibiotics (code)	Frequency (%)						
	P. aeruginosa[a] (n=25)	Coliforms[a] (n=56)	*Salmonella spp*[a] (n=15)	*A. hydrophila*[a] (n=32)	*Vibrio spp*[a] (n=22)	*Staphylococcus spp*[b] (n=12)	Fecal Strep.[b] (n=41)
AMX	84.00	60.71	6.67	81.25	68.18	50.00	0.00
CF	76.00	5.36	6.67	78.13	18.18	0.00	21.95
S	76.00	21.43	0.00	15.63	9.09	8.33	100.00
K	84.00	7.14	0.00	15.63	0.00	8.33	90.24
GM	0.00	1.79	0.00	0.00	0.00	0.00	68.29
TE	96.00	96.43	86.67	90.62	54.55	33.33	46.34
C	68.00	5.36	6.67	9.38	4.55	0.00	2.44
G	56.00	21.43	6.67	15.63	18.18	0.00	100.00
1	4.00	17.86	6.67	18.75	27.27	33.33	24.39
2	0.00	1.79	0.00	18.75	13.64	33.33	95.12
3	76.00	0.00	6.67	12.50	22.72	0.00	12.20
4	76.00	7.14	6.67	9.38	0.00	25.00	0.00

a: 1. Carbenicillin, 2. Colistin, 3. Nalidixic acid, 4. Trimethoprim-Sulfamethoxazole.
b: 1. Erythromycin , 2. Lincomycin, 3. Nitrofurantoin, 4. Novobiocin.
AMX: Amoxycillin, CF: Cephalothin, S: Streptomycin, K: Kanamycin, GM: Gentamicin, TE: Tetracycline, C: Chloramphenicol, G: Sulfamides

TABLE 2. Coefficients of correlation between the antibiotic resistance patterns of the studied microorganisms.

	P. aeruginosa	Coliforms	*Salmonella* spp	*A. hydrophila*	*Vibrio* spp	*Staphylococcus* spp	Fecal Streptococci
P. aeruginosa	---						
Coliforms	0.429	---					
Salmonella spp	0.376	0.833*	---				
A. hydrophila	0.475	0.756*	0.621**	---			
Vibrio spp	0.294	0.829*	0.552**	0.805*	---		
Staphylococcus spp	0.539**	0.838*	0.463	0.703*	0.921*	---	
Fecal Streptococci	-0.218	-0.214	-0.142	-0.535	-0.474	-0.225	---

Confidence level of coefficients of correlation: * 99% ** 90%

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M-II2

Recherche de champignons potentiellement pathogènes (Dermatophytes) dans le sable des plages méditerranéennes de la Côte d'Azur (France)

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Key-word: Fungi, contamination, sand, beaches, Mediterranean

SUMMARY

During the summers 1986 and 1987, a survey of the french mediterranean beach contamination by potentially pathogenic keratinophilic fungi was undertaken. 125 sand sampling from 12 different beaches were examined. Among the 145 fungi identified only 8 keratinophilic and weakly pathogenic species were accountered.

Les dermatophytes, champignons kératinophiles provoquent diverses affections de la peau et des phanères (cheveux et ongles). Certaines espèces sont incriminées dans les mycoses estivales. Peu de données sont disponibles sur la présence de dermatophytes dans le sable des zones côtières marines à vocation balnéaire et récréative ; Kishimoto et Baker, 1969 ; Bergen and Wagner-Merner, 1977 ; Todaro, 1978 ; Esterre et Agis, 1983 ; Dabrovna et al., 1984 ; Gip and Paldrok, 1986.

Dans la présente étude, les champignons kératinophiles ont été recherchés dans 125 échantillons de sable de plages (82 récoltés en flacons plastiques stériles et 43 par empreinte de moquettes stérilisées. L'échantillonnage a été réalisé selon des radiales perpendiculaires à la rive en prélevant pour chaque échantillon 100 g de sable à partir de la surface et jusqu'à 5 cm de profondeur. Les premiers prélèvements de sable ont été effectués à des distances comprises entre 1 à 5 m de la mer, les autres à des distances comprises entre 5 et 15 m, puis supérieures à 15 m.

Pour chaque échantillon de sable, trois techniques ont été utilisées pour l'isolement des dermatophytes :

La technique du piégeage par cheveux (Vanbreuseghem, 1952), modifiée par Orr (1969), la filtration sur membrane (0,45 µ) des eaux de lavage de sable et la technique d'empreinte par moquette (10 cm x 10 cm).

Les primocultures ont été effectuées sur gélose Sabouraud au chloramphénicol (0,05 %) et à l'actidione (0,05 %) et sur gélose Dermatophytes Sélective selon Taplin. La croissance des champignons filamenteux a été observée pendant 2 à 8 semaines, puis les souches suspectes repiquées sur gélose au malt pour identification.

Parmi les 145 champignons filamenteux isolés, les espèces kératinophiles que nous avons le plus fréquemment rencontrées ont été : *Arthrographis kalrai* (4,8 %), *Microascus trigonosporus* (2,8 %), *Chrysosporium keratinophilum* (1,4 %) et *Chrysosporium carmichaeli* (0,7 %).

Les espèces non kératinophiles mais faiblement pathogènes ont été : *Paecilomyces lilacinus* (11 %), *Acremonium strictum* (4,8 %), *Geotrichum candidum* (2,8 %). Le seul dermatophyte isolé au cours de ce travail, *Trichophyton terrestre* (0,7 %) est une espèce strictement géophile jamais rencontrée en pathologie.

Nos observations sur les champignons kératinophiles isolés du sable des plages de la côtes d'Azur sont comparables à celles d'autres auteurs et plus particulièrement à celles de Todaro (1978) qui a signalé la faible fréquence des dermatophytes dans le sable des plages méditerranéennes (Sicile, Italie), ce qui peut être expliqué par la pauvreté du milieu en matière organique, sa forte dessication et l'influence des ultra-violets.

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M

Survival of Candida albicans in sea water

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Introduction

The contact of microbial cells with an adverse environment, may result in physiological damages which may be sublethal or produce the death of the cell. The physiological damage or stress exerted by the marine environment on the allochtonous bacteria can be studied by observing either the bacterial structural disorganization or its inability to grow in a selective medium. However, these stressed cells can be developed in cultural media which do not contain inhibitory substances (1).

Candida albicans is a component of the intestinal flora of animals and birds and its occurrence in natural waters is associated to fecal contamination (2). *C. albicans* has been proposed as a potential water quality indicator organism (3), and as an agent of mycotic infections in humans.

In this paper the influence of some environmental factors on the inactivation process of *C. albicans* by sea water is studied.

Materials and Methods

Five test solutions were investigated to study the effect of the different factors of the seawater on *C. albicans* (C.E.C.T., 1394): (a) unpolluted raw seawater, (b) artificial seawater, (c) filtered artificial seawater, supplemented with 1 % of sewage, (d) artificial seawater with light. Physiological saline solution (0.85 % NaCl) was used as control solution. All the test solutions were maintained in darkness and at a constant temperature of 18°C, except one artificial seawater solution that was subjected to constant sunlight.

The microbial suspensions were sampled at 0, 1, 3, 7 and 14 days from the start of the experiment. Enumeration of microorganisms was carried out by the spread plate technique on selective mCA agar, (2), and non-selective media (TSA) (Difco), from decimal dilutions of the test suspensions. All the tests were performed on triplicate plates for each dilution and medium.

Results and Discussion

No significant inactivating effects of artificial seawater, filtered seawater and artificial seawater supplemented with sewage was observed on the survival of *C. albicans*, because in these media, as well as in the saline solution, *C. albicans* concentrations remained more or less constant. The conditions which produce the highest negative effects on this pathogen were the established by raw seawater (0.28 % of survivors after 14 days) and, mainly, artificial seawater exposed to visible light, which provokes the inactivation of almost the total of the microbial titre (Figure 1).

The biotic unfiltrable factors were the principal responsibles for the inactivation of the microorganism populations in the sea. These biotic factors are mainly formed by predators (4), and micropredators (5). Another inactivation factor is the competition for nutrients by the autochtonous microflora (6,7).

Light action produces photooxidation of vital mechanisms of the cell (8). This inactivation effect is proportional to the intensity and time exposure to radiation, its effect being determined by the transparency and concentration of particulate matter dissolved in water (9).

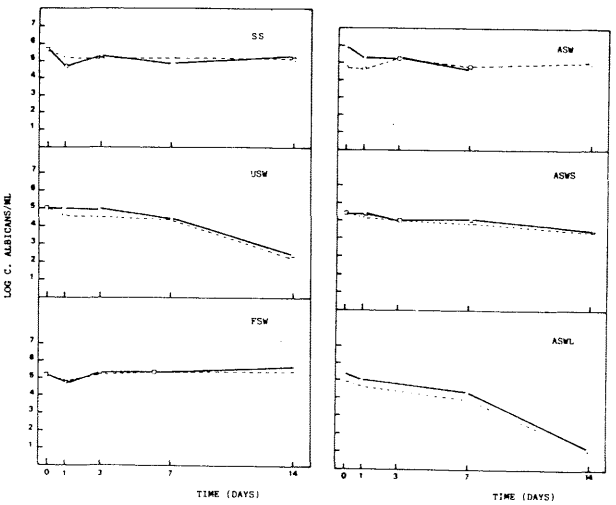

Figure 1 : Survival of C. albicans in : Saline solution (SS) ; untrated seawater (USW) ; filtered seawater (FSW) ; artificial seawater (ASW) ; artificial seawater plus sewage (ASWS) ; artificial seawater plus light (ASWL). (--- Recounts on mCA, —— Recounts on TSA).

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Comparison of faecal coliform levels in Mussel flesh and flesh/intervalvular fluid

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The scope of this investigation is to establish the difference betwéen faecal coliform levels in shellfish flesh and faecal coliform levels in the flesh and intervalvular fluid of shellfish.Obtained results would be used as the basis for the recomendations concerning the most appropriate method for for shellfish studies in the framework of our participation to WHO/UNEP MED POL Phase II Project.

Material and Methods

Samples (Mytilus galloprovincialis and their growing sea water) were collected in the coastal area of Split in 1986 through 1987.

Faecal coliforms were analysed in the mussel flesh and in the mussel flesh together with intervalvular fluid. At the same time faecal coliforms were studied in the mussel growing water.

Methods proposed by WHO/UNEP were used (mussel-multiple test tube method,[1] sea water-membrane filtrations method[2]).

Results and Discusion

High correlation was established between faecal coliform concentration in the mussel tissue alone and faecal coliform concentration in flesh/intervalvular fluid (Fig.1). The correlation coefficient was 0.96. No essential difference in concentration of FC were found between them.So it led us to the conclusion that both methods were equally suitable.

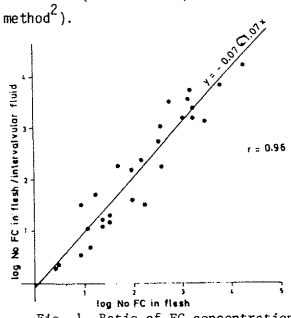

Fig. 1. Ratio of FC concentrations in flesh/intervalvular fluid to those in flesh.

The comparison of the faecal concentration in the flesh/intervalvular fluid and in flesh alone with that in the growing water shows their relationship to be for the most part proportional.This means that in more polluted areas the concentration of FC in flesh/intervalvular fluid is higher than in flesh alone (Fig.2).

The same conclusions could be drawn from the analyses of the relationship between faecal coliform concentration in flesh and that in growing water (Fig.3) and the faecal coliform concentration in the flesh/intervalvular fluid and growing water (Fig.4). In the former case the correlation coefficient was 0.75 and in the latter 0.80.

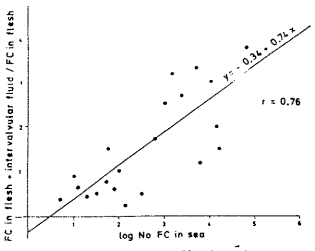

Fig. 2. Ratio of FC in flesh + intervalvular fluid/FC in flesh to FC concentrations in the sea.

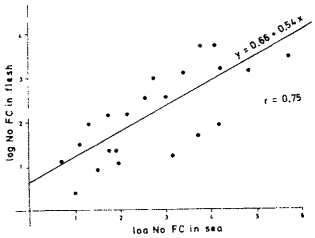

Fig. 3. Ratio of FC concentrations in flesh to those in the sea.

Conclusions

No essential difference in faecal coliform concentration in shellfish flesh alone and that in flesh/intervalvular fluid was established,which points to the fact that both methods are equally applicable.

However, we should like to recommend the flesh/intervalvular fluid method for determination of faecal coliform concentration from the following reasons:

- The coefficient of correlation with the growing water is slightly higher particularly in more polluted areas.
- The method is more simple since flesh needn't be separated from intervalvular fluid
- Both flesh and intervulvular fluid are used as human food.

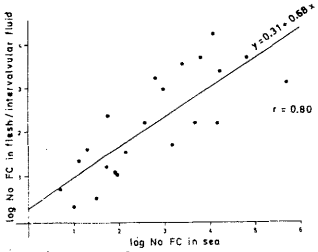

Fig. 4. Ratio of FC concentrations in flesh/intervalvular fluid to those in the sea.

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M-II5

Isolation and counting of S. aureus from sea water samples

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Attempts to isolate and count staphylococci by direct plating on selective media come up against a number of difficulties as a higher number of other cocci (planococci, micrococci) grow and mask or inhibit the growth of S.aureus colonies.As a result small quantities of sea water (0.2-0.5 ml) can be plated in order to obtain growth which permits the recognition and isolation of S.aureus.To analyse a greater quantity of sea water and to get better results with greater volumes of sea water we used the membrane filtration technique and the membranes were incubated on 4 selective media:1)Vogel & Johnson agar(VJ) (DIFCO),2)110 staphylococcus agar (OXOID), 3)Chapman medium (OXOID), 4)4-S agar modified by Mintzel-Morgenstern & Katzenelson (Yospe-Purer & Golderman,1987).The referencemethod by direct plating 0.2-0.5 ml of sample on Baird-Parker medium was applied in parallel.Plates were incubated at 37°C for 24 - 48 hours. A number of typical for staphylococci and atypical colonies were identified according to Morello & Randall 1981 (TABLE 1).The VJ agar was proved to be the most selective for S.aureus colonies. A great number of typical colonies on VJ agar were shown to be coagulase positive.The 4-S agar gave the greatest number of atypical colonies, then the Chapman and the Baird-Parker media.Again on VJ agar the highest number of other staphylococci species grew, followed by Baird-Parker medium and the smallest number of other Gram-positive cocci (mocrococci,planococci).

However, even with the more selective VJ agar we could not get satisfactory results when volumes such as 100 ml of sea water were filtered We turned to a MPN technique proposed by Standard Methods 1981 for drinking and surface water samples.The m-staphylococcus broth formulated for drinking and surface water samples produced appreciable amount of precipitation with sea water.Appropriate modifications were applied and finaly the medium was formulated as follows:

Single strength:Tryptone 10gr,yeast-extract 2,5gr, lactose 2,0gr, mannitol 10,0gr,sodium chloride 75gr,sodium azide 0,049gr, dist. water 11, final pH 7,0.

Double strength: Tryptone 20,0gr,yeast extract 5,0gr, lactose 4,0gr, mannitol 20,0 gr,sodium chloride 70,0 gr,sodium azide 0,098gr, Dist.water 11, final pH 7,0.

The modified medium was found to perform properly both in supporting the growth of staphylococci and not to produce precipitation. Positive tubes were streaked on Vogel - Johnson agar (VJ) (DIFCO) and on Lipovitellin - Salt - Mannitol agar (LSM), proposed by the Standard Methods, 1981.Typical staphylococci colonies were typed according to Morello & Randall, 1981.Of the 68 samples examined 27 (39,7%) were positive when the VJ agar was used while 11 (16,2%) were positive when the LSM agar was used.Nineteen samples positive on VJ plates were negative on LSM ones but only 3 positive on LSM plates were negative on VJ ones(TABLE 2).On samples positive with both media the MPN was generally higher on the VJ agar.False positive colonies appeared on VJ plates of 7 samples and on LSM plates of 28 samples ($P < 0,001$).

In conclusion MPN technique using modified m-staphylococcus broth and plating on VJ agar seems to be a suitable method for the detection and enumeration of S.aureus in sea water samples.Further research should include the growth of other staphylococci sp., as S.epidermitis, on VJ agar and the evaluation of other media proposed in the bibliography.

TABLE 1

Identification of 179 strains recovered on staphylococcus selective media.

MEDIA	TYPICAL COLONIES S. aureus	planococcus	micrococcus	staphylococcus sp	atypical colonies
Vogel and Johnson agar	8	0	1	15	3
110 staphylococcus agar	2	7	4	4	13
Chapman medium	2	10	1	7	18
4 - S agar (modified)	3	6	1	6	25
Baird - Parker medium	1	2	3	10	17

TABLE 2

Results of the isolation of S.aureus from sea water samples using the MPN technique.

	No of samples	positive	negative	P
Vogel - Johnson agar	68	27	41	
Lipovitellin - salt Mannitol agar	68	11	57	<0,01

M-II6

Serologic characterization of Salmonellas isolated from polluted seawaters

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Introduction.

More then two thousands serotypes of *Salmonella* are known considering to this microorganism potentially pathogen to human and animal populations (1,2). Salmonellosis are transmitted usually by fecal contamination of the water and food, and some serotypes, such as *S. typhimurium* and *S. enteritidis*, cause a large number of infections.

In the present study were characterized serologically 172 isolates belong *Salmonella* genus. All the microorganisms were isolated from two marine zones subject to polluted discharges.

Sampling Areas.

Two zones were selected for the sampling. One of them was sited in one marine area influenced by the discharges of Guadalhorce river (Málaga-Spain). This area is polluted by fecal and industrial discharges. The second area of study was established in the zone influenced by the upwelling of a submarine outfall in Fuengirola (Málaga-Spain). The pollution of this zone is produced by domestic sewage discharges.

Results and Discussion.

In Tables 1 and 2 are described the *Salmonella* serotypes isolated and their frequency percentages. As can be seen in the marine area affected by river discharges, there is a lower number of serotypes, due probably to the nature of discharge (mixed pollution). In both zones, the same serogroup of *Salmonella* were isolated, and C_1 serogroup was preponderant in both zones. Others serogroups that were significantly detected were C_2 in marine zone affected by river discharges and B in the area of submarine outfall influence.

The percentages of detection of *Salmonella* serotypes were lower than 10 % except in the cases of *S. typhimurium* and *S. ohio* in the zone affected by the river (25 and 23.36 %, respectively), and *S. thompson*, *S. bloctley* and *S. typhimurium* in the zone affected by the outfall discharges, although the values of these threes serotypes never were equal or higher than 20 %. *S. bloctley* was only isolated from source that posses a domestic fecal influence and for this reason their detection may be associated to exclusivelly fecal origin.

In Tables 1 and 2 are exposed the relationship between isolation percentage and drift time in the sea. As can be seen a close relation may not be established between these parameters, results that are in agreement with those obtained by other authors (3,4) in *Salmonella* survival studies.

Table 1: Detection percentage of different serotypes isolated from marine zone affected by discharges of the river.

Serotypes	Serogroup	Drift Time in the sea 0 min (n=33)	0-10 min (n=18)	>10 min (n=25)	Total (n=76)
Self-agglutinable	-	21.21	5.55	24.00	18.42
Inmobile	-	3.03	-	-	1.31
S. typhimurium	B	12.12	27.77	40.00	25.00
S. infantis	C_1	9.09	9.09	-	5.26
S. ohio	C_1	18.18	33.33	-	7.89
S. paratyphi	C_1	-	5.55	-	1.31
S. postdam	C_1	3.03	-	-	1.31
S. thompson	C_1	3.03	-	4.00	2.62
S. bloctley	C_2	3.03	-	-	1.31
S. bovis-morbificans	C_2	-	-	4.00	1.31
S. muenchen	C_2	6.06	-	-	2.62
S. enteritidis	D	12.12	-	4.00	6.57
S. london	E_1	6.06	22.22	-	7.89
S. senftemberg	E_4	-	5.55	-	1.31
S. tatsony	E_4	3.03	-	-	1.31

Table 2: Detection percentage of different serotypes isolated from marine area affected by discharges of the submarine outfall.

Serotypes	Serogroup	Drift time in the sea 0 min (n=60)	0-10 min (n=22)	>10 min (n=14)	Total (n=96)
Self-agglutinable	-	-	-	-	-
Inmobile	-	-	-	-	-
S. typhimurium	B	13.33	-	9.09	10.41
S. braenderup	C_1	1.66	-	-	1.04
S. infantis	C_1	6.66	-	7.14	5.20
S. menden	C_1	-	4.54	-	1.04
S. montevideo	C_1	-	4.54	-	1.04
S. ohio	C_1	8.33	13.63	7.14	9.37
S. orunaiemburg	C_1	1.66	4.54	-	2.08
S. postdam	C_1	-	13.63	-	3.14
S. thompson	C_1	15.00	22.70	9.09	16.66
S. virchow	C_1	10.00	-	7.14	7.29
S. bloctley	C_2	8.33	22.70	7.14	11.45
S. bovis-morbificans	C_2	-	-	7.14	1.04
S. muenchen	C_2	-	-	7.14	1.04
S. enteritidis	D	3.33	4.54	-	3.12
S. london	E_1	10.00	-	7.14	7.29

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Relations between indicator microorganisms and the presence of Salmonella in a polluted marine zone

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Introduction.

The increase of the sewage disposal have intensified the detection of pathogens in the marine environment. The analysis of these microorganisms is not easy, and for this reason to evaluate the quality of water the indicator microorganisms are employed (Bonde, 1977; W.H.O., 1977), because they are relationed with the pathogens (Cabelli, 1977), and are easier to detect.

Objectives

In this work the *Salmonella* detection percentage in relationship with the median of the log-normal distributions of the indicator microorganisms is studied. Seven sampling stations were choosen in one marine zone, which supported the discharges of the Guadalhorce river (Málaga-Spain). The source of these discharges are urben and industrial.

Results and Discussion

To evaluate the quality of these waters are used the criterions specified by M.O.P.U. (1977) and W.H.O. (1974).

In Table 1 the correlation equations between the detection percentage of pathogen and the median of the log-normal distributions of concentration$_{50}$ of indicator microorganisms are schematiced. The most significative and high correlations were obtained with Total Coliforms (TC) and Fecal Streptococci (SF). The coliphages (Ph), which are proposed as indicator by different authors, showed a similar values to TC and SF, although his significance level was lower than TC and FS.

In Tab.2 it is possible to observe that in cases of an elevate pollution (high concentrations$_{50}$ of indicators), the quality of water is guaranteed by the analysis of indicators, but is different when the pollution is low (with titles of FC$_{50}$: (W.H.O., 1974, M.O.P.U., 1977) and FS$_{50}$ (Mujeriego et al., 1980) ≤100/100 ml) it was possible to detect *Salmonella* at least with a hazard of 10 %.

At least 10 % of hazard to detect salmonellas was observed with concentrations of other indicator microorganisms such as 600 TC/100 ml, 50 Clostridia sulfite reducers(Cs)/100 ml and 100 Ph/100 ml, which are tittles of waters with scarce pollution.

In short, in these waters, which are influenced by discharges of mixed pollution, and due the relative resistence of *Salmonella* to adverse environment (Majori et al., 1978; Cornax, 1986; Moriñigo, 1987), the quality of these waters is not guarenteed by analysis of indicator microorganisms when the pollution is very low or moderate.

Table 1: Correlations established between the concentrations$_{50}$ (x) of the indicator microorganisms and the probability to found *Salmonella* (y) in the marine area afected by the discharges od Guadalhorce river.

$y = \text{Log (TC)}_{50}\ 1.2159 - 0.9076 \quad (r = 0.8939;\ p < 0.005)$
$y = \text{Log (FC)}_{50}\ 0.9108 - 1.0352 \quad (r = 0.7231;\ p < 0.1)$
$y = \text{Log (SF)}_{50}\ 1.3595 - 0.2165 \quad (r = 0.8497;\ p < 0.001)$
$y = \text{Log (Cs)}_{50}\ 2.4965 - 1.6653 \quad (r = 0.7326;\ p < 0.1)$
$y = \text{Log (Ph)}_{50}\ 1.1930 - 0.0529 \quad (r = 0.8182;\ p < 0.02)$

Table 2: Concentrations $_{50}$ of the different indicator microorganisms with which the probability to found the pathogen are 50 and 10 %.

Indicator Microorganisms	50 %	10 %
Total Coliforms (TC)	4×10^4	5.5×10^2
Fecal Coliforms (FC)	10^4	≤ 50
Fecal Streptococci (FS)	3.5×10^3	$\leq 10^2$
Clostridia sulfite reducers (Cs)	3.5×10^2	≤ 50
Coliphages (Ph)	10^4	$\leq 10^2$

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Influence de la salinité sur la survie d'une souche d'Escherichia coli en eau de mer. Comparaison avec d'autres bactéries telluriques

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Introduction :

De nombreuses études ont été entreprises depuis près d'un siècle sur le devenir des bactéries telluriques dans le milieu marin (8, 9, 1). Toutes aboutissaient à la conclusion que ces micro-organismes mouraient rapidement en mer, sous l'action d'un certain nombre de facteurs physiques, chimiques et biologiques propres à ce milieu (3). Vers le milieu des années 70, certaines observations ont montré que ce déclin pouvait n'être dû, au moins en partie, qu'à la technique de numération elle-même (2, 6), les cellules "stressées" étant incapables de se développer sur des milieux sélectifs et devenant plus sensibles à la température et à la salinité. Elles évoluent ainsi progressivement vers un état viable mais non cultivable (10, 11).

Ce travail avait pour but d'étudier l'influence de la salinité sur la survie d'une souche d'*Escherichia coli* en milieu carencé ("starvation survival"). Une comparaison avec d'autres bactéries telluriques appartenant ou non aux Entérobactéries a été faite. L'importance du NaCl dans la récupération des cellules stressées est également discutée.

Résultats - Discussion :

L'effet du NaCl sur la survie de *E. coli* dans l'eau de mer apparaissait assez complexe, avec une mortalité apparente plus importante quand les cellules étaient préalablement cultivées à une concentration saline de 10 g/l, mais cependant un effet protecteur à 30 g/l (5). Cette adaptation au NaCl semblait moins importante que celle observée après croissance dans un milieu à l'eau de mer (4, 7).

Les mêmes résultats ont été obtenus avec trois autres Entérobactéries (*Klebsiella pneumoniae, Salmonella typhimurium* et *Shigella dysenteriae*, qui étaient presque totalement adaptées aux conditions marines après préculture en milieu salé. Quatre autres bactéries telluriques n'appartenant pas aux Entérobactéries présentaient le même comportement, qu'elles aient été ou non préadaptées au milieu marin (7).

Le NaCl peut également intervenir au niveau de la récupération d'un certain nombre de cellules stressées par un séjour plus ou moins long dans l'eau de mer. Ainsi, une numération des cellules non adaptées sur un milieu contenant 15 g/l de NaCl a permis un taux de récupération, par rapport à ce même milieu sans NaCl, de 55 fois. Cette addition de NaCl n'avait cependant aucun effet sur les cellules préadaptées (7).

La présence de sels et en particulier de NaCl paraissait donc être un facteur important dans l'adaptation possible de *E. coli* et des Entérobactéries en général, au milieu marin.

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M-II9

Relation between densities of indicator organisms and microbial pathogens in sea water

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This research programm was carried out to examine possible relations among the densities and the species of indicator organisms on the one hand and the presence and numbers (if possible) for organisms pathogenic for man on the other. This investigation was planned to include sea areas with different degrees of pollution and to search for significant correlations between densities of microbe indicators and patho genic organisms.

Samples of sea water were collected from 5 areas of the Saronic Gulf, with different grades of faecal contamination, from May 1984 to Novenber 1986 at 5 day intervals. Each sample was examined for the following: 1) Plate colony count/100ml at 37°C for 48h. 2) Coliform count/100ml 3) E.coli count/100ml 4) Enterococci count/100ml 5) Staphylococci for the first and second year in 0.5ml and afterwords in 100ml with modified technique 6) Salmonellae in 1L 7) Yearsiniae in 1L 8) V.cholera and V.parahaemolyticus in 1L 9) Yeasts in 50ml 10) Campylobacter in 200ml.

For Campylobacter isolation we tested different methods but finally selected the following technique: Enrichment of 200 ml in double strength Preston broth at 43°C/24h (semianaerobic conditions) and plating on Skirrow agar incubated under the same conditions for 48h.

Attempts to isolate Staphylococci by direct plating on selective media come up against a number of difficulties as a higher number of other cocci (Planococci, Micrococci) and even rods grow and mask or inhibit the growth of S.aureus. We tested different methods but finally used the MPN technique. m-staphylococcus broth was modified in order not to produce precipitation with sea water and to support the growth of S.aureus. For plating Vogel and Johnson agar (DIFCO) was used.

The comparison of Rappaport-Vassiliadis medium and Muller-Kauffmann's tetrathionate broth for salmonella isolation after a common preenrichment step shows clearly the great superiority of R-V medium, both in the number of isolations and also the variety of serotypes (P 0.0001).

Statistical analysis of the densities of microbe indicators in relation to the pre sence of Salmonella shows a significant correlation between Salmonella and coliforms, E.coli, Enterococci and plate count colonies (TABLE 1). There was no significant association between plate count colonies Enterococci and Salmonella in moderately polluted areas. There was no significant association between the microbe indicators and Salmonella when M-K broth was used nor between Campylobacter and the microbe indicators or between S.aureus and Salmonellae. Vibrios and Y.enterocolitica were not isolated from any of the samples. More work is necessary for species identification and epidemiological correlation with their origin.

TABLE 1

Association between microbe indicators and presence of Salmonella and Campylobacter level of significance, p, from Mann-Whitney test comparing microbe densities between samples with and without Salmonella or Campylobacter.

		Keratsini (heavily polluted)	N. Faliron (moderately polluted)
Col-	R-V *	.006	.007
	M-K **	.80	.24
	Salmonella ***	.008	.015
	Campylobacter	.73	.13
E.coli-	R-V *	.007	.002
	M-K **	.54	.37
	Salmonella ***	.005	.017
	Campylobacter	.51	.27
Ent-	R-V *	.005	.044
	M-K **	.72	.77
	Salmonella ***	.010	.22
	Campylobacter	.56	.34
PCA	R-V *	.001	.022
	M-K **	.36	.42
	Salmonella ***	.001	.028
	Campylobacter	.74	.60
Saph. - aureus	R-V *	.66	.34
	M-K **	.67	.28
	Salmonella ***	.38	.82
	Campylobacter	.06	.98

* Salmonella isolation when Rappaport-Vassiliadis medium was used

** Salmonella isolation when Muller-Kauffmann's tetrathyonate broth was used

***Salmonella isolation when either of the media was used

M-II10

Relationship between the persistence of Pseudomonas aeruginosa in seawater and its resistance to antibiotics and heavy metals

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Introduction.

Detection of *Pseudomonas aeruginosa* in natural waters is usually associated with pollution produced by sewage discharges. The high resistance of *P. aeruginosa* to heavy metals, antibiotics, and other environmental factors could be an important aspect in relation to the persistence and selection of strains in the marine environment (3,4). The purpose of the present study is to determine the relationship between some characteristics of *P. aeruginosa* strains (pyocines production and antibiotics and heavy metals resistance) isolated from seawater and their survival ability in this environment.

Material and Methods.

One hundred and eighty eight isolates of *P. aeruginosa* on mPA-E agar (5) were studied. Water samples were collected from two areas near Málaga (Spain): a sewage-polluted beach and the Guadalhorce river and the coastal area influenced by the river mouth. In both areas, three sample groups have been considered: the pollution sources (sewage and river), mixing area (<250 m from the outfall and estuary), and the marine area influenced by these pollution sources (>500 m from the sewage outfall in the beach and the coastal area of 1000 m around the river mouth).

The antibiotic resistance patterns were studied by disk diffusion method, and the heavy metal resistance was evaluated by agar dilution method (6). The pyocin types were investigated by scrape and streak method (6).

Results and Discussion.

Among antimicrobial agents assayed, variable results were only observed for gentamicin, sulfadiazine, mercury, arsenic, and chromium, being the resistance to these agents used as markers for the studied strains.

In Table 1 it can be observed that the highest frequencies of resistant strains, except for chromium, are detected in the farthest areas from the pollution sources, especially for mercury and arsenic, so the frequencies of resistant microorganisms to these agents are twofold higher than the frequencies observed in the river and sewage. Likewise a higher frequencies of multiresistant strains in seawater is obtained.

When it is considered the distribution of pyocin types in the different areas, higher percentages of pyocin types 13B and 12A are observed in the strains isolated in the farthest areas from the pollution source (seawater) respect to the frequency in the nearest areas. On the contrary, the frequency of the other pyocin types decreases at longer distances from the pollution sources (Table 2). The mentioned pyocin types are associated with noticeable heavy metals resistance characteristics (Table 3), thus, the 13B strains have the highest percentages of resistance to arsenic, and all 12A strains are mercury resistant and they have the maximum frequencies of resistance to gentamicin and sulfadiazine.

The observed increase of the frequencies of heavy metals resistant strains and pyocin types 13B and 12A in seawater suggests that these strains may have better characteristics of survival in the marine environment. It is probably due to a higher resistance to environmental factors, such as sunlight or biotic agents, which usually affect negatively to *P. aeruginosa* cells and another allochtonous microorganisms in seawater (6).

It is not possible assume a direct selective pressure by heavy metals on these bacteria (3,4) as explanation to the antibiotics and metals resistant selection in seawater, because the heavy metal concentrations in the studied area are clearly lower than the MIC of these metals for the studied *P. aeruginosa* strains. The results of this study suggest an association between some characteristics of these strains (heavy metals resistance and pyocin types) and a higher survival ability in the marine environment.

TABLE 1. Antibiotic and heavy metal resistance of *Pseudomonas aeruginosa* isolated from polluted waters. Frequency of resistant strains (%).

RESISTANCE TO:	ISOLATION SITE: Pollution source (n=83)	Mixing area (n=45)	Seawater (n=60)	Overall (n=188)
GM (10 µg)[a]	21.69	22.22	28.33	24.47
SD (1000 µg)[a]	36.14	35.56	38.33	37.23
Hg^{2+} (7.5 µg/ml)[b]	16.87	26.67	36.67	25.53
AsO_2^{3-} (5702 µg/ml)[b]	7.23	4.44	15.00	9.04
CrO_4^{2-} (956 µg/ml)[b]	6.02	6.67	5.00	5.85

[a]:Disk potency
[b]:Concentration
GM:Gentamicin
SD:Sulfadiazine

TABLE 2. Pyocin types of *P. aeruginosa* strains isolated from polluted waters. Percentage of strains of each type.

PYOCIN TYPE	ISOLATION SITE: Pollution source (n=83)	Mixing area (n=45)	Seawater (n=60)	Overall (n=188)
88D	22.89	20.00	15.00	19.68
13B	6.02	8.89	20.00	11.17
16A	7.23	8.89	5.00	6.91
12A	2.41	6.67	11.67	6.38
16B	8.43	4.44	3.33	5.85
Others	53.00	51.11	45.00	50.00

TABLE 3. Relationship between pyocin types and antibiotic and heavy metal resistance of *P. aeruginosa* strains.

PYOCIN TYPE (%)	RESISTANCE TO: Gm	SD	Hg^{2+}	AsO_2^{3-}
88D (19.68)	29.73	51.35	18.92	13.51
13B (11.17)	0.00	4.76	9.52	23.81
16A (6.91)	23.08	38.46	30.77	7.70
12A (6.38)	50.00	66.67	100.00	0.00
16B 5.85)	0.00	63.64	0.00	0.00
Others 50.00)	27.66	31.91	24.47	6.38
OVERALL	24.47	37.23	25.53	9.04

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Premières données sur l'écologie des vibrions dans la zone lagunaire de Oliveri-Tindari (Messine, Italie)

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Au cours de la derniere décennie, l'écologie des vibrions de l'environnement a suscité un grand intérêt étant donné l'étroit rapport entre la consommation d'aliments marins crus et les épisodes de toxi-infections alimentaires ou de gastro-entérites attribuées au V.cholerae et au V.parahaemolyticus. Outre les vibrions sus-mentionnés dont la pathogénicité a été vérifiée, les milieux marins et saumâtres hébergent d'autres espèces considérées potentiellement pathogènes: V.fluvialis, V.vulnificus, V.alginolyticus et ceux qu'on appelle les Vibrions NAG.

Les travaux écologiques de Colwell et al. (1984) et de Kaper et al. (1979) dans la baie de Chesapeake ont apporté une contribution valable à l'étude de l'écologie du V.parahaemolyticus et du V.cholerae en ce qui concerne la température et la salinité: il n'existerait au contraire aucun rapport avec la pollution fécale.

Dans le présent travail, on rapporte les résultats d'une étude sur la distribution des vibrions halophiles dans un milieu lagunaire non contaminé par les collecteurs urbains et ayant des caractéristiques hydrologiques particulières (Abbruzzese et Aricò, 1955 ; Crisafi et al. 1981).

En 1987, on a effectué des prélèvements d'eau en surface dans les étangs saumâtres de Oliveri-Tindari avec une cadence saisonnière. On a examiné 72 échantillons, transportés en laboratoire dans les quelques heures qui ont suivi le prélèvement. Ils ont été ensemencés et opportunément concentrés sur des membranes filtrantes déposées sur TCBS agar (Difco) afin d'obtenir le nombre de PV (vibrions présomptifs) en les incubant à 24°C pendant 48h et de PVP (V.parahaemolyticus présomptifs) en les incubant à 37°C pendant 24h (Crisafi et al., 1985a). **Simultanément**, on a procédé à la quantification des coliformes fécaux totaux et des entérocoques moyennant la technique des membranes filtrantes.

On a effectué la recherche de certaines espèces ayant des caractéristiques de pathogénicité pour l'homme sur un échantillon d'eau provenant de chacun de ces étangs, moyennant l'emploi de milieu d'enrichissement; la croissance a été vérifiée sur TCBS agar. Pour la recherche du V.cholerae, on a utilisé l'AP (eau peptonée alcaline) (Kaper et al., 1979); pour le V.parahaemolyticus, le VPSM (V.parahaemolyticus salt meat) (OMS 1977) et le milieu PPC (phytone, peptone, carbenicillline) mis au point par Toti et al. (1983); pour le V.fluvialis, le milieu FEM (V.fluvialis enrichment medium), conseillé par Nishibuchi et al. (1983).

Les colonies isolées sur T C B S ont été identifiées sur la base des caractéristiques morphologiques, culturales et biochimiques déjà décrites dans des travaux précédents (Crisafi et al., 1985b). **Les souches ayant une affinité avec** V.cholerae ont été soumises à des tests d'agglutination sur lamelle de verre avec un antisérum polyvalent 01 (Difco).

Les charges bactériennes en PV et PVP (avec des oscillations comprises respectivement entre 10^3-10^4 et 10^2-10^4/ 100ml d'eau) montrent en général une augmentation graduelle suite à l'augmentation de la température en été.

L'espèce rencontrée le plus fréquemment a été le V.alginolyticus, comme on a déjà observé au cours des recherches antérieures effectuées dans divers milieux.

4 des 6 étangs étudiés se sont révélés positifs à cause de la présence du V.cholerae non 01 avec un total de 12 souches (fig.1); ces sites présentaient une salinité variant de 21,50°/$_{oo}$ à 38,57°/$_{oo}$ et une température variant de 14°,1 à 28°,8. Ces souches ont été isolées pendant toutes les campagnes, sans rapport apparent avec la température de l'eau.

Le V.parahaemolyticus a été isolé uniquement du lac Marinello (8 souches) en hiver, en été et en automne. La salinité de cet étang était légèrement inférieure à celle des autres étangs avec une valeur minimum de 16,14°/$_{oo}$, enregistrée pendant l'hiver; ceci confirmerait les affirmations de Colwell et al, (1984) lesquels considèrent ce micro-organisme comme étant typique des milieux côtiers et des estuaires à haut contenu en substances organiques.

Les coliformes totaux et fécaux étaient presque toujours absents, et ceci confirme les résultats de divers auteurs, en ce qui concerne le manque de corrélation entre la présence du V.cholerae et du V.parahaemolyticus et les indices bactériologiques de pollution fécale. Selon Kaper et al. (1975), il existerait au contraire un rapport entre la présence du V.cholerae et la salinité (avec un optimum compris entre 4 et 17°/$_{oo}$).

5 souches attribuables à l'espèce V.fluvialis ont été isolées des étangs Marinello (3souches), Verde et Porto; on a seulement rencontré le V.metschnikovii dans trois échantillons au cours de la période de basse température des eaux.

Il faut enfin signaler qu'on n'a jamais isolé le V.vulnificus.

Le milieu d'enrichissement qui a fourni les meilleurs résultats a été l'AP broth. Les autres milieux ont montré une basse sélectivité vis-à-vis des espèces pathogènes à cause de la croissance abondante du V.alginolyticus.

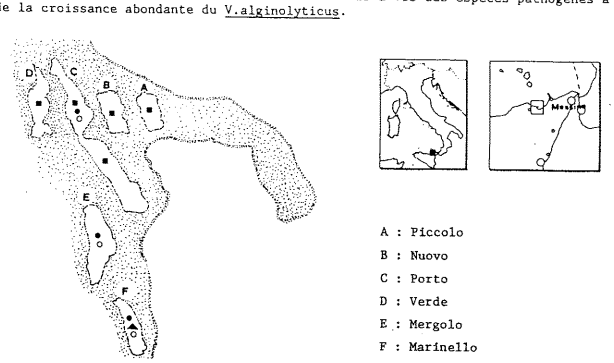

Fig.1- Sites de découverte des diverses espèces de Vibrio: ■ V.Cholerae; ▲ V.parahaemolyticus; ● V.fluvialis; ○ V.metschnikovii.

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Surveillance virale des eaux de mer et des autres eaux de baignade

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La contamination par des virus des eaux de baignade, les eaux marines surtout, a été prouvée au moyen de la détection dans ces eaux de nombreuses espèces et types de virus pathogènes pour l'homme. Contrairement à la contamination par les virus des eaux de boissons où prédominent les virus entériques, la contamination des eaux de baignade se produit surtout par des virus qui affectent les voies respiratoires supérieures et les téguments, à cause semble-t-il du contact beaucoup plus étendu de l'organisme avec l'eau lors de la baignade et de la natation (1). Les affections causées par ces virus ont un spectre très large: paralysies, encéphalites, méningites gastroentérites, hépatite, affections respiratoires et de la conjonctive oculaire et affections cutanées.

Que les eaux de baignade contaminées par des virus puissent constituer un risque sanitaire public a été prouvé par les nombreuses épidémies sévissant au sein des baigneurs (2,3).

Pour la détection des virus dans les eaux de baignade marines et douces on a élaboré et appliqué de nombreuses méthodes. Mais comme la détection des virus dans l'eau en tant que tels présente des difficultés, comme l'est la complexité de la méthodologie, le temps assez long et le coût élevé, on a suggéré de recourir, tout comme pour les bactéries pathogènes de l'eau, à l'utilisation d'indicateur microbiens dans le cas des virus de l'eau de baignade. En ce sens l'on a visé: nombre total de bactéries hétérotrophes dans/sur agar à 37°C, coliformes totaux, coliformes fécaux, streptocoques fécaux et dans une moindre mesure d'autres genres et espèces microbiens (Clostridium, Pseudomonas, Mycobacterium, Bifidobacterium, Bacillus, Thiobacillus, Selmonella). Une attention particulière a été accordée aux bactériophages entériques, sur la base des ressemblances de groupe entre ceux-ci et les virus animaux (4). Il existe cependant des différences parmi lesquelles celle d'une moindre résistance dans l'eau, face aussi au chlorinage, de quelques-unes de ces espèces (coliformes); une résistance trop élevée (bactéries sporulées) ou bien d'autres non-concordances, qui font qu'aussi bien les bactéries en question que les bactériophages ne peuvent constituer que des indicateurs de présomption de la pollution fécale, donc de la pollution avec des virus et que la certitude d'une pollution virale des eaux de baignade ne peut être donnée que par la détection du virus en tant que tel.

La surveillance virale de l'eau devient de plus en plus possible par l'amélioration de la méthodologie d'isolation des virus dans l'eau en général. Cette amélioration connait ces derniers temps de nouveaux progrès par l'adoption de méthodes modernes de détection des virus dans les produits pathologiques cliniques et qui tendent à être adoptées également pour la détection des virus dans l'eau. C'est ainsi que sont adoptées momentanément dans ce but les techniques pour l'isolation des rotavirus et du virus de l'hépatite A (3,5).

Sous ce rapport se pose évidemment aussi le problème de la standardisation non seulement des conditions de surveillance des virus dans les eaux de baignade en rapport avec la situation épidémiologique ou pour la vérification de l'efficacité des procédés de traitement de l'eau, mais aussi la standardisation des volumes d'eau à examiner (6).

Il va de soi que le plus important dans la protection sanitaire contre le risque que comporte la présence des virus dans les eaux de baignade, plus important même que la détection des virus, c'est d'assurer l'efficacité antivirale des procédés de traitement des eaux de baignade ou des eaux usées qui les polluent.(7).

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M-III1

Eléments chimiques dans l'hémolymphe de Mytilus galloprovincialis Lamarck

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ABSTRACT

The concentration of ten hydrosolubie elements and oligoelements from the soft tissues of Mytilus galloprovincialis Lamarck was determined by atomic absorption spectrophotometry. With a few exceptions, the concentrations are similar to those in the human serum. High values were registered in spawning animals.

RESUME

On a déterminé la concentration de 10 macro- et micro-éléments hydrosolubles dans les tissus mous de Mytilus galloprovincialis Lamarck par spectroscopie à absorption atomique. A quelques exceptions près, ces concentrations sont voisines des valeurs normales du sérum humain. Des valeurs supérieures ont été enregistrées chez les animaux en état de reproduction.

Mytilus galloprovincialis a été prélevé sur le littoral roumain de la mer Noire (Constantza Nord) au printemps et en été 1987. Les animaux se trouvaient à deux stades physiologiques distincts, celui de reproduction (en mai) et celui de l'après ponte (en juin).

Le matériel biologique a été libéré de tout organisme épibiotique, lavé à l'eau désionisée et, après avoir ouvert les valves, on a écarté le liquide intervalvaire, on a lavé les tissus à l'eau désionisée en les tamponant ensuite avec du papier filtre, et après on a recueilli l'hémolymphe par des coupes longitudinales du corps de l'animal. L'hémolymphe a été déprotéinée et délipidée avec de l'acétone 1:3 V/V et, après avoir écarté le solvant par distillation sous vide, on l'a encore délipidé avec du benzène V/V. Le produit obtenu après la séparation du solvant a été utilisé pour les déterminations.

La présence, dans l'extrait d'une large gamme de cations en diverses concentrations, depuis des dizaines jusqu'à des milliers de ppm, à côté de différents composants organiques, a nécessité un procédé d'élimination des interférences par destruction par voie humide, en deux variantes, en utilisant le mélange d'acides HNO_3-H_2O_2 et $HClO_4$-HNO_3 respectivement, à une pression de 1.5 at et à la température de 120°C.

Quant aux interférences chimiques, les perturbations des éléments analysés ont été insignifiantes à l'exception du Ca et du Mg, où l'on a utilisé le tampon spectral Sr. Les micro-éléments ont été déterminés à l'aide d'un spectrophotomètre AAS IN Zeiss Jena, par deux procédés : émission et absorption atomique à la flamme, les conditions expérimentales étant choisies de telle manière que l'on obtienne le maximum de sensibilité.

Les courbes d'étalonnage ont été calculées analytiquement par la méthode des plus petits carrés, selon un programme de calcul LSDRQ utilisé sur un calculateur CORAL 4030. L'équation des droites a la forme Y=ax+b, où les paramètres a et b calculés selon le programme LSDRQ sont présentés dans le tableau 1, à côté des coefficients de corrélation qui attestent la concordance avec les résultats expérimentaux.

TABLEAU 1
Calcul des droites d'étalonnage par la méthode des plus petits carrés

Elément	Cu	ZN	Ca	Mg	Mn	Co
a	0.024	0.126	0.022	0.623	0.028	0.015
b	-0.001	-0.020	-0.002	0.017	0.004	0.002
coefficient de corrélation	0.999	0.993	0.994	0.998	0.996	0.998

	K	Cr	Ni	Fe	Na
a	4.23	0.033	0.010	0.016	9.840
b	2.89	0.002	0.001	-0.001	3.700
coefficient de corrélation	0.999	0.999	0.987	0.995	0.997

TABLEAU 2
Composition des éléments chimiques dans le sérum humain et dans l'hémolymphe de Mytilus

Eléments	Valeurs normales dans le sérum(1)	Hémolymphe de Mytilus Spectroscopie à absorption atomique
Fer	0.700 - 1.700	0.13 - 0.70
Cuivre	0.850 - 1.500	0.20 - 0.66
Zinc	0.800 - 1.400	0.30 - 0.91
Nickel	0.001 - 0.005	0.13 - 0.70
Cobalt	0.001 - 0.036	0.13 - 0.30
Chrome	environ 1.000	0.13 - 0.30
Sodium	1.332.000 -1.378.000	2.400.00
Potassium	183.000	1.030.00
Calcium	90.000 - 100.000	21.00 -71.60
Magnésium	18.200 - 22.000	19.00 -30.78

Les données mettent en évidence une ressemblance, de l'ordre de grandeur des concentrations des éléments chimiques, du sérum humain, et de l'hémolymphe de Mytilus, à l'exception du Ni, Co, Na et K (Tableau 2).

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M-III2

Caractéristiques biochimiques des protéases partiellement purifiées d'Engraulis encrasicolus ponticus

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ABSTRACT

The paper presents several parameters of partially purified proteases from Engraulis encrasicolus ponticus : optimum pH and temperature, the effect of the enzyme (partially purified) concentration on the reaction speed as well as the optimum substrate concentration and the substrate specifity. The existence of some natural inhibitors for these proteases in the blood, heart and pig spleen is noticed.

RESUME

Ce travail présente plusieurs paramètres des protéases partiellement purifiées d'Engraulis encrasicolus ponticus : pH optimal, température optimale, influence de la concentration des enzymes partiellement purifiés sur la vitesse de réaction, concentration optimale du substrat et spécificité du substrat. On signale la présence de certains inhibiteurs naturels de ces protéases dans le sang, le coeur et la rate du porc.

Les travaux ont été effectués sur l'anchois - Engraulis encrasicolus ponticus - prélevé sur le littoral roumain de la mer Noire en juin 1980, dans la zone d'Agigea (Constantza Sud). Les poissons ont été homogénéisés et extraits à l'aide d'eau désionisée 1:1 V/G, pendant deux heures à 4°C. Les enzymes furent obtenus par la précipitation en acétone 1:4 V/G de la phase aqueuse. Après avoir séché le précipité protéique, on a procédé à une purification sur colonne de Sephadex G 50 avec élution en gradient de concentration de NaCl. Les protéases furent dosées par la méthode de Anson (1), et les protéines par la méthode de Lowry et coll.(2). En vue d'effectuer les déterminations on a utilisé les tampons acide citrique - phosphate bisodique (pH 3.30-7.10), Tris (hydroxyméthyl) aminométhane - HCl (pH 7.2-8.6), et le pH 2.0 a été obtenu avec HCl 0.2 N.

Les caractéristiques biochimiques des protéases partiellement purifiées obtenues de Engraulis encrasicolus ponticus, sont les suivantes :

1. A la concentration optimale des enzymes de 0.2 - 0.5 mg protéine/ml, la vitesse des réactions catalysées augmente d'une façon linéaire.
2. Les pH optimaux sont : 2.1; 6.1; 8.0.
3. La concentration optimale du substrat est : pH - 6.1/15 mg hémoglobine Anson; pH - 8.0/20 mg hémoglobine Anson; pH 8.0/15 mg caséine Hammersten; pH - 2.0/20 mg hémoglobine Anson.
4. La température optimale de réaction est de 33°C à un pH de 6.1 et de 51°C pour le pH de 8.0.
5. La spécificité du substrat est présentée dans le tableau ci-dessous :

Substrat	Activité protéolytique nmol tyrosine.minute^{-1}.g protéine^{-1}	
	pH 6.1	pH 8.0
Sérumalbumine bovine (BDH)	25.529.9	7.508.0
Albumine ovi (Merck)	25.529.9	36.642.9
Hémoglobine Anson (UCB)	12.013.0	30.003.5
Pepton aus Fleisch Triptisch Verdant (Merck)	12.015.0	7.508.0
Bacto tripton (Difco)	19.222.8	52.561.0
Bacto beef extract (Difco)	90.105.0	3.003.5
Tripticar (Inst.Cantacuzino)	18.621.8	24.328.0

Les protéases obtenues de l'anchois hydrolysent également les protéines à grande masse moléculaire (sérumalbumine, ovalbumine, hémoglobine) et les peptones obtenues par hydrolyse bactérienne ou tryptique, ce qui met en évidence la possibilité de ces enzymes extraites du poisson, d'hydrolyser un large spectre de liaisons peptidiques.

Les protéines dégradées partiellement par l'ébullition, extraites de divers organes de porc, ont été hydrolysées par les protéases de l'anchois comme suit (les résultats sont exprimés en nmol tyrosine. minute^{-1}.g produit^{-1}):foie-54.063; sang-0.00;rognon-66.377; coeur-0.00; pancréas-78.091; duodénum-52.861; rate-0.00;ovaire-30.035; langue-5.105; poumons-36.342. Les déterminations ont été faites à des valeurs du pH de 8.0. Des effets similaires ont été observés au pH 6.1.

Les données ci-dessus suggèrent la présence d'inhibiteurs naturels de protéases dans le sang, le coeur et la rate du porc.

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M

Rapp. Comm. int. Mer Médit., **31**, 2 (1988).

Quelques propriétés de l'hyaluronidase extraite et purifiée à partir de l'espèce Engraulis encrasicolus ponticus de la mer Noire

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SUMMARY :

The hyaluronidase obtained from viscera and gonads of Engraulis encrasicolus ponticus by extraction in buffer CH_3COOH/CH_3COONa at pH 4.3 and precipitation with $(NH_4)_2SO_4$ at 75% saturation, dialysis, aseptic filtration and lyophilisation, has an enzymatic activity of at least 300 IU/mg at pH 4.7 to 5.0 and 37°C and of 62 IU/mg at pH 6.45 and 37°C respectively. The enzyme has a maximum activity in the pH domain ranging between 3.6 and 5.6 and optimum pH at 4.2 to 4.4, 4.8 to 5.2 and 5.6. The optimum temperatures occur at 40° and 60°C and the enzyme shows a high degree of thermostability. The most efficient activator of this hyaluronidase is NaCl. It produces a highest activation at a concentration of 0.3M by an optimum pH action of 4.4 and an optimum temperature of 60°C.

L'hyaluronidase a été extraite et purifiée des viscères, y compris les gonades, du petit poisson Engraulis encrasicolus ponticus au cours de la période de maturation des gonades, quand l'activité hyaluronidasique atteint un maximum (ROSOIU et coll., 1985a), par un procédé qui consiste dans l'extraction de l'enzyme en tampon CH_3COOH/CH_3COONa à un pH de 4.3 (qui permet l'extraction sélective de l'enzyme, étant le milieu optimal d'extraction de l'hyaluronidase), puis précipitation avec $(NH_4)_2SO_4$ à une saturation de 75%, dialyse en courant continu d'eau distillée, filtration aseptique et lyophilisation. On obtient une hyaluronidase pure avec une activité enzymatique d'au moins 300 UI/mg à un pH de 4.7-5.0 et à 37°C, et respectivement 62 UI/mg à un pH de 6.4 et à 37°C.

Le domaine des concentrations enzymatiques où la vitesse de réaction varie proportionnellement s'étend seulement jusqu'à 0.008 mg d'hyaluronidase dans le milieu de réaction, suivi ensuite d'une inhibition due probablement aux produits de réaction.

L'hyaluronidase extraite et purifiée des viscères, y compris les gonades, d'Engraulis encrasicolus ponticus manifeste une activité enzymatique dans l'intervalle de pH 3.6-8.0. Le maximum d'activité est enregistré dans l'intervalle de pH compris entre 3.6 et 5.6, avec le pH optimal d'action 4.2-4.4; 4.8-5.2, 2 et 5.6 (ROSOIU et coll., 1987).

Par rapport aux données obtenues dans le cas des extraits non purifiés (ROSOIU et VOINESCU, 1985 b, 1986), on constate l'activité maximale dans le même intervalle de pH, ainsi que des valeurs optimales d'action du pH très proches, bien que les courbes de vitesse de réaction selon le pH soient un peu différentes entre elles.

Tant l'hyaluronidase purifiée que celle non purifiée, manifestent une activité maximale à 40°C et à 60°C, fait dû probablement à certains phénomènes d'activation qui ont lieu à des températures plus élevées. Les deux préparations enzymatiques manifestent un haut degré de thermostabilité.

La vitesse de réaction augmente selon une fonction hyperbolique jusqu'à seulement 62.5 µg de hyaluronate de sodium dans le milieu de réaction. A des concentrations plus élevées du substrat, on observe un phénomène d'inhibition accentuée, dû probablement à l'inhibition par les produits de réaction. Un phénomène similaire a été constaté aussi pour l'hyaluronidase non purifiée.

Par rapport à l'hyaluronidase non purifiée, la vitesse de réaction est directement proportionnelle au temps de réaction, l'ordre de réaction n'étant pas modifié.

Le plus efficace activateur de l'hyaluronidase extraite et purifiée de l'Engraulis encrasicolus ponticus est le NaCl, qui produit une activation maximale à la concentration de 0.3M dans le milieu de réaction, avec un pH optimal d'action de 4.4 et une température optimale d'action de 60°C.

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Propriétés chimiques et pharmacologiques d'un inhibiteur naturel de la pepsine extrait du Gastéropode Rapana thomasiana Grosse

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SUMMARY :

The paper presents some data on chemical composition and some pharmacological properties of the natural inhibitor of pepsin that was extracted and purified from the marine gastropod Rapana thomasiana Grosse. The natural inhibitor of pepsin shows an intense inhibitory effect on this enzyme and, in addition, displays very important pharmacological properties.

Les données publiées antérieurement sur l'inhibiteur naturel de la pepsine, isolé et purifié de Rapana thomasiana Grosse, prouvent sa nature peptidique. Il a les propriétés suivantes :

1) il manifeste une intense activité d'inhibition vis à vis de la pepsine,
2) il exerce une inhibition de type non-compétitif,
3) il entre instantanément en réaction avec l'enzyme,
4) l'activité d'inhibition de la pepsine n'est pas dépendante du degré de pureté du produit, etc (ROSOIU et al., 1982; ROSOIU, 1985).

Dans ce travail nous présentons de nouvelles données concernant les caractéristiques chimiques et certaines propriétés pharmacologiques de l'inhibiteur naturel de la pepsine extrait et purifié du gastéropode marin Rapana thomasiana Grosse.

L'isolation et la purification de l'inhibiteur naturel de la pepsine ont été effectuées suivant un procédé original, le produit bioactif étant obtenu, conformément à la technologie, sous forme de :

1) - poudre amorphe de couleur jaune à brun-rougeâtre (P),

2) - solution opalescente jaune, ayant une odeur caractéristique et un résidu actif de 0.54 g% (S).

Dans les deux formes, les produits manifestent une intense action inhibitrice vis à vis de la pepsine : 200 µg d'inhibiteur inhibent en proportion de 80-100% 400 µg de pepsine étalon, le rapport enzyme/inhibiteur (E/I) étant 2/1.

A côté des peptides, qui constituent le principe bioactif, les produits contiennent des acides aminés libres, glucides (hexoses, pentoses, méthylpentoses) et des micro-éléments (Na, K, Ca, Mg, Cu, Zn et Fe).

Le produit sous forme de solution (S) présente une action hypnotique en fonction de la teneur en substance active, et manifeste un effet d'augmentation de l'action d'inhibition des barbituriques, ce qui suppose une activité tranquillisante-neuroleptique. Ces actions se manifestent fortement aux doses élevées et moins aux faibles doses (1/10 de DL_{50}).

L'administration p.o. du produit sous forme de poudre (P) en doses relativement faibles, de 56 mg/kg, empêche l'apparition des lésions ulcéreuses dans les deux cas d'ulcères (par la ligature du pylore et réserpinique). En même temps, dans l'ulcère par la ligature du pylore on constate la diminution du volume du liquide gastrique et de l'activité du liquide de l'estomac.

Les actions pharmacologiques, spécifiques sous l'aspect de l'intensité et des paramètres modifiés, s'expliquent par la composition chimique différente, selon la technologie utilisée en vue de l'obtention de l'inhibiteur naturel de la pepsine, sous forme de poudre (P) et de solution (S), respectivement. (ROSOIU et al., 1985).

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M-IV1

Cause principale des variations de la production des sels nutritifs azotés dans les sédiments de la baie de Roquebrune-Monaco

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Une grande part de la matière organique qui se dépose sur les fonds des mers est rapidement incorporée aux sédiments superficiels à cause de la bioturbation (Billen, 1977; Meadows et Tait, 1984; Schink et al., 1975). Là, cette matière organique est généralement soumise à une intense activité microbienne, ce qui permet la production de sels nutritifs azotés (Emerson et al., 1979; Golterman, 1984; Klump et Martens, 1981; Lyons, 1979. Knodgrass et Klapwijk, 1986; Wilson et al., 1985). Il en résulte qu'en général les teneurs en ces sels sont plus élevées dans les eaux interstitielles que dans l'eau de mer sus-jacente. Ainsi, un flux de sels azotés peut s'établir des sédiments vers l'eau de mer.

La distribution verticale des sels azotés dissous dans les eaux interstitielles des sédiments superficiels de la Réserve sous-marine du Larvotto à Monaco a été mesurée à 10 reprises, de Mars 1984 à Juillet 1986. Les sels azotés dissous dans les eaux interstitielles ont été prélevés à l'aide de capteurs qui utilisent le principe de la dialyse (cf Hesslein, 1976; Van Eck et Smits, 1986). Ces capteurs comportent, sur 30cm de hauteur, 10 logettes superposées de 10ml, qui sont remplies d'eau distillée et recouvertes d'une membrane de 0,2µm de porosité. Le capteur est planté verticalement dans le sédiment où il reste 3 semaines jusqu'à ce que l'équilibre ionique soit atteint. Les dosages des sels nutritifs ont été faits en appliquant les méthodes classiques en océanographie (Treguer et Le Corre, 1975).

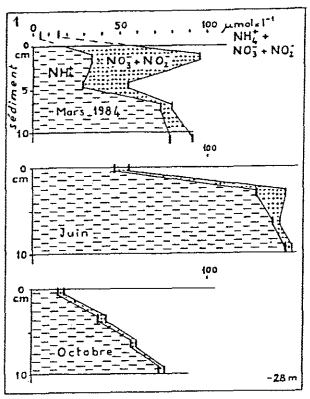

Fig.1. Distribution verticale des sels nutritifs azotés dissous dans les eaux interstitielles.

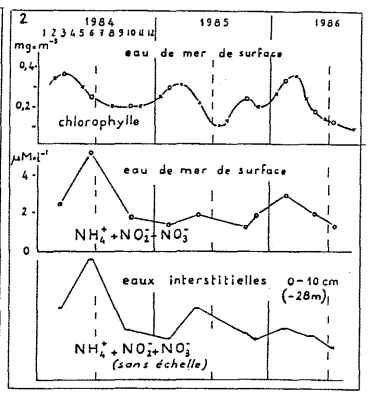

Fig.2. Variations au cours du temps des teneurs en chlorophylle dans l'eau de mer, des sels nutritifs azotés dans l'eau de mer, et des sels azotés dans les eaux interstitielles.

On constate que les teneurs en sels nutritifs dans les 10 premiers cm de sédiments varient au cours du temps (Fig.1). Afin d'exprimer les fluctuations de l'ensemble des profils, on considère la surface qu'ils délimitent, autrement dit on intègre linéairement les teneurs mesurées à chaque niveau. Les teneurs étaient les plus élevées en Mai-Juin de 1984 et 1985. Elles étaient faibles en automne de ces mêmes années. L'évolution est différente en 1986.

Quelle est la cause des fluctuations ? Afin de pouvoir apporter un élément de réponse il convient de considérer les teneurs en sels azotés dans l'eau de mer de la même région, ainsi que les concentrations de la biomasse phytoplanctonique qui a été estimée par la mesure de la fluorescence.

Considérées globalement, les teneurs en sels azotés fluctuent d'une façon similaire dans les eaux interstitielles et dans l'eau de mer de surface (tel n'est cependant pas le cas des eaux à mi-profondeur). Cela suggère que les fluctuations dans les deux milieux ont, du moins en partie, une même cause. Pour cerner le problème, considérons les fluctuations des concentrations en chlorophylle, telles qu'elles sont données par les moyennes mobiles (Fig.2). Le maximum des concentrations se produit à la fin de l'hiver, peu avant le maximum des teneurs en sels azotés du mois de Juin qui est principalement dû à l'ammoniaque. La diminution de la concentration en chlorophylle est sans doute liée à la consommation du phytoplancton par le zooplancton herbivore. Précisément, les Salpes se sont grandement développées en Avril de 1984 et 1985. Ces organismes produisent des pelotes fécales qui ont tendance à sédimenter rapidement (Morris et al., 1987). Arrivée au fond, cette matière organique, plus ou moins agglomérée par du mucus, est rapidement décomposée. Cependant, une autre part de la matière organique particulaire a une vitesse de chute beaucoup plus lente, et elle se décompose en pleine eau (Suess, 1980). La décomposition de la matière organique en pleine eau ainsi que les excrétions du zooplancton conduisent à la formation d'ammoniaque. Il n'est donc pas surprenant que les rythmes de production des sels nutritifs dans les deux milieux présentent une tendance à un certain synchronisme.

En 1986, l'allure des fluctuations des teneurs dans les eaux interstitielles est apparue différente. Les teneurs étaient faibles en Mai. Précisément, cette année là les Salpes n'ont pas connu un développement aussi important que les deux années précédentes.

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M-IV2

Matière organique dissoute en milieu marin : les amino-acides

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Bien que les océans renferment une quantité considérable de matière organique (MO) à l'état dissous, les concentrations sont si faibles qu'elles se situent aux limites de détection des méthodes analytiques. Les connaissances, dans ce domaine, ont progressé au cours de la dernière decennie, notamment dans le domaine des petites molécules. Ainsi les amino-acides (AA) ont-ils fait l'objet d'un grand nombre de travaux , notamment dans les régions côtières; ces études ont montré que les AA ne représentent qu'une faible fraction du C organique disssous (0,2 à 0,3 %) mais leur rôle dans la biologie des océans est primordial; ils sont présents sous deux structures chimiques: soit sous forme de monomères, ce sont les AA libres dissous (AALD), soit sous forme de polymères ou d'hétéropolycondensats comme les acides humiques, ce sont les AA combinés dissous (AACD); les formes libres ne constituent que 1/10 des AA dissous.

Les AA interviennent dans la vie des océans sous des aspects divers: - soit comme molécule active physiologiquement du fait de leur assimilation par les organismes hétérotrophes et de leur rôle dans le métabolisme proteique; à la différence des glucides , ils participent peu à la constitution de substances de réserve ; - soit comme agent complexant pour les métaux-traces en raison de leur structure amphotère.

Les concentrations en AALD sont comprises entre 0,02µM et 1-2µM, et les AACD sont présents à des concentrations 5 à 10 fois supérieures, mais le principal obstacle à la détermination des AA dissous dans l'eau de mer réside dans la concentration en sels minéraux 10^5 fois supérieure. Un profond changement se produisit en 1980 avec le développement de la chromatographie sous haute pression (HPLC) et son application à la détermination des AA dans l'eau de mer par Mopper et Lindroth (1979); la complexation des AA avec l'ortho-phtalaldehyde fournit des complexes fluorescents qui peuvent être séparés par chromatographie sur une colonne de silice . La sensibilité de la méthode de détection par fluorescence est si grande , qu'elle permet de déceler les AALD sans concentration préalable (limite de détection : 10^{-15}mole); et ceci dans un temps relativement court (durée de l'analyse: 30 minutes);

Les teneurs en AALD ont été suivies pendant un an , dans la baie de Marseille. Les résultats font apparaitre des valeurs irrégulières en surface et au fond (70 m), la zône la plus stable étant située à 30 m de profondeur avec des teneurs comprises entre 944 et 1278 nM. Les plus fortes valeurs sont observées en Décembre et en Juin , elles doivent être attribuées, en hiver, à la dégradation bactérienne du matériel organique accumulé sur le fond , et , en été, à la lyse du phytoplancton. Les taux les plus bas sont trouvés en Février-Mars; ils sont observés dans toute la colonne d'eau. En zone océanique, la distribution du seston, et de la fraction proteique des microparticules a été comparée aux teneurs en AALD et AACD pour une colonne d'eau prelevée au large de Villefranche. Les résultats obtenus font apparaître une concordance entre l'augmentation des microparticules et des teneurs plus élevées en AA dissous, pour une couche d'eau comprise entre 300 et 400 m de profondeur. L'existence d'une barrière ralentissant la chute des particules peut être à l'origine d'une augmentation des AA dissous; le même phénomène a été observé au large de Toulon, l'augmentation des AA dissous correpondait à une variation de la température et de la salinité. L'analyse compléte de la colonne d'eau sur un fond de 1600 m met en évidence des fluctuations concomittantes entre les AALD et les AACD qui interessent surtout la fraction supérieure de la colonne d'eau .

L'existence d'un pool relativement stable d'AA dissous dans l'eau de mer ne constitue en fait que le résultat de plusieurs actions , les unes ayant pour effet d'accroître le stock d'AA et les autres visant à les utiliser; ainsi dans le premier compartiment on placera les bactéries responsables de l'hydrolyse des biopolymères et de la dégradation des proteines particulaires, les mécanismes d'excrétion du phytoplancton , des algues benthiques et du zooplancton, et surtout les mécanismes de lyse cellulaire qui vont être à l'origine d'apports massifs d'AA dissous lors de la dégénérescence des populations planctoniques. Le deuxieme compartiment est dominé par les bactéries qui constituent les principaux utilisateurs d'AA dissous; le phytoplancton, le zooplancton et certains organismes de la macrofaune peuvent absorber des AA à l'état dissous soit dans des périodes de pauvreté du milieu environnant, soit pour combler un déficit en certains AA, non synthétisés par l'organisme . La présence d'un seuil d'utilisation des AALD par les bactéries et la limitation des populations bactériennes par les ciliés et les flagellés semblent être les causes principales de l'existence d'un stock minimum d'AALD. La régulation de ce stock est facilitée par la vitesse d'assimilation des AALD par les bactéries qui peut être de l'ordre de quelques minutes dans les cas les plus favorables. Ainsi le cycle des AA dissous passe-t-il en grande partie par les bactéries qui jouent le rôle de régulateur du stock existant en milieu marin; mais la population bactérienne n'est pas homogène et son influence sur le cycle des AA dépendra notamment de son aptitude à hydrolyser les structures protéiques transportées par les particules; c'est par l'intermédiaire d'enzymes hydrolytiques situées dans ou sur la membrane que plus de la moitié de la production pélagique primaire des systèmes côtiers est utilisée par les bactéries.

M-V1

Importance of microalgae as a source of food and chemicals

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ABSTRACT

Several species of microalgae are potential suppliers of food and various chemicals. Among the about 30,000 species which exist on the Earth, only a limited number was studied. At present, the most promising are Botryococcus (hydrocarbons), Dunaliella (beta-carotene and glycerol), Porphyridium (polysaccharides) and Spirulina (food and chemicals). However, screening of the numerous other microalgae might reveal new valuable species. In addition, modern biotechnological techniques may be applied for improving the quality of the microalgal species having a commercial interest.

1. INTRODUCTION

Many species of microalgae and blue-green bacteria (known as blue-green algae), under suitable growth conditions, produce large biomass quantities, which may be used as a source of food and chemicals (Shelef and Soeder, 1980). Research is being developed on a number of microalgae for the detection of active compounds such as antibiotics, antifungal agents and various other pharmaceuticals (Metting and Pyne, 1983 ; Baker, 1984 ; Lustigman, 1988). It is thus probable that new valuable algal species shall be discovered and exploited for the production of food and commercially interesting products.

2. CULTURE AND UTILIZATION OF MICROALGAE

Although the culture and utilization of microalgae has a long story, the development of open and closed systems (photobioreactors) for algal biomass production is rather recent (Shelef and Soeder, 1980 ; Gudin, 1981 ; Materassi, 1981). The various culture systems were reviewed by Gudin et al. (1981) and by Terry and Raymond (1985). At present, the microalgae most investigated are Botryococcus, Dunaliella, Porphiridium, Spirulina (fig.1) and few others (Bonotto et al., 1988). The species Botryococcus braunii is of particular interest for its capability of producing various hydrocarbons, which by the "hydrocracking" process may be transformed into oil (Casadevall et al., 1984 ; Weetall, 1985). The halotolerant microalga Dunaliella is utilized for various purposes. The species Dunaliella lardawil grown outdoors in 3 M NaCl contains about 30% glycerol, 29% proteins, 18% lipids, 11% carbohydrates, 8% beta-carotene and 1% chlorophyll (Ben-Amotz et al., 1982). Similarly, the species Dunaliella salina contains beta-carotene and other products, including a broad spectrum antibiotic (Lustigman, 1988).
In addition, Dunaliella parva produces large amounts (up to 50% of the dry weight) of glycerol (Ben-Amotz, 1976), which may be used as raw material in the petrochemical industry. Another species, Dunaliella tertiolecta, included in Ca-alginate beads under hypersaline conditions, was found to release glycerol into the external medium. The red microalga Porphyridium seems promising for the production of polysaccharides, which form thermally reversible gels similar to agar and carrageenan. With respect to macroalgae producing agar (agarophytes), Porphyridium has the advantage of growing faster.
The importance of Spirulina as a source of food was underlined by various authors (Durand-Chastel, 1980 ; Ciferri, 1981 ; Materassi, 1981). Its protein content may attain 50-70% on a dry weight basis. For this reason, Spirulina is marketed in the form of dry powder or of tablets, as a nutritional supplement.
In spite of recent efforts, the mass culture of microalgae is economically less attractive than that of traditional agricultural crops, mainly because the production costs remain rather high. However, the introduction of new technologies might reduce the total costs. The perspectives for the culture of microalgae and their commercial utilization seem thus encouraging.

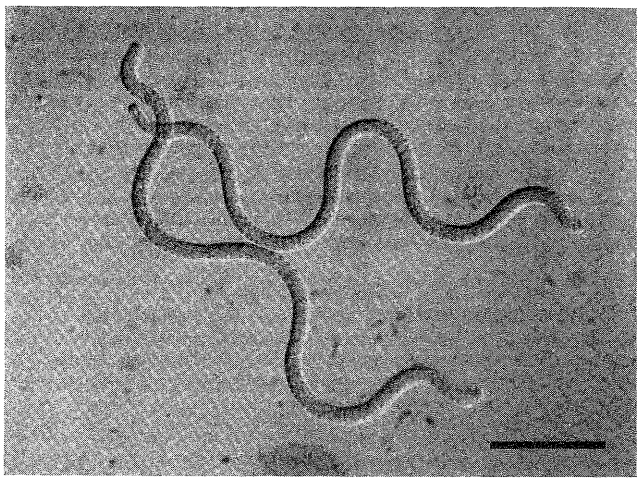

Fig.1.
Spirulina platensis from an outdoor culture. Scale = 50 µm. (Picture done by the author thanks to the courtesy of Dr Enrico Sandbank, Israel Institute of Technology, Haifa, Israel).

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M-V2

Utilisation de l'Algue unicellulaire géante Acetabularia acetabulum comme modèle pour des études dans le domaine de la toxicologie fondamentale et appliquée

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RESUME

L'algue unicellulaire géante Acetabularia est un matériel de choix pour des recherches toxicologiques. On a étudié les effets de trois produits, ayant un intérêt pharmacologique (méclofénoxate et les deux analogues PM 170 et PM 198), sur la morphogenèse de l'algue et sur certaines activités cellulaires (activité électrique et mouvements cytoplasmiques).

1. INTRODUCTION

L'Acetabularia acetabulum (= A. mediterranea) est une algue unicellulaire géante pouvant atteindre une longueur de plusieurs centimètres. Découverte dans la Méditerranée, elle fut domestiquée au laboratoire, où son cycle biologique complet s'achève en environ 150 jours (Puiseux-Dao, 1970). La grande taille de la cellule, sa capacité de croissance et de régénération, sa polarité morphologique très accentuée et sa morphogenèse particulière en font un matériel de choix pour des études dans le domaine de la toxicologie fondamentale et appliquée. Le fait que l'algue montre des courants cytoplasmiques et possède une activité électrique facilement mesurable augmente davantage son intérêt, en permettant de tester l'action de certaines substances chimiques sur ces fonctions cellulaires. On peut ainsi obtenir une réponse dans un délai relativement bref (quelques heures ou même quelques minutes). L'effet de nombreux composés chimiques sur la morphogenèse (formation du chapeau) d'Acetabularia a été étudié par plusieurs auteurs (Borghi et coll., 1972 ; Bonotto et coll., 1976). Ce travail reporte les effets de trois produits ayant un intérêt pharmacologique, à savoir le méclofénoxate (dit aussi "Lucidril") et deux analogues structuraux, représentés respectivement sous les sigles PM 170 et PM 198 (Arapis, 1982).

2. RESULTATS ET DISCUSSION

Des algues végétatives, traitées par des concentrations élevées de méclofénoxate (140-200 mg/l), PM 170 (10-60 mg/l) et PM 198 (130-220 mg/l) subissent une cytolyse, qui peut être évaluée en déterminant les valeurs de la dose lethale 50 (DLyse50). Après 48 heures de traitement les valeurs de la DLyse50 pour les trois produits mentionnés ci-dessus étaient respectivement 167, 31 et 171 mg/kg.
Cependant, à des concentrations plus faibles, ces trois produits peuvent favoriser la formation des chapeaux chez des algues maintenues dans du milieu synthétique ayant une concentration 6,8 mM en Ca2+ (fig.1). L'effet favorable se manifeste de manière encore plus nette pour des teneurs en Ca2+ inférieures, qui provoquent un ralentissement de la formation des chapeaux (3,4 mM) ou une inhibition forte (2,7 mM).
Il a été, en outre, observé que la polarité électrique cellulaire s'inverse lorsque la teneur en KCl du milieu est augmentée ainsi que lorsque le milieu est additionné des produits étudiés. La fréquence des potentiels d'action est fortement accrue lorsque les molécules expérimentées sont ajoutées. Pour le méclofénoxate (100 mg/l) et le PM 170 (15 mg/l) cette fréquence élevée se maintient pendant trois heures environ. Avec le PM 198 (50 mg/l), la fréquence se situe beaucoup plus longtemps au dessus des fréquences témoins. Il convient de signaler, aussi, que le méclofénoxate (5 mg/l) et le PM 170 (3 mg/l) favorisent la reprise des mouvements cytoplasmiques en influençant la structure dynamique du cytoplasme. De plus, il parviennent à provoquer des mouvements même dans des cellules à la limite entre dormance faible et hybernation (Arapis, 1982). L'action des produits étudiés sur Acetabularia suggère un effet auxinique couplé vraisemblablement avec des échanges ioniques.

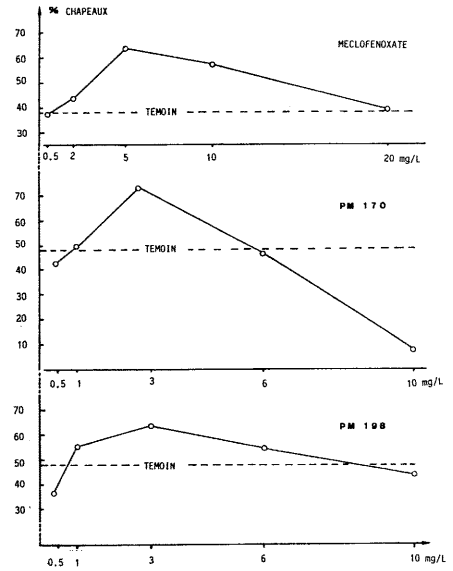

Fig.1.
Pourcentage de chapeaux formés chez l'Acetabularia acetabulum en fonction de la dose des trois produits testés, après 10 jours de traitement.

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M-V3

Uptake, distribution and biological effects of Cadmium in the unicellular marine Alga Acetabularia acetabulum

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ABSTRACT

Uptake and cellular distribution of cadmium in the green marine alga Acetabularia acetabulum (= A. mediterranea) were studied by using the gamma emitting isotope Cd109. This radioelement enters the cell, where it binds to organic compounds. Parallel experiments have shown that morphogenesis and cell regeneration are sensitive to cadmium poisoning.

1. INTRODUCTION

It is well known that important amounts (about 10 million kg) of cadmium are annually brought to the oceans from the atmosphere and from the rivers (Seeliger et al., 1988). Since, according to the classification of Förstner and Wittmann (1981), cadmium belongs to the group of very toxic elements, it is of interest to investigate its uptake, distribution and biological effects in marine organisms. Acetabularia acetabulum is a giant unicellular marine alga, which is particularly suitable for studying the effects of toxic compounds (Arapis et al., 1988). The large size of the cell (several cm in length) allows a rapid visual screening of inhibitory effects (on growth and cap formation) and of cytolysis. In this paper are summarized the main results of recent experiments on the uptake and biological effects of cadmium in this organism.

2. RESULTS AND DISCUSSION

Accumulation and desorption of cadmium in Acetabularia acetabulum was studied by using Cd109, a gamma emitting isotope which decays into stable Ag109 with a half-life of 464 days. After short (a few hours), exposures, the release of Cd109 was nearly complete, suggesting that little or no cadmium was fixed by the cell under these conditions. After a 7 days incubation, concentration factors (CFs) comprised between 500 and 800 were found. These values are similar to that reported for Dunaliella bioculata (CF = 300) by Saraiva and Fraizier (1975). It was ascertained that Cd109 accumulation is not due to adsorption to the polysaccharidic (mannan) cell wall, by differential centrifugation of labelled homogenates. Column chromatography on Sephacryl S-200 of buffered cell extracts (2 M NaCl, 5 M Urea, 0.02 M Tris HCl, pH = 7.5) has revealed that Cd109 becomes associated with both high (> 50 kdaltons) and low (< 10 kdaltons) molecular weight organic molecules. Enzymatic digestion with proteinase K has shown that the high molecular weight compounds capable of binding Cd109 are mainly constituted by proteins. Early studies have demonstrated that Cd combines with -SH groups, competes with and displaces Zn in a number of Zn-containing metalloenzymes by irreversibly binding to active sites (Förster and Wittmann, 1981). Possibly, a similar process occurs also in Acetabularia. The nature of the low molecular weight compounds which bind Cd109 deserves further investigations. Recently, a class of small, cysteine-rich peptides capable of binding heavy metals via thiolate coordination, named phytochelatins, were found in Euglena gracilis and Ochromonas danica as well as in yeasts and higher plants (Grill et al., 1985, 1986, 1987 ; Piccinni et al., 1985). It would be worth searching whether phytochelatins are present also in Acetabularia. Several experiments on whole and anucleate cells and on regenerating basal fragments have revealed that this alga is sensitive to cadmium poisoning. Inhibitory effects on cell regeneration were observed already at 0.1 mg/l (fig. 1A, arrows). At higher concentrations, inhibition of cell regeneration is stronger and no whorls are formed at the apex of the fragments (fig. 1B). In preliminary experiments, the calculated LDlysis50 for whole and anucleate cells and for regenerating basal fragments, after a 48 hours treatment, were respectively 1, 0.5 and 0.8 mg/l. These results suggest that Acetabularia may be useful as test organism for studies on environmental pollution by heavy metals.

Fig.1.
Inhibitory effects of cadmium on the regeneration of Acetabularia (basal fragments), after a 11 days treatment. A : 0.1 mg/l ; B : 1 mg/l. Scale = 2.5 mm.

3. ACKNOWLEDGEMENTS

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M-VI1

Bactéries associées à la surface d'Eponges d'eau douce

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Bacteria associated with the surface of freshwater sponges reflect the environmental microflora.

Les mécanismes de capture des bactéries par les éponges sont relativement bien connus. Il n'existe cependant que peu de travaux d'identification des germes associés in situ à leur surface En outre ces recherches n'ont porté que sur des espèces marines.

On sait notament que de nombreuses éponges contiennent des bactéries intra- ou extracellulaires, symbiotiques ou non, soit dispersées dans la masse de tissus, soit situées à leur surface (VACELET et DONADEY 1977, WILKINSON 1978, WILKINSON et al. 1981 et 1984).

VAN WEEL (1949) suppose que la "propreté" de l'épithélium des spongiaires est due à la capacité phagocytaire des cellules épithéliales tandis que GILBERT et ALLEN (1973) incriminent la sécrétion d'antibiotiques par l'éponge. Leurs hypothèses ont été vérifiées par FROST (1976) et WILLENZ et VAN DE VYVER (1982). VACELET (1975) suggère que les substances antibiotiques pourraient être synthétisées par les bactéries associées, bien que des éponges sans microflore possèdent une activité antibiotique.

MADRI et al. (1967) font état d'une flore indigène chez Microciona prolifera, constituée de pseudomonadacées, coryné-bactéries, flavobactéries et entérobactéries. Leur densité est plus élevée que dans le milieu environnant. BERTRAND et VACELET (1971) ont identifié des Pseudomonas et des Aeromonas associés à des éponges cornées de Méditerranée. WILKINSON (1978) a réalisé une classification de bactéries par taxonomie numérique. Trois éponges marines taxonomiquement différentes contenaient des symbiontes bactériens phénotypiquement assez semblables mais différents du milieu. Une quatrième contenait une population mixte semblable à celle de l'eau ambiante.

Au cours de ce travail, nous avons entrepris d'identifier les bactéries associées à la surface de trois espèces d'éponges d'eau douce de Belgique: Ephydatia fluviatilis (étang de Linkebeek), Ephydatia mülleri et Spongilla lacustris (étang de Virelles).

Des boîtes de Pétri remplies d'un milieu de culture solide (EMB, TGE, KING et PSEUDOMONAS AGAR) sont appliquées sur la surface de l'éponge, celle-ci restant liée à son support : branchage, caillou ou mur de soutènement. Conjointement, de l'eau de l'étang est ensemencée sur une autre série de boîtes.

Les boîtes sont ramenées au laboratoire et incubées à différentes températures selon le milieu d'isolement. Les colonies qui en résultent sont isolées puis soumises aux tests permettant leur identification : coloration de Gram, morphologie, mobilité, oxydase, catalase, croissance sur milieu Mac Conkey, pour terminer par la gamme de tests des galeries API (20 E, 20 NE, CHB). Par cette méthode, on n'isole évidemment que les bactéries hétérotrophes aérobies.

Les bactéries associées aux éponges appartiennent à deux groupes : 1) les Bacillus, Gram positifs, sporulés; 2) les bâtonnets Gram négatifs, pouvant eux-mêmes être partagés en deux sous-groupes : les "oxydase plus" et les "oxydase moins"

Parmi les "oxydase moins", nous trouvons des Enterobacteriaceae (Enterobacter, Escherichia, Klebsiella, Serratia, Citrobacter), des Vibrionaceae (Aeromonas), un Pasteurella et un Acinetobacter. Parmi les "oxydase plus", nous trouvons des Pseudomonadaceae (Pseudomonas et Achromobacter). Les deux groupes et sous-groupes contiennent des germes couramment rencontrés dans les eaux à l'exception de Pasteurella haemolytica qui est en principe un pathogène de mammifères et d'oiseaux.

Sur les cinquante six souches isolées, neuf n'ont pu être identifiées. Il s'agit de bâtonnets Gram négatifs aérobies. Cinq ont un métabolisme diversifié mais qui ne répond pas aux critères habituels de détermination. Quatre ne métabolisent pratiquement aucune des substances qui leur ont été fournies.

D'une manière générale, les bactéries retrouvées à la surface de ces éponges dulcicoles correspondent aux groupes présents dans les eaux d'où elles proviennent. Elles sont donc un reflet des bactéries de l'environnement. Il ne s'agit pas ici de bactéries symbiotiques mais de représentants de la flore microbienne servant de nourriture aux éponges ou adhérant à leur surface.

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Nutrition bactérienne des Eponges : 1. Rétention et digestion d'Escherichia coli par l'Eponge Ephydatia fluviatilis

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This work describes a sensible and accurate method for measuring the retention and digestion rate of bacteria by sponges. Results are presented for the freshwater sponge Ephydatia fluviatilis fed with Escherichia coli suspensions.

Les spongiaires se caractérisent par une capacité élevée de filtration et de rétention de divers types de particules dont les bactéries (REISWIG 1975, FROST 1978). In vitro, des taux de croissance importants ont été observés lorsque les éponges sont nourries uniquement de suspensions bactériennes (RASMONT 1961, FRANCIS and POIRRIER 1986, HUYSECOM et al., 1988).

Ce travail présente une méthode permettant d'évaluer la capacité de rétention et de digestion des bactéries par les éponges, en particulier par l'éponge d'eau douce Ephydatia fluviatilis qui se cultive aisément en laboratoire (RASMONT 1961). La méthode proposée est une amélioration de celle de WILLENZ et al. (1986) consistant à marquer les bactéries à la thymidine tritiée et à enregistrer leur ingestion dans les éponges par une mesure de la radioactivité au cours du temps.

En plaçant des éponges pendant 1h dans une suspension de bactéries marquées et en mesurant ensuite le traceur accumulé dans chaque éponge, on détermine la vitesse de rétention (nombre de bactéries retenues par heure et par éponge). L'expérience peut être réalisée soit sur des éponges à jeûn soit sur des éponges cultivées au préalable pendant une période déterminée en présence d'une suspension de bactéries non marquées.

La thymidine tritiée n'étant pas ou peu incorporée par les éponges, on y observe rapidement une décroissance du marquage et une augmentation correspondante de la radioactivité dans le milieu extérieur. Selon WILLENZ et al.(1986), cette situation serait liée à une exocytose des produits de la digestion. La vitesse de digestion des bactéries par les éponges peut donc être évaluée en transférant ces dernières en milieu stérile, après incubation dans une suspension bactérienne marquée, et en mesurant l'évolution du marquage de l'éponge au cours du temps.

Cette méthode nous a permis d'étudier dans un premier temps la cinétique de rétention par E.fluviatilis d'Escherichia coli à différentes concentrations. L'influence de l'état nutritionnel des éponges ainsi que l'existence d'une valeur optimale du taux de rétention ont été mises en évidence (HUYSECOM et al., 1988).

La digestion d'E.coli par E.fluviatilis a été étudiée dans un second temps en plaçant des éponges pendant 1h dans une suspension de bactéries marquées (10^7 bact/ml) et en les transférant ensuite en milieu stérile.

La mesure de la radioactivité apparaissant dans le milieu extérieur montre qu'E.coli est totalement digéré par l'éponge. En effet, le passage du milieu sur filtre millipore (0.45µm) n'en réduit pas la radioactivité de manière significative ce qui indique que celle-ci n'est plus liée aux bactéries. Par ailleurs, l'absence d'augmentation du nombre de bactéries vivantes dans le milieu extérieur a été vérifiée par dénombrement des germes au cours du temps.

La décroissance de la radioactivité dans les éponges transférées en milieu stérile est linéaire. La pente de la droite permet d'évaluer la vitesse de digestion d'E.coli à 8.8% des bactéries ingérées par heure.
La même expérience a été appliquée à des éponges nourries au préalable pendant 12h avec une suspension d'E.coli non marqués. Dans ce cas, la décroissance de la radioactivité dans les éponges est retardée de 3 à 5h.

En conclusion, la sensibilité et la reproductibilité de cette méthode permettent de distinguer et de quantifier les phénomènes de rétention et de digestion des bactéries par les éponges.

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Nutrition bactérienne des Eponges : 2. Etude comparative de la digestion de trois espèces bactériennes par Ephydatia fluviatilis

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The present work analyzes, in standardized laboratory conditions, the digestion of three bacterial species by the freshwater sponge Ephydatia fluviatilis. The results suggest that digestion rate of sponges could be related to bacterial morphological characteristics and/or the nature or abundance of their glycocalyx.

Dans la première partie de ce travail consacré à la nutrition bactérienne des éponges, nous avons montré à l'aide d'une méthode basée sur l'ingestion de bactéries marquées à la thymidine tritiée qu'Escherichia coli était très efficacement retenu et totalement digéré par Ephydatia fluviatilis. Divers travaux ayant montré que d'autres bactéries et des levures pouvaient être retenues par les éponges avec des efficacités très variables (FROST 1980, VAN DE VYVER et al. 1988), nous nous sommes proposés dans le présent travail de comparer la rétention et la digestion de trois espèces bactériennes : Escherichia coli, Enterobacter agglomerans et Aeromonas hydrophila.

Les souches utilisées ont été isolées à partir d'éponges récoltées dans les étangs de Linkebeek et de Virelles (Belgique). Ce sont des bâtonnets gram négatifs, mobiles et communs dans les eaux douces, appartenant au groupe des bactéries entériques.

Après une heure de contact avec des bactéries marquées (10^7 bact/ml), on observe une accumulation importante de la radioactivité par E.fluviatilis correspondant à une rétention de 90% pour E.coli, 87% pour E.agglomerans et 77% pour A.hydrophila. Par dénombrement des bactéries dans le milieu d'incubation, on constate que leur réduction numérique est en relation avec leur taux de rétention.

L'analyse des résultats montre que les trois espèces bactériennes sont digérées par l'éponge mais que leur temps de transit est différent. E.coli est digéré plus rapidement que les deux autres bactéries testées. Bien que les résultats soient plus hétérogènes pour ces dernières, on peut cependant estimer leur vitesse de digestion (bactéries/heure) à 4,4% des bactéries ingérées pour E.agglomerans et à 3,3% pour A.hydrophila alors qu'elle est de 8.8% pour E.coli.

L'observation, au microscope électronique à balayage, des suspensions bactériennes utilisées permet de comprendre partiellement ces différences. Bien que les trois types de bactéries aient une morphologie semblable, la présence de chaînettes chez A.hydrophila, de fibrilles de glycocalyx reliant les cellules entre elles chez E.agglomerans pourrait expliquer l'allongement du temps de digestion de ces bactéries.

En conclusion, il nous paraît vraisemblable que la vitesse de digestion des bactéries par les éponges puisse être liée aux caractéristiques morphologiques, à l'abondance et/ou à la nature du glycocalyx bactérien. Il serait cependant intéressant de poursuivre ce travail avec des bactéries présentant des caractéristiques fort différentes (coques, bactéries encapsulées, ...).

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M-VII1

Accumulation du Cadmium par une pseudomonadacée marine : influence de certains paramètres physico-chimiques

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L'un des aspects les plus importants des interactions entre le cadmium et les bactéries réside dans la fixation du métal par les cellules, son accumulation et sa biotransformation sous une forme plus ou moins accessible et utilisable par d'autres organismes. La souche test utilisée au cours de ce travail était une pseudomonadacée halophile, isolée d'un sédiment non pollué par les métaux (Villefranche-sur-mer, France). Cette souche sensible au cadmium (concentration minimale inhibitrice 10 mg/l, sous forme de chlorure) (1) fixait en 24 h plus de 1,5 mg de cadmium par gramme de cellules sèches, à partir d'une solution saline additionnée de 1 mg Cd(chlorure)/l (2). La quantité de métal fixée était 2 à 3 fois plus élevée en eau de mer naturelle ou en solution saline, que dans ces mêmes milieux additionnés de peptone et d'extrait de levure, ou bien en milieu organique complexe. Ceci pouvait être dû à la complexation du métal par les composants organiques de ces milieux de culture (3, 4). La quantité de cadmium fixée par cette souche dépendante du sodium était maximale dans la gamme des salinités proche de l'eau de mer naturelle (30-50 g/l). Aux salinités plus basses, la fixation était plus faible, ce qui pouvait être expliqué par une détérioration du métabolisme dû à un manque de sodium (aucune croissance n'a été observée en l'absence de cet ion) (5), ou par la présence de l'espèce toxique Cd^{2+} (6). Aux salinités plus élevées, la plus faible fixation pouvait être expliquée par la présence de $CdCl_3^-$ et $CdCl_4^{2-}$ moins accessibles que la forme $CdCl_2$ (6), prédominante en eau de mer (7). La fixation du cadmium était 5 fois plus élevée à 27°C (température de croissance optimale) qu'à 4°C. D'autre part, cette souche aérobie stricte placée en anaérobiose pendant 4 h accumulait 2 fois moins de métal, bien que n'étant pas tuée par le manque d'oxygène. La fixation du cadmium était constante pour de faibles variations de pH (0,5 pH) autour de la neutralité. De plus fortes variations induisaient des modifications dans la fixation du métal. Plusieurs substrats intermédiaires du cycle de Krebs ou donneurs d'électrons, augmentaient l'activité respiratoire de la bactérie, mais ne modifiaient pas le taux de fixation du métal.

Les paramètres physico-chimiques du milieu entraînent la modification des formes du cadmium, le rendant probablement plus ou moins accessible aux micro-organismes (8, 9). Toutefois, les variations drastiques de ces paramètres pourraient aussi induire des modifications du métabolisme des cellules et modifier ainsi l'accumulation du cadmium. Ces observations suggèrent que la fixation du cadmium par cette bactérie halophile sensible au métal était gouvernée non seulement par son état physiologique, mais aussi par les paramètres physico-chimiques du milieu.

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M-VII2

Rôle de certaines bactéries dans la fixation du Cadmium par la Moule (Mytilus edulis)

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Introduction :

Le cadmium, comme de nombreux éléments métalliques rejetés en mer, est capable de se lier à des substances organiques ou minérales. Ainsi complexé, ce métal peut devenir plus accessible à certains organismes comme la moule (George et Coombs, 1977) ou au contraire moins accessible à d'autres comme le barnacle (Rainbow et al., 1977). De nombreux travaux ont montré l'accumulation par les bactéries des métaux lourds, dont le cadmium (Doyle et al., 1975 ; Gauthier et Flatau, 1977 ; 1980), et le mercure (Austin et al., 1977). En modifiant la forme physico-chimique du mercure, elles peuvent augmenter son accessibilité en formant des alkylmercures plus assimilables par les animaux marins (Gavis et Fergusson, 1972 ; Fowler et al., 1978) : l'huître *Crassostrea virginica* fixe par exemple plus de mercure en présence de *Pseudomonas* capables de le réduire ou de le fixer préalablement (Sayler et al., 1975).

Le but de ce travail était de comparer la fixation du cadmium par la moule, le métal étant apporté sous forme ionique ou préalablement incorporé par des bactéries marines l'accumulant (S) ou l'accumulant peu (R), et d'en déduire le rôle des bactéries sur la fixation de ce métal par des organismes plus évolués.

Matériel et Méthodes :

La cinétique d'accumulation du cadmium par des moules a été suivie pendant une dizaine de jours. Le cadmium était fourni sous forme de chlorure (1 mg Cd/l) en présence de bactéries non préalablement cadmiées (R ou S), ou bien fixé par les mêmes souches (équivalent à 20 µg Cd/l). La charge bactérienne était identique dans toutes les expériences.

Résultats :

Que le cadmium ait été sous forme ionique ou sous forme fixée par les bactéries, l'accumulation a décru dans le sens : viscères > branchies > manteau, quelle que soit la souche bactérienne utilisée. Ce résultat avait déjà été décrit par d'autres auteurs dans le cas de certains chélatants (George et Coombs, 1977).

L'accumulation du cadmium par les moules à partir du métal ionique était d'allure non exponentielle et, au bout de 10 jours de contact, elle était 5 à 9 fois moindre qu'à partir du métal préalablement fixé par les bactéries, suivant l'organe concerné (Tableau n° 1). Dans ce cas, les moules pouvaient accumuler le cadmium dissous et le cadmium progressivement fixé par les bactéries (initialement non cadmiées) rajoutées dans le milieu pour équilibrer la charge bactérienne dans les deux types d'expériences. Ceci expliquerait la plus grande accumulation chez les moules en présence de la souche (S) qui fixait plus de métal que la souche R.

Tableau n° 1. Facteur d'accumulation du cadmium par différents organes après 10 jours de contact, le métal étant sous forme "chelatée" par les bactéries, ou sous forme ionique.

Organes	Cd chélaté par les bactéries	Cd ionique
Viscères	1500	170
Branchies	500	60
Manteau	250	50

La plus grande accumulation par les moules à partir du cadmium lié aux bactéries pourrait être due à sa plus grande disponibilité et aussi à l'importante capacité des moules à filtrer l'eau environnante et à en retenir les particules en suspension comme les micro-organismes. Dans ce même cas, l'accumulation plus rapide par les moules en présence de la souche (R) pouvait être due à une fixation plus labile du métal sur la paroi cellulaire de cette bactérie.

Les résultats de ce travail suggèrent donc que les organismes marins filtreurs comme la moule peuvent avoir des réactions différentes en présence de polluants métalliques selon la microflore associée, les micro-organismes pouvant conditionner dans une certaine mesure le devenir des métaux dans la chaîne alimentaire.

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M

Adhérence bactérienne sur supports inertes et vivants*

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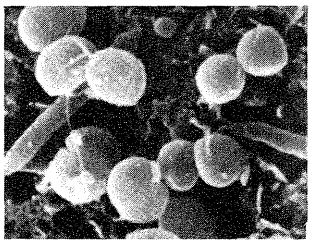
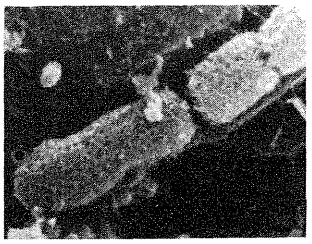
Microscopie à balayage : coloration au rouge de ruthénium



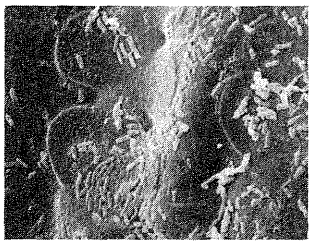
Sédiment marin
15 mm=1 µm



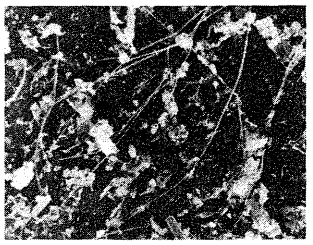
Sédiment lacustre
15 mm=1 µm

Typha latifolia
2 mm=5 µm

Iris pseudacorus
8 mm=10 µm

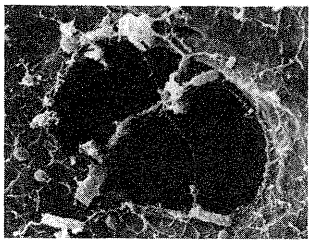


Glyceria maxima
18 mm= 10 µm

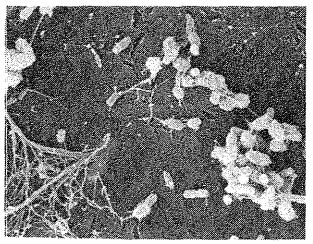


Phragmites australis
3 mm= 10 µm

In vitro : Ephydatia fluviatilis cultivée sur lamelle de ver



Ostiole
32 mm= 10 µm



Lamelle de verre
8 mm= 10 µm

Dans la nature, tout support inerte ou vivant est colonisé par les bactéries de l'environnement qui y adhèrent par l'intermédiaire de leurs glycocalyx. On observe des phénomènes similaires en laboratoire.

* Ces photos sont extraites d'une série de diapositives qui illustreront l'exposé présenté lors de la Réunion Pluridisciplinaire sur les "Phénomènes d'adhérence bactérienne sur le benthos, les sédiments et leurs implications".

O-I1

Results from the Gibraltar Experiment on the Exchange between the Mediterranean and Atlantic Basins

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A major field program was carried out in the Strait of Gibraltar from October 1985 to October 1986, involving approximately 20 research groups from the United States, Spain, Morocco, Great Britain, France and Canada. The goal of the Gibraltar Experiment is to understand how the dynamics of two-layer flow through the narrow and shallow Strait controls the amount of exchange between the Atlantic and Mediterranean basins. Here, we present a brief summary of the research projects carried out as part of the Gibraltar Experiment. Next, we show that the estimate of the outflow of Mediterranean water through the Strait depends on a definition of the characteristics of the outflowing water. Finally, we discuss the investigations of the hydraulic control conditions for the two-layer flow through the Strait.

The research projects consisted of synoptic shipboard surveys, moored time series measurements and modeling studies. Five hydrographic cruises were carried out over the year-long experiment including CTD stations and water sample analyses for salinity, freons and trace elements in order to examine the hydrographic structure and the heat and salt transport of the flow through the Strait. Two cruises measured turbulence and dissipation and one examined the internal hydraulics at critical regions in the Strait. There were shore-based radar and airborne synthetic aperture radar measurements of the solitary waves propagating eastward into the Mediterranean. Finally, there was a study of the funneling effect of the atmospheric flow due to the Strait orography during high wind events. The moored time series measurements consisted of 30 moorings measuring currents, pressure, sea level, temperature and salinity throughout the year-long period at critical locations (Figure 1). Modeling studies emphasized the problem of hydraulic control of the two-layer flow by the combination of sills and narrows present in the Strait.

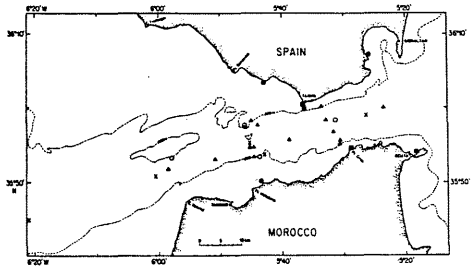

Figure 1. Gibraltar Experiment mooring array. Not all locations were occupied for the duration of the experiment. The mooring array was designed to provide intensive coverage at one across-strait section (Camarinal sill, northeast of Tangier), good along-strait coverage, and less intense coverage at a second across-strait section (in the narrowest part of the strait, east of Tarifa). The along-strait moorings generally follow the deep outflow path, which is south of the centerline west of the sill. Solid circles indicate sea level gages, open circles are bottom pressure gages, solid squares are meteorological stations, open triangles are doppler acoustic profilers, closed triangles are current meter moorings, and crosses are thermistor chain moorings (the four crosses in the along-strait alignment included current meters).

On the first hydrographic cruise, observations were made of western Mediterranean deep water exiting directly over the sill confirming a long-standing hypothesis. The moored current meter measurements show that the time-averaged Eulerian outflow over the sill is only 0.4 Sv. However, the interface between Atlantic and Mediterranean waters moves up and down over the tidal cycle and when the interface is shallow there is strong outflow of Mediterranean water. The current and salinity time series show that the strong correlation between the outflow velocity and the depth of the Mediterranean water yields a net outflow salinity transport (above a base Atlantic water salinity of 36.2 ppt) of 1.5 Sv ppt. Thus, the outflow can be considered to be either a 0.7 Sv outflow of pure (S = 38.4 ppt) Mediterranean water or a 1.1 Sv outflow of mixed (S = 37.5 ppt) Mediterranean-Atlantic water.

Many of the measurement programs were designed to investigate the hydraulic control conditions of the flow through the Strait. The flow at the sill exceeds a critical Froude number of one for short periods during nearly every semidiurnal tidal cycle. Critical Froude number flow was also observed at certain times in the narrowest part of the Strait just east of Tarifa. Also, the outflow over the westernmost sill north of Cape Spartel was always observed to be close to critical Froude number. Thus, the flow does appear to be hydraulically controlled at certain places and times. A remaining issue is to determine whether the two-layer exchange through the Strait is maximal or submaximal. Both hypotheses have been put forward and a close examination of the time series of the eastern parts of the Strait is being carried out to distinguish between the two.

O-I2

Resonant generation of nonlinear internal waves in a channel

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Satellite remote sensing and field experiments have shown that regions of abrupt topographic change can be the sites of significant internal wave activity in the coastal oceans. In Gibraltar Strait the exchange flow over bottom topography and past lateral constrictions gives rise to periodic generation of internal waves that propagate into the Alboran Sea. In the Gulf of California, tidal flows in the channels and past islands generate internal waves which propagate into the northern regions of the Gulf. If the waves were linear and dispersive they would decay in amplitude and not be of significance far from the generation site. The observation that the flows which generate the waves may be near a critical Froude number makes resonance and finite amplitude effects of interest. The balance between nonlinearity and dispersion then makes waves of (almost) permanent form which can propagate to great distances from the generation site.

There has been a great deal of interest in the resonant generation of nonlinear waves by moving disturbances in nonrotating systems (see WU (1987) for a review), and some work on the forcing of nonlinear Rossby waves ; however, little has been done on the generation of nonlinear Kelvin waves. Indeed, the subject of nonlinear Kelvin waves is one of some controversy (MAXWORTHY, 1983 ; GRIMSHAW, 1985 ; RENOUARD et al., 1987 ; KATSIS & AKYLAS, 1987). The primary result in the nonrotating case is that three-dimensional forcing may lead to two-dimensional solitary waves upstream. This result is unlikely to hold in rotating systems in which rotation influences the reflection process that permits the transition to two-dimensional waves upstream. Further, the presence of other modes, most notably Poincare waves, leads to a more complicated picture.

Experiments were conducted, at the Coriolis Laboratory, I.M.G., to investigate the generation of nonlinear waves upstream of a transcritical disturbance in a rotating channel. A channel 10 m long and 2 m wide was placed on the large rotating platform. The channel was stratified with layers of fresh and salt water. A "ship-shaped" body was suspended from a motorized carriage and towed at constant speed along the channel. Internal waves were measured with a set of interface followers.

The measurements show that nonlinear waves are generated upstream. The leading wave profile at the wall has a sech^2 shape, similar to a KdV solitary wave (cf. RENOUARD et al., 1987). The nonlinear correction to the wave speed is proportional to the amplitude at the wall, which increased with increasing Froude number in the transcritical regime ; although some experiments showed a local maximum at supercritical Fr (cf. MELVILLE & HELFRICH, 1987). The decay of the wave across the channel was approximately exponential (scaling on the Rossby radius), with a tendency to be a little slower at the larger Froude numbers. The waves showed a clear change in phase across the channel, consistent with the curvature observed in earlier related experiments (MAXWORTHY, 1983 ; RENOUARD et al., 1987).

The results are discussed in the light of the recent controversy regarding the existence of solitary Kelvin waves. In particular, attention is drawn to the fact that for some parameter ranges transcritical forcing of Kelvin waves is not separable from transcritical forcing of Poincare waves ; in consequence of which the presence of both modes may be anticipated.

O-I3

Observation of internal solitary waves generated in a strait

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Packets of internal solitary waves observed in summer 1986 in the gulf of Korinthos ,Western Greece, are described in this note. Thermistor chain data (from 10 to 60 m at 5m intervals) were collected at a station 17 km east of the Rio-Antirio strait (western entrance of the gulf, sill depth 60 m) from 26 june to 29 july in 15 min. intervals. The strait is 5 km wide and has a sill depth of 60 m. Important tidal currents are known to be present in the strait. Upwellings have been reported to occur in the north-western coasts of the gulf extending to the Rio-Antirio strait [5]. The internal solitary wave signal was extracted from measurements by first applying a high pass filter to each of the original time series. The in-phase lowering and rising of the interfaces (a well known characteristic of solitary waves) [7] were visualized by multiplication of all individual high-pass time series.

A series of internal solitary waves were thus observed. They appeared at the end of distinct upwelling events and were found to occur every 12.45 hours at flood tide. It is evident from those remarks that their generation mechanism is related both to upwelling and tide. In fact, strong tidal flow and strong winds, which generate upwelling, form an important isopycnal depression behind the sill [2]. When both the wind stops and the tidal-flow reverses, the released energy disintegrates into internal waves. The tide-sill interaction has already been reported in litterature [1] as a solitary wave generation mechanism. In our case, it seems that this mechanism is not sufficient in itself. When the conditions following an upwelling event are also present, solitary waves are produced.

In figure 1 are shown the two strongest solitons observed. Their amplitudes were computed to be 15 and 10 meters respectively and were found to fullfill the shallow water KdV theory requirements [4], namely that : sqrt(a/H)=O(H/λ) where a,H,λ denote the amplitude, total depth and wavelength respectively. It can be seen that the second wave displays positive polarity (upward thermocline displacement), an unusual feature in

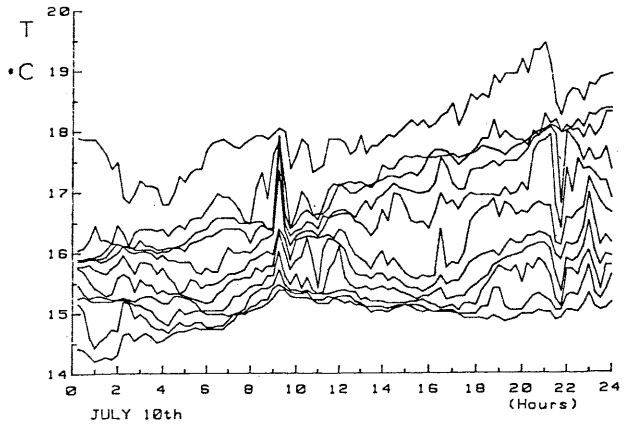

Figure 1

marine solitary waves. Such positive polarity waves are predicted by KdV theory [6] to occur in the case of thicker upper layer (h1>h2) and have been simulated in numerical experiments [3]. It is suggested that the change of polarity took place during the passage of the wave over a 40 meter deep neighbouring bank.

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O-I4

A model for the Alboran Sea internal solitary waves

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The propagation into the Alboran Sea of the interface depression generated at the Strait of Gibraltar by the interaction of the semidiurnal tidal current with the main (Camarinal) sill is studied numerically by using a unidirectional model with two horizontal space dimensions (PIERINI, 1986).

An initial waveform within the strait -just east of the sill- has been determined whose evolution compares well with the train of internal solitary waves detected in the Alboran Sea via current measurements at different depths, as described by KINDER (1984).

The agreement is good in two points (where data are available) located at about 45 km East of the strait, the first aligned with the strait axis and the second 20 km to the North.

Moreover, the shape and amplitude of such initial condition is in agreement with a typical interface depression generated by the interaction of the tidal current with the sill.

A series of numerical experiments with different initial conditions is also performed and the reason why solitary waves may or may not be observed in the Western part of the Alboran Sea is thus clarified.

In general, the horizontal shape of the waves is similar to that exhibited in pictures taken by the Space Shuttle Challenger.

A discrepancy between the numerical and the observed shape, i.e. the higher curvature of the waves in a beam aligned with the strait axis, is to be accounted for the advection due to the Atlantic water inflow which is not modelled here.

The present study helps to understand the observed connection between the weakening of the Atlantic water jet (and corresponding weakening of the Alboran Sea gyre) and the appearance of energetic internal solitary waves.

O-I5

The Levantine intermediate water outflow from the Strait of Sicily

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The Levantine Intermediate Water (LIW) reaches the Western Mediterranean Basin through the Strait of Sicily flowing over two sills 430 and 365 metres deep. Past the sills it enters first into the large valley delimitated by the Sicily and the Tunisia continental slopes, and by the M. Elimi chain to the North.

The LIW has three possible ways out into the western basin: directly toward the sardinia Channel, between M. Aceste and M. Drepano, and along the Sicily continental slope.

Seasonal hydrological surveys of the above area were carried out in the framework of the POEM Project in October 1986, March and September 1987, March 1988. The first results obtained from the distribution of salinity maximum, which is a good tracer of the LIW, are reported.

The isolines representing the salinity maximum obtained from the observed data indicate at first sight the area occupied by the LIW, their weak diluition along the "core" which points out the flow direction, and the cross gradient which gives an idea of the flow intensity (Fig. 1).

The larger influence of the deepr sill is easily recognized (this however does not exclude the transit of LIW over the shallover sill, where less dense water is observed).

The "core" of the LIW tends to dispose itself along the Sicilian side of the valley up to our farthest cross section, south of Ustica Island.

In the vicinity of the sill near to seamounts Drepano and Aceste a secondary branch stems out of the main flow and moves counterclockwise toward NW. One remarks in the vertical section (Fig. 2) that the former flow transports the upper part of the LIW, namely water lying between the depths of 300 and 400 m; the water underneath feeds the East flow of the LIW.

The seasonal changes appear through the shape and size of the areas the LIW occupy rather than through the salinity variations. Indeed these variations, after the CTD accurate calibrations, resulted in the range of errors.

In wintertime the flow is observed to be generally compact in comparison with the widespread one observed in summertime. Its deeper part follows closey the Sicilian side of the valley and moves Eastward. The shallower flow appears as a water tongue of more saline water than the other.

In summertime a displacement of the flow away from the Sicily is noted as well as some prevalence of the shallower flow with its transport toward the Sardinia Channel.

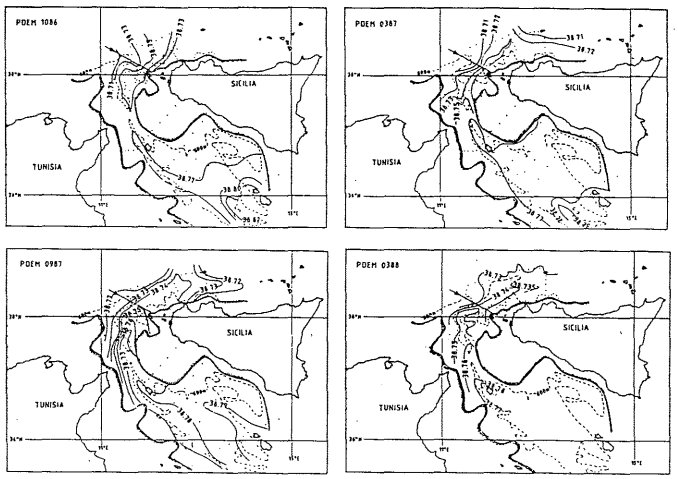

Fig. 1 - Salinity maximum distribution. The shaded line indicates the bottom boundary of LIW salinity maximum.

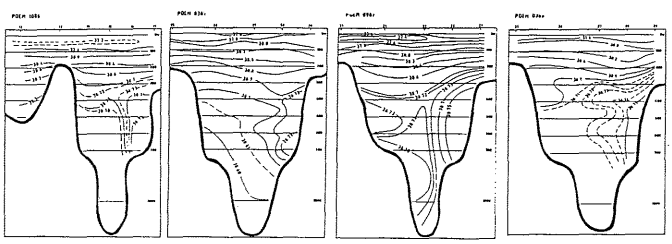

Fig. 2 - Vertical salinity distribution along cross section of Fig. 1.

O-I6

Mixing and internal hydraulic characteristics of Bosphorus exchange flow

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The main oceanographic features of the Bosphorus water exchange associated with its mixing and internal hydraulic characteristics are reported in the following using the findings from a total of 24 surveys of R/V Bilim comprising the period of November 1985-October 1987.

A persistent two-layer system of exchange normally takes place in the Bosphorus. The two-layer system attains marked seasonal variations depending particularly on the intensity of the Black Sea inflow at the surface layer as well as the shorter-term changes occuring in response to the prevailing wind conditions. The two-layer stable density stratification is dominated by the salinity, even though the temperature undergoes considerable seasonal variations. The salinity of the upper layer varies between 16.5-18.5ppt at the northern half of the Strait throughout the year, with the lower values indicating summer conditions corresponding to the peak Black Sea inflow (June-July). The salinity of the lower layer waters attains a maximum value of 38.5ppt near the Marmara exit region. The surface and bottom waters are separated by a sharp interfacial layer with an average thickness of 10m at the northern part of the Strait. The interface extends horizontally with a mild slope towards the constricted area and is situated close to the bottom (about 40-50m below the free surface). The transitional layer may be identified in the salinity transects by the zone located between the salinity limits of 16-22ppt and 33-38ppt. Towards the southern end of the Strait, significant changes take place with respect to the position of interface as well as the stratification, mixing and flow characteristics. This region is characterized by intense mixing of the bottom waters into the upper layer, a sharp upward tilt of the interface and the intensification of the upper layer currents. The vertical mixing results in a total increase of about 2-3ppt in the upper layer salinity between the two ends of the Bosphorus. The salinity of the northerly flowing bottom layer waters decreases accordingly by about 2-3ppt. The interfacial zone becomes much broader as compared with further upstream and has a thickness of 20-30m. The surface layer flow eventually exits from the southern entrance in the form of a turbulent buoyant jet.

Noteable changes encountered in the property fields and increased mixing observed in the southern Bosphorus are related with certain morphological features of the channel which effectively lead to hydraulic controls of the exchange flow. The contraction of the channel at the southern part of the Strait, the sills located to the south of the constricted region and immediately outside the northern entrance as well as the abrupt terminations of the channel at the exit regions of the adjoining seas evidently cause significant changes in the mixing and flow characteristics as the two distinct water masses traverse the Strait in opposite directions.

The observations generally indicate the presence of three internal hydraulic controls of the flow at the abruptly widening southern end of the Bosphorus, the constricted area and the crest of the northern sill. The internal hydraulic adjustment of the flow occuring within the constricted region near the Kandilli-Bebek section is observed in most of the surveys but no evidence for its existence could be observed in some cases corresponding to the periods of weak upper layer flows in the Strait. When the controlled flow condition exists at the constriction, the interface which is located at deeper levels to the north of the region is sharply elevated. In this way, the flow adjusts itself to the critical hydraulic condition, and the upper layer flow becomes supercritical immediately to the south of the constriction. Thereafter, the interface depth declines and the surface layer flow undergoes through an internal hydraulic jump so that it passes through another critical section at the southern exit region. The surface layer flow which becomes critical at the exit section enters into the adjoining Marmara region in a supercritical state. The supercritical flow is, eventually, matched to the subcritical flow of the Marmara Sea through an internal hydraulic jump taking place in the vicinity of the exit. The northern sill, on the other hand, exercises internal hydraulic control on the lower layer flow which almost permanently enters the Black Sea by flowing over the sill in the form of a thin plume. The blockage of the underflow can only take place temporally under extreme conditions of abnormally high Black Sea inflow into the Bosphorus. Under normal conditions, the effluent passing over the sill has a thickness of about 10m, and proceeds in the north-northwest direction towards the western Black Sea shelf in the form of gravity flow along the bottom slope.

As a result of these hydraulic controls, the two-layer water exchange between the Marmara and Black Seas will be determined by the conditions within the Bosphorus Strait, and not dictated by the conditions at the adjacent basins. In other words, depending on the average densities of the layers, the geometry and the magnitude of net southerly flowing barotropic flow, the critical controls will determine approximately the shape of interface established in the Bosphorus and the magnitudes of flows in the layers entering into the Strait from the upstream basins.

O

Evidence of isopycnal mixing across a thermohaline front in the Strait of Otranto

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** National Centre for Marine Research, Aghios Kosmas, 16604 Hellinikon (Greece)

The region of Otranto strait was visited during POEM-02-86 cruise by R/V AEGAIO. Three CTD casts, over the eastern part of the sill, were taken on April 23rd (fig.1). The existence of a thermohaline front, at the point where Ionian and Adriatic waters meet, is revealed by the distribution of hydrological characteristics (fig.2). The spatial scale of the front was found to be of the order of 30-40 nautical miles. Temperature and salinity inversions are observed throughout the water column (Georgopoulos et al, 1986). Those vertical structures are more important at the northernmost station and become weaker as one moves to the south of the sill. Near the bottom of the sill, dense water (σ_θ = 29.17) was found to outflow towards the Ionian sea.

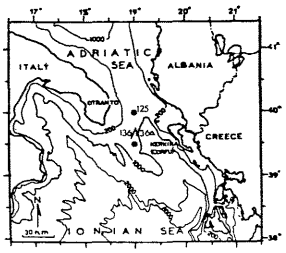

Fig.1. Bathymetric chart of Otranto strait (depth in meters). Location of hydrographic stations.

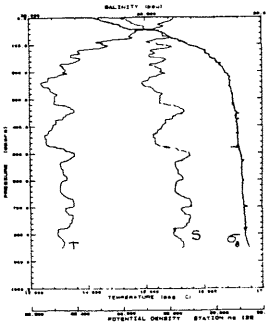

Fig.2. Vertical profiles of T, S, ϕ_θ at station 125.

The objective of this paper is to study mixing mechanisms occuring in the front. Finestructure theory techniques are used.

Data were filtered by a cosine-type filter. Subtraction of smoothed profiles from original ones provides zero-mean temperature and salinity fluctuations T' and S' (fig. 3). Spectral analysis of those fluctuations revealed important oscillations at wavelengths of 78m, 45m and 25m, throughout the water column. From ratios of vertical to horizontal dimensions of such structural elements (known to be between 10E-2 and 10E-3) it follows that the horizontal scale of the features observed are typical of mesoscale variability.

To separate vertical and horizontal mixing mechanisms, values of smoothed T-S diagram slope ($d\bar{T}/d\bar{S}$), ratios of expansion coefficients β/α and ratios of temperature and salinity anomalies T'/S' were computed along the vertical. Results for the northernmost station over the sill are shown in Table 1.

Table 1

Pressure range dbars	β/α °C/ppt	T'/S' °C/ppt	$d\bar{T}/d\bar{S}$ °C/ppt
250-345	3.66	3.48	2.78
346-437	3.66	3.22	4.04
438-514	3.64	3.42	3.14
515-561	3.64	3.42	4.71
562-585	3.64	3.61	2.25
586-624	3.64	3.54	4.11
625-704	3.63	3.38	3.17
705-800	3.63	3.47	4.08

From table 1 it is evident that T'/S' ratio values are closer to β/α than to $d\bar{T}/d\bar{S}$ (fig. 4) and hence that isopycnal mixing dominates in the 250-800 dbar range. Vertical mixing could also play a role in the ranges 438-514 and 625-704 dbars.

In depth study is needed to elucidate any eventual relation of the mixing processes described above to the formation of the dense water observed near the bottom of the sill.

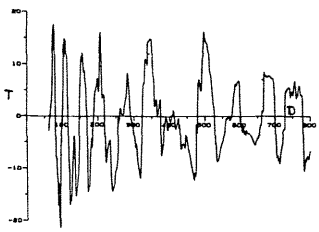

Fig. 3.Temperature anomaly (T'°C, E-2) vs depth (dbars) for station 125.

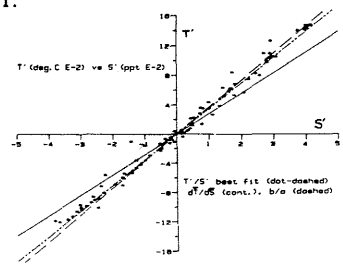

Fig.4. T',S' pairs, the line of best fit, the mean gradients $d\bar{T}/d\bar{S}$ and the isopycnal lines b/a for the 250-345dbars layer.

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The outflow conditions of the Mediterranean effluent at the Black Sea exit of the Bosphorus Strait

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The outflow of the Bosphorus underflow into the Black Sea has been a puzzling subject since it was first investigated in 1940's. Many of the earliest studies have been based on the assumption that the underflow could be blocked at the northern end of the Bosphorus in the form of a salt wedge. While the earliest version of this hypothesis, i.e. the lower layer current being blocked for extended peroids (a few months) have become obscure at present, it has often been argued that the excessive cases of Black Sea outflows through the Bosphorus upper layer or strong northerly winds could cause temporary blocking at the northern end of the Strait. The earlier information on the bottom topography of the region has misplaced the sill depth of 45-50 m. Because of this misconception on the sill depth, observations showing interface depths of larger than 50 m within the northern Bosphorus were interpreted as corresponding to blocking conditions.

The exit conditions of the lower layer flow of the Mediterranean origin into the Black Sea has been investigated during recent surveys. The topography is found to be unique in many respects and play important roles on controlling and steering the bottom currents. A narrow bottom groove (the Bosphorus Canyon) extends from the northern exit towards offshore and directs the outflow across the continental shelf. About 3 km from the exit, a sill of 60 m depth exists within the Bosphorus Canyon. The Canyon is initially in the northeast direction and after passing the sill it gradually turns north and finally to the northwest. The presence of the Mediterranean waters to the northwest of the exit, as observed in the earlier studies, is therefore explained by the steering of topography and had earlier remained puzzling because of the expectations of easterly bending on the basis of Coriolis effect.

At the sill, the flow is hydraulically controlled and after overflowing the sill it reaches the continental shelf region in the form of a gravity current. However, the presence of another control section at the constriction of the Bosphorus within its southern half imposes modifications on the nature of single control at the sill. A maximal exchange occurs between the Marmara and Black Seas and is often controlled by the combination of the constriction and sill controls. The presence of a constriction control on the high density basin side of the sill reduces the influence of the sill on the exchange and the control by the constriction dominates. Becuse of the widths at the sill and the constriction are different (the sill is narrower) the blocking of the lower layer can occur at smaller values of net barotropic currents as compared to the single sill case.

In the reported set of observations, these controls are evident and the Bosphorus underflow is observed to reach the Black Sea in almost all of the cases. However, during periods of strong northerly winds and peak Black Sea outflows blocking of the lower layer was observed for short periods (1-2 days). In such cases, the ordinary controlled flow conditions resume shortly after the transient forcing ceases. The interface depth varies nonlinearly between the two controls and is often close to the bottom in this region.

O-I9

Deep water renewals and oxygen deficiency in the Sea of Marmara

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The Marmara Sea is located between the Black Sea and the Aegean Sea, connected to those adjacent basins via the narrow, shallow and long straits of Bosphorus and Dardanelles. The results and analyses of recent repeated surveys are reported in the following.

A distinguishing feature of the Sea of Marmara is the permanent oxygen deficiency below the halocline. The deficiency of oxygen is due to natural causes and dates back at least to the most recent geological evolution of the basin (3000 years b.p.). In the Black Sea, oxygen ceases to exist below a mean depth of 200m, while in the Aegean Sea the whole water column is effectively ventilated. The Marmara Sea is stratified in two layers with a sharp pynocline located at a depth of 25m. The density changes are mainly accounted by the differences of salinity between the layers, with fresh (brackish) waters of Black Sea origin overtopping the high salinity Mediterranean waters below the halocline.

The Black Sea surface waters entering the system through the Bosphorus Strait and the Aegean waters entering through the lower layer of the Dardanelles Strait are both in saturated in oxygen. In spite of this supply of oxygen, the subhaloclinic waters in the basin are deficient (20-30% of saturation). The sharp pycnocline ($\Delta\rho/\rho \simeq 0.01$) prevents ventilation of the deep waters by mixing from the surface and the organic decomposition processes in the deep layer partially utilize the oxygen supplied by the Dardanelles underflow to the deep waters. The renewals of deep Marmara basin waters by the dense, saline and oxic Dardanelles inflow prevents the basin from becoming anoxic, although this input is insufficient to completely meet the oxygen demand. Therefore, the competing effects of oxygen utilization by the sinking flux of organic matter and supply by the Dardanelles underflow are in a state of equilibrium.

The relatively deep Marmara trough ($\simeq$1300m at the deepest points of its three sub-basins) acts as a settling basin for POC, which is predominantly generated by its own primary productivity, with POC in-out fluxes playing secondary roles.

The annual mean primary productivity is estimated to be 60 gC/m^2, and supported by estimates obtained from the carbon content of the bottom sediments.

The sinking flux of POC is estimated from New Production, and is found to be equally contributed by upward mixing of neutrients in the Bosphorus exit region adjoining the Marmara Sea (a permanent biochemical cycle related to hydraulic jump/jet induced mixing in this zone) and the supply of neutrients from the Black Sea. The sinking POC is entrapped in the basin and utilizes oxygen with an estimated rate of 0.50-0.75 mg/l/yr.

The deep water renewals which make up for the oxygen losses occur in the spring months when the Aegean water density is a maximum. The dense water sinks to the bottom of the western sub-basin and relatively enriches the deep oygen concentrations (1.7 ml/l) as well as increasing the bottom water density. This patch of water then partially penetrates into the central and eastern sub-basins over the sills ($\simeq$700m) separating the basins, but by the time it reaches the eastern basin oxygen decreases to values less than 1.0 ml/l. The sinking water is also identified by small but significant salinity and temperature anomalies and fine structure superimposed on an otherwise constant temperature (14.5 °C) and salinity (38.5 ppt) distribution in the subhalocline waters.

The water entering with the Dardanelles underflow is modified in the Strait by mixing and further evolves during a sinking plume stage. The interior density distribution is continually modified by the horizontal intrusions after the sinking plume stage, and in the seasons other than spring, intermediate level (100-300m) intrusions can also be observed. Since the sinking process dependes on the Aegean seasonal conditions, the mixing in the Dardanelles and the plume stage and the evolution of the interior density, it appears to be highly intermittent although the traces of renewal are always observed since the residence time of the subhalocline waters are sufficiently long (6-7 years). In general, the sinking water is denser due to its higher Mediterranean salinity, but occasions where the excess density is caused by low temperatures of the inflowing water have also been observed. Immediately below the halocline (50-70m), a permanent warm layer (15 °C) exists, which also has lower oxygen and relatively longer estimated transit times than the deeper waters.

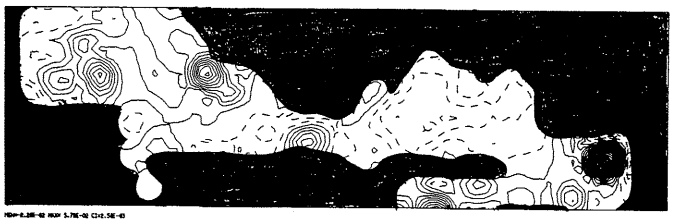
O-II1

POEM-V-87 General circulation survey : Maps of the Eastern Mediterranean Basin variability

POEM Group

444 CTD and 124 XBT were collected during the period August-September 1987 in the whole Eastern Mediterranean basin. Preliminary analysis of the isoltherm depths (14°, 15°C) and dynamic height topography (referred to 800 m) reveals a new picture of the basin circulation: large anticyclonic centers (south of Cyprus and Crete, in the middle of the Ionian basin) and a meandering cyclonic Rhode Gyre. The general circulation flow is there difficult to be seen as a basin-wide current: the picture hints at an intense mesoscale/gyre circulation pattern dominating the instantaneous circulation flow. Both LIW and AW are found interspaced or trapped in this mesoscale/gyre system.

Dyn Ht (250/800)



Dyn Ht (400/800)

Observations on the Atlantic water present in the Ionian Sea during POEM-V-87 cruise (August 31 - September 19, 1987)

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** Cooperativa "Mare Ricerca", Ancona (Italia)

From August 31 to September 19 1987, as taking part of the international oceanographic cruise, we made 81 hydrological stations covering the Ionian sea area and the strait of Otranto, from 35.5 to 40.5 of latitude North and from 16 to 19.5 of longitude East. (Fig. 1). The T-S diagrams and the temperature and salinity fields show that the area is interested by three distinct mass of waters (excluded the surface layer of approximately 20 meters depth):

a) The Atlantic Water (AW) that interest the first 100 m, its thermohaline characteristics vary strongly from one side to the other of the area investigated. The salinity minumum ranges from 37.3 PSU at the South of the Ionian Sea, to 38.4 PSU in the northern part.

b) The Levantine Intermediate Water (LIW) with temperature of approximately 14°C and a salinity greater than 38.80 PSU (the maximum that we found was 39.08 PSU in station 79), the depth of the core varies from 200 to 500 m.

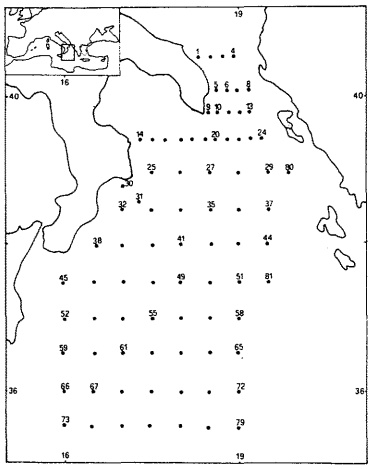

Fig. 1 - Map of the stations.

c) The Deep Water (DW) with a temperature less than 13.8 °C(we found the minimum of 12.84 °C at the bottom of the station 12) and a salinity less than 38.75 PSU.

The AW enter in the Mediterranean Sea from the Strait of Gibraltar and spread eastward with a certain number of branches that leave the main flow (Lacombe 1970).

One of these branches interst the Ionian Sea. The distribution of salinity minima (fig. 2) show that the core of the AW is in the centre of the area and is surrounded by nuclei of saltier and warmer water. The AW it keeps at the left of the 19th meridian.

In fact approximately along this meridian is present a very definit thermic front, from the surface to about 50 meters, at the depth of 30 m the front is sharper than at the surface.

At the station 73, in the South-West part of the area, the AW dominate from the surface to further 100 m. with the minimum of 37.29 PSU at 34 m.

In the northern part of the area, near the Strait of Otranto, the minimum of salinity is deeper (in station 20 is of 37.89 PSU at 38 m depth and in station 27 is of 38.29 PSU at 45 m depth). The layer of the AW is compressed between a mass of surface water, saltier than 38.60 PSU, and the LIW that in this part of the area we found from 500 m until 100 meters.

The planimetries and sections of temperature and salinity show filaments, termohaline fronts and many detached parcels of AW.

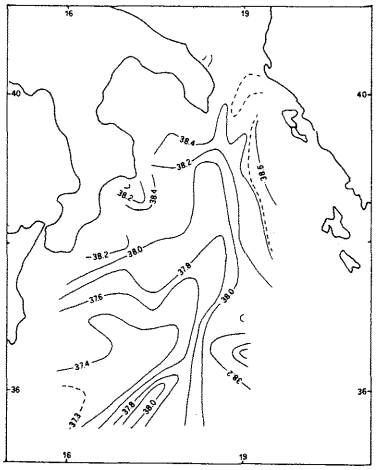

Fig. 2 - Distribution of the salinity minima.

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Horizontal oceanic circulation generated by deep water formation

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In this paper, we study the horizontal circulation generated by vertical convection and subsequent deep water formation. This work was initiated in order to explain the cyclonic circulation which is observed in the northern part of the Western Mediterranean basin (i.e. the Ligurian-Provencal sea) . Attention is focused on mesoscale motion generated by buoyancy forcing and the role played by non linearities and instability phenomena on their long term evolution. In order to investigate the importance of the above processes, we use a 3 D primitive equation numerical model, where temperature and salinity are included.

First, we deal with an "academic scheme". The Ligurian sea is schematized by a rectangular domain of 500 * 250 km whose center is located at 42°N. We start from rest. The density is homogeneous horizontally and the vertical gradients of temperature and of salinity are those encountered in winter. The grid mesh in the horizontal is 5 km which is smaller than the radius of deformation of the first baroclinic mode (≃ 8 km). Variation in the vertical is modelled by 12 levels whose separation is variable (from 10 m near the surface to 1700 near the bottom). In the vertical , we choose the parametrization of diffusion as a function of the Richardson number (PHILANDER and PACANOVSKI 1981).

The forcing occurs over an oval area of 200*100 km . It corresponds to a total heat flux (sensible plus latent) of 220 Wm^{-2}. The evaporation is 6.3 mm per day and triggers the latent and the salt fluxes. This forcing is constant during the first three months of the year and equal to zero thereafter. As long as the thermohaline forcing is active, the temperature decreases and the salinity increases. Hence, a homogeneous column of water is formed in the forcing area. The horizontal density gradient which is generated drives a horizontal baroclinic current in geostrophic balance. A gyre is formed and its pattern is linked to that of the forcing. The current flows in the cyclonic sense in the surface layer, and it is anticyclonic in the deep layer. Its maximum speed occurs near the surface where it is about 0.1 ms^{-1}. The flux of the cyclonic current is about one Sverdrup, a value which is close to valus computed from observations (GASCARD - 1978, CREPON et al 1981).

After two months, oscillations begin to develop along the front that defines the homogeneous column. Horizontal sections taken at different levels show waves whose wave length λ is about 40 km . They propagate in the cyclonic direction with a speed of about 1.8 cms^{-1} which corresponds to 1/5 of the mean velocity of the current. A phase lag in the vertical of λ/4 is found between the surface and the bottom. This phase lag is typical for baroclinic instabilities which has been found in analytical models (TANG - 1975, GASCARD -1978, CREPON et al -1981) and which has been observed in situ measurements by J.C. GASCARD (1978).

When the forcing stops, the oscillations decrease; they vanish after two months. At the end of the year a small dome is still observed. The isopycnal elevation is about 100 m and preconditions the stratification for the following year.

In order to enhance the similarity between the model results and the observations, we have done a numerical experiment with a realistic coast. One observes good agreement between the patterns observed in NOAA infra-red satellite images and the surface thermal field produced by the model.

In those experiments we have neglected the surface circulation that flows through the Corsica channel towards the Gulf of Lion. This circulation will be taken into account in the model of the general circulation of the Western Mediterranean Basin that we are in the process of developing.

ACKONOWLEDGMENTS

We thank P. DELECLUSE and P. ANDRICH for providing the numerical code and for their stimulating remarks. We are grateful to J.C GASCARD and F. AIKMAN for fruitful discussions.

This reseach was supported by the French governemental agencies CNRS and DRET. It is a contribution of the program MEDMODEL. The computations were done on the CRAY2 of the Centre de Calcul Vectoriel pour la Recherche (CCVR) and on the IBM of the Centre Inter-Regional de Calcul Electronique (CIRCE).

O-II4

An isopycnic study of the circulation in the different layers of the Eastern Mediterranean

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The large-scale circulation in three different strata of the Eastern Mediterranean Sea were studied using isopycnal analysis technique. The materials used are relatively homogeneous and new hydrographic data collected in the winter of 1977. According to a vertical salinity section representing the whole basin, three isopycnal surfaces were selected to perform the analysis. These surfaces are the σ_{θ} = 29.03 surface in the intermediate Levantine layer, the σ_{θ} = 33.55 surface (potential density referred to 1000 db) in the mid-depth layer and the σ_{2} = 37.84 surface (potential density referred to 2000 db) in the deep layer. Salinity, potential temperature and depth were looked at along these surfaces which produced new features of the circulation, particularly in the deep water.

The circulation of the intermediate water was characterized by a cyclonic movement in the Central Levantine basin and by an anticyclonic gyre in the Ionian basin East of Sicily (Fig. 1). In addition, there is a little indication of a westward movement of the saline Levantine water from the Levantine basin to the Ionian basin which might be considered consistent with the old picture of WUST (1960). The other features of the map are greatly in accordance with those found in OVTCHINNIKOV work (1966).

The gross feature for the mid-depth circulation (Fig. 2) is the existance of an anticyclonic eddy in the Levantine basin and an outflow from the Eastern Aegean Sea straits was indicated at depths of about 500 m near the straits. In the Ionian basin however there is a flow of relatively low-salinity water from a region Southeast of Sicily to the middle of the basin.

The circulation pattern in the deep layer (Fig. 3) indicated a spreading of low-salinity water from West of Cyprus to the Eastern border of the Ionian Sea. A limited flow of low-salinity water heading to the West was found in the middle of the Ionian basin. Such features differed entirely from those produced by WUST (1960) for the deep water.

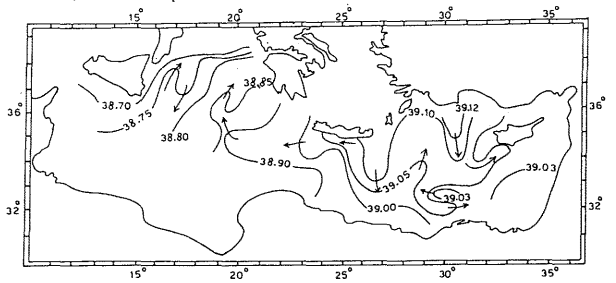

Fig. 1 Salinity (‰) on the σ_{θ} = 29.03 surface in winter of 1977.

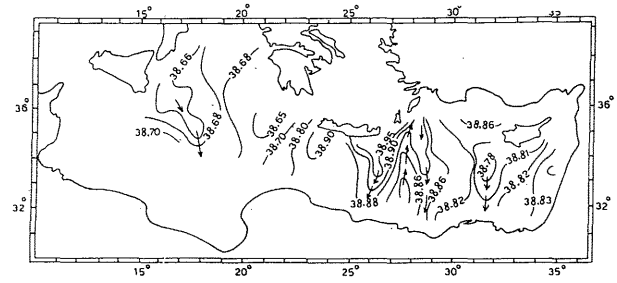

Fig. 2 . Salinity (‰) on the σ_{θ} = 33.55 surface in winter of 1977.

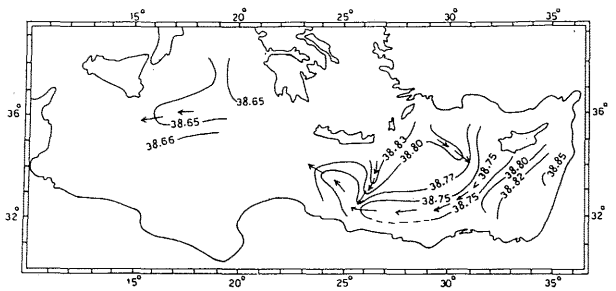

Fig. 3 . Salinity (‰) on the σ_{2} = 37.84 surface in winter of 1977.

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O-II5

Atmospheric pressure forcing and low frequency sea level variability in the Northeastern Mediterranean

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ABSTRACT Time-series of one year of sea level data from eleven stations in the Northeastern Mediterranean (Adriatic, Ionian and Aegean Seas) have been analysed in terms of local atmospheric pressure forcing. The attention is focused on low-frequency oscillations having time scales from one day to several weeks but shorter than the seasonal scale. Summer and winter season have been analysed separately. An EOF analysis of both sea level and atmospheric pressure resulted in the separation of lower frequency oscillations of planetary wave time scale expressed by the first mode from the higher frequency synoptic time scale variability included in the second mode. The first mode is related to the in-phase sea level or atmospheric pressure variations in the entire area, while the second mode represents variations for which the Adriatic Sea is out-of-phase with respect to both Ionian and Aegean Seas. Only those first two modes represent a regionally coherent signal subtracting more than 90% of the total variance from both sea level and atmospheric pressure. Sea level EOF's are closely related to respective atmospheric pressure modes in both space and time. Departures from isostatic response, evidenced in the low frequency range of atmospheric planetary waves, are not due to geostrophic control in straits. It has been shown that the second mode time dependence is related to the surface pressure changes induced by the cyclonic activity in the study area. The location of the zero-crossing of the atmospheric pressure second mode over the area of Otranto Strait is being explained in terms of prevalent cyclone paths over the area of the Northeastern Mediterranean.

O

Long term variations of monthly mean sea level and its relation to atmospheric pressure in the Mediterranean Sea

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Abstract

The records of the monthly mean sea level at 19 stations and the monthly mean atmospheric pressure at 15 stations in the Mediterranean Sea are analysed to find out the trend of the sea level and to identify the significant oscillations from the power spectral estimates.

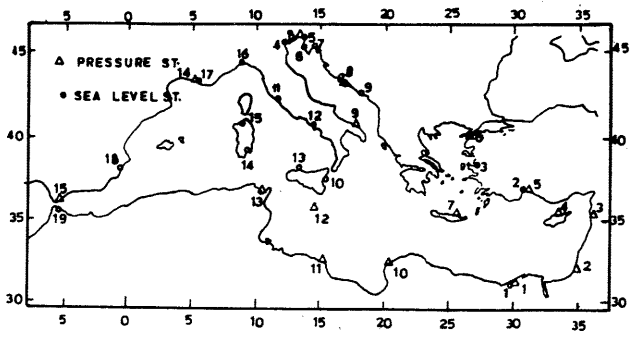

Figure 1. Positions of stations of sea level and atmospheric pressure in the Mediterranean (see Table 1, 2).

The results show that from the present data at Marseille, Triesta and Genova, it is expected, the sea level tends to increase by 13 cm/100 years, which will affect the water budget of the area.

The power spectral analysis of the pressure could explain most of the oscillations in the sea level time series at 12, 6 and 4 months periods, except in the Adriatic and Aegean Sea where the steric effect has an important contribution.

Table 1. Mediterranean stations where monthly mean sea level was taken, and Spectra characteristics.

Region	Station	position Lat. N	position Long. E	period	No. of points	No. of c.f.	period of sign. peaks
Levantine	1-Alexandria	31° 12'	29° 53'	1938-1972	180	10	12,6,4
	2-Ayalim	34°33'	32° 49'	1929-1938	240	13	12,6,2,7
Aegean	3-Izmir	38°24'	27° 10'	1937-1961	300 (60 Lags)	10	6,5,4.1
Adriatic	4-Bakar	45°16'	13° 32'	1933-1967	180	10	12,6,2,4
	5-Trieste	45°39'	13°45'	1937-1956	180	10	12,6,2,1
	6-Ancona	43°37'	13°30'	1936-1970	168	10	12,6
	7-Ortona	42°22'	14°24'	1955-1969	180	10	12,6
	8-Split	43°30'	16°26'	1955-1969	180	10	12,6,3.1,2.4
	9-Stončica	43°19'	16°04'	1936-1970	168	10	3,5
Ionian	10-Catania	37°30'	15°05'	1960-1971	144	8	12,4.8,3.3
Tyrrhenian	11-Civitavecchia	42°05'	11° 48'	1888-1916	240	13	12,6
	12-Amalfi	40°34'	14° 36'	1897-1916	240	13	12,6,4
	13-Palermo	38°08'	13° 22'	1901-1930	240	13	12
	14-Cagliari	39° 12'	09° 10'	1897-1916	240	13	12,3,1,2.4
	15- La Maddalena	41° 24'	09° 22'	1920-1941	144	8	12,4,2.3
Western Basin	16-Genova I	44°24'	08° 54'	1884-1899	180	10	20,12,6
	Genova II	44° 24'	08° 54'	1931-1960	360	20	
	17-Genova II a I	43° 18'	08° 21'	1906-1935	600	20	12,6,3,4
	Marseille II	43° 18'	05° 21'	1938-1957	240	13	12,6
	18-Alicante	38° 20'	00° 29'	1960-1974	180	10	12,6,3.6,2.1

Table 2. Mediterranean station where monthly mean pressure was taken and some spectral characteristics.

Region	Station	Position Lat.	Position Long.	period	No. of points	No. of c.f.	period of significant peaks
Levantine	1-Alexandria	31° 12'	29° 53'	1963-1973	180	10	12,6,4.3,4 (3.8 .....2.0
	2-Beirut	33° 54'	35° 54'	1955-1974	240	13	12,6
	3-Latakia	35° 31'	35° 47'	1956-1973	240	13	12,6,4.3,6,..2.4
	4-Mersin	36° 48'	34° 38'	1955-1966	180	10	36,12,6,4.3,6
	5-Antalya	36° 53'	30° 44'	1955-1974	240	13	12,6,4,(3.6..3.0
Aegean Sea	6-Canakkale	40° 09'	26° 24'	1955-1974	240	13	12,6,4.3,2.4
	7-Izmir	38° 25'	27° 11'	1955-1974	240	13	7
Adriatic	8-Trieste	45° 39'	13° 45'	1955-1966	180	10	4
	9-Ancona	43° 37'	13° 31'	1955-1966	180	10	4
Ionian Sea	10-Bengazi	32° 05'	20° 16'	1963-1973	144	8	12,6,4
	11-Tobruk	32° 05'	23° 58'	1963-1973	144	8	12,6,3,4
	12-Luxor	25° 41'	32° 39'	1955-1974	240	13	7
Western Mediterranean	13- Tunis	36° 50'	10° 14'	1955-1974	240	13	4.4
	14-Marseille	43° 27'	05° 21'	1955-1974	240	13	4.4, 4
	15-March Front	36° 09'	05° 21'	1955-1974	240	13	12,6

Seasonal variations of oceanographic properties in the Middle Adriatic

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Data from six stations of the Split-Gargano profile (Fig.1) were processed for the period 1971-1983 and partly for the earlier period, as well.

Currents were measured at Stončica station (9) every month in the period 1967-1974 and seasonally in other years, always in 24-hour series from the anchored ship. Monthly mean values of the NW and NE components, i.e. directions along-shore and onshore to the eastern coast were calculated. In the first half of the year the NW direction is dominant in all layers and in the second part of the year the NE direction. This pattern may be due to the corresponding pattern in the geostrophic current field (Fig.1). In winter the incomming current over the Palagruža Sill, i.e. in the profile area, is pushed towards the western coast. On the contrary, in summer it is pushed towards the eastern coast.

Such changes in the current pattern in the course of the year could also be connected to the seasonal distribution of salinity on the profile Split-Palagruža. In March (Table 1) the highest value of the average salinity is at Palagruža (station 12) i.e. closer to the western coast. In spring (June) maximum average salinity appears at station 11 i.e. in the central part of the profile. High value appears also at Stončica station, but only in the bottom layer. At the same station, i.e. closer to the eastern coast, the highest values of the average salinity appear in September in the whole layer from 10-100 m, and in December the highest values appear at surface, as well. Observing from the eastern coast, the highest salinities at the profile are most distant in winter and therefrom they approach the eastern coast, first in the bottom layer (spring) and finally (autumn) in the whole layer. A comparison between average monthly surface salinity and current component normal to the coast at Stončica station (Fig. 2) shows well the dependence of annual salinity variations on the current regime.

Table 1. Longterm average salinities (1971-1983) at the profile Split-Gargano.

m	March					June				
0	35.68	37.66	38.22	38.46	38.47	38.18	35.67	37.53	38.04	38.38	38.21	38.11
10	36.69	38.04	38.25	38.52	38.53	38.30	37.09	37.81	38.11	38.45	38.36	38.23
20	37.18	38.14	38.30	38.54	38.55	38.46	37.53	38.11	38.31	38.54	38.55	38.43
30	37.60	38.19	38.37	38.56	38.57	38.51	37.74	38.32	38.49	38.58	38.54	38.52
50		38.32	38.43	38.58	38.57	38.54		38.49	38.56	38.63	38.59	38.56
75		38.45	38.46	38.58	38.59	38.55		38.55	38.59	38.63	38.59	38.55
100			38.51	38.57	38.60	38.56			38.64	38.64	38.64	38.53
	September					December				
0	36.56	36.27	38.32	38.34	38.26	37.85	35.09	37.96	38.37	38.38	38.32	38.18
10	37.35	38.35	38.38	38.42	38.43	38.27	36.53	38.13	38.39	38.39	38.33	38.29
20	37.93	38.42	38.45	38.47	38.49	38.37	37.51	38.21	38.42	38.41	38.37	38.35
30	38.28	38.50	38.52	38.54	38.56	38.46	37.95	38.26	38.43	38.43	38.40	38.36
50		38.56	38.59	38.56	38.58	38.53		38.36	38.50	38.48	38.43	38.41
75		38.61	38.64	38.58	38.66	38.53		38.46	38.54	38.54	38.55	38.51
100			38.66	38.62	38.65	38.55			38.67	38.60	38.62	38.56

Temperature regime on the profile also depends on the current system, even though less clear. Maximum average temperatures are closer to the western coast in the upper layers and closer to the eastern coast in the lower layers. This is due to the advection of warmer water from the south, which is more efficient at the eastern coast of the profile in summer during the vertical stratification. In winter during the vertical homogeneity, it is more efficient on the western coast of the profile.

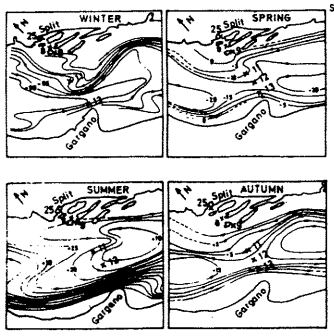

Fig. 1. Profile Split-Gargano and geopotential topographies for the region (after Zore, 1956).

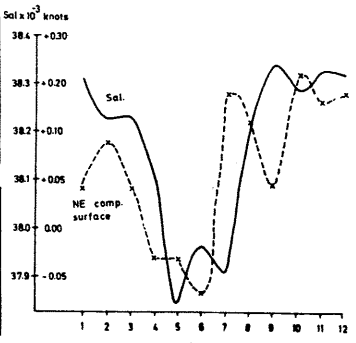

Fig. 2. Annual variation of average monthly values of NE current component in the surface layer and the same for monthly salinities for station 9 (Stončica).

O-II8

Wave evaluation in the Mediterranean Sea

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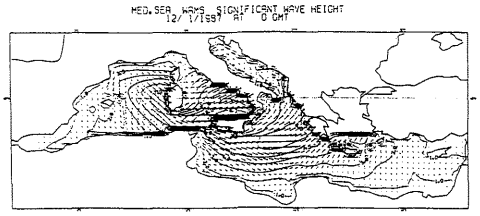
On a previous occasion we had reported about a project for the development of an advanced wave model. Wave models were born in the fifties, but up to recent times there was always some drastic short-cut in their theoretical approach. Only recently some drastic theoretical and experimental improvements, associated with basic experimental results and with the rapidity improving computer power, have allowed a complete physical formulation of the processes involved and their implementation in a mathematical model. The effort was anyhow too large for any single group, and the WAM Group was formed, involving all the major experts in the field.

The results are rapidly accumulating. A global model, with three degrees resolution, is run daily at the European Centre for Medium Range Weather Forecasts in Reading, U.K. Hindcast studies have been performed. We have mainly concentrated our attention on the Mediterranean Sea, where the phenomenology is more complicated than in the Open Ocean.

We have hindcasted several storms in the Mediterranean Sea, and we have found that the wind fields, strongly influenced by the bordering orography, lead to very complicated wave patterns. Also, the Mediterranean is not the nice calm basin that people from other areas like to think. The figure shows the wave conditions (isolines in meters) present during a remarkable storm which happened in January 1987.



In an attempt to estimate the reliability of the results, we have hindcasted this storm with different wind fields, from different sources and with different resolutions. The results are quite instructive, clearly showing how strong attention must be paid to the wind accuracy. We have found differences up to 30 % in modulus with strong bias in direction. The evidence is that, in a complicated basin as the Mediterranean Sea, local high resolution models are required for its evaluation. If not, not only the single event, but even statistics are likely to be substantially wrong.

O-III1

Hydrographic structure of the Mediterranean shelf waters off the Egyptian Coast during 1983-1986

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Throughout the period from August 1983 to July 1986, eight cruises were carried out using the Egyptian R/V Noor Ya Nabi to the Southeastern Mediterranean waters off the Egyptian Coast between long. 29°45 E and 33°45 E. Discrete samples from surface to bottom (up to 200 m) were collected from 180 stations, representing the coastal, middle and offshore waters, arranged along eight sections more or less perpendicular to the coast (Fig.1). The present paper deals with the hydrographic situation of the area based on data of corrected temperature, salinity and dissolved oxygen collected from the area during this period. The area of investigation receives about 17×10^9 $m^3 y^{-1}$ of fresh, brackish as well as industrial and sewage waters from various land based sources.

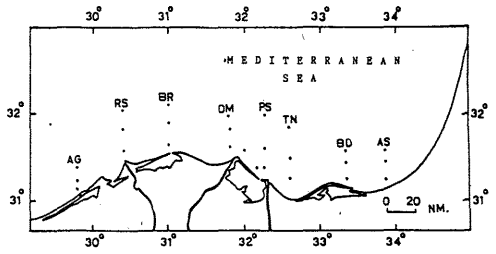

Figure 1. Area of investigation.

The usual three water masses known in the Southeastern Mediterranean were identified. The characteristics and range of each layer varied from previous records. The surface layer (salinity 38.70-39.00 ‰) extends to 75 m depth. The subsurface water layer of minimum salinity (38.64-38.90 ‰) and maximum oxygen (>5.2 ml/l) which is of Atlantic ocean origin extends between 50-150 m. The intermediate layer of high salinity (38.90-39.15 ‰) corresponding to the Levantine intermediate water mass extends below 150 m. These layers were normally characterised in summer and autumn season. During winter, T-S diagrams illustrated that the offshore area is a one water mass characterised by a narrow range of salinity (38.70-39.00 ‰) and temperature (16.5-18.0°C) due to winter convection and vertical mixing which may extend at least to 200 m depth.

The present data indicated that, at Damietta station (DM), in winter, a completely homogeneous layer occupies the 200 m and is characterised by a small range of temperature (Fig. 2). It has an isohaline water column of high salinity (>38.90 ‰) than that of its surroundings and a great homogenity in its σ_t values (>28.3). In spring distinct stratification occurs in the water column with the upper 25 m becoming less saline and warmer. In summer and autumn seasons, three layers were indentified ; the surface warm layer having salinity higher than April, the subsurface minimum salinity layer (50-100 m) and the intermediate maximum salinity layer (>150 m). These seasonal changes in the water column indicates a process of formation of intermediate water similar to that suggested by LACOMBE and TCHERNIA (1960) for the Rhodes-Cyprus region and MORCOS (1972) for the Egyptian Mediterranean shelf area. Consequently, the area in front of Damietta may be one of the regions of formation of the intermediate water of maximum salinity.

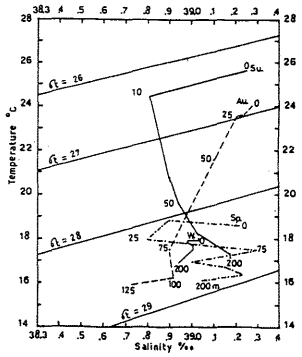

Figure 2. Seasonal characteristics of the T-S diagrams at Damietta station during the study period. (W = winter, Sp = spring, Su = summer, Au = autumn).

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La dynamique des courants devant Monaco

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INTRODUCTION

Les variations de direction et de vitesse du courant dans la baie de Monaco ont été rélevées dès 1981 (BETHOUX N., et all. 1983). Nous décrivons ici les caractéristiques générales de la dynamique côtière. De juillet 1981 à juin 1982, direction, vitesse des courants et température sont relevées toutes les dix minutes à -20 et -75m sur un fond de 80m à 400m du rivage, comparées aux variations du niveau de la mer à Monaco, Nice, Toulon, Port Vendres et au vent observé à Cap Ferrat, Cap Béar et Toulon. L'hydrologie est relevée tous les quinze jours aux profondeurs standard.

CARACTERISTIQUES GENERALES

Température et salinité n'ont pas mis en évidence, les caractéristiques des eaux intermédiaires. Une salinité supérieure à la moyenne observée en 1982 est attribuée à un déficit de pluie important. Les vents au Cap Béar sont supposés caractéristiques des conditions prévalant au large de la Côte d'Azur. Ceux du Cap Ferrat montrant des intensités 10 fois moindres ne représentent que des effets locaux ; les plus intenses sont de NW, les plus fréquents de SE, directions toutes deux perpendiculaires au rivage. Les variations du niveau de la mer, corrigées de l'effet barométrique, montrent une oscillation annuelle de 16 cm d'amplitude. Le niveau baisse lorsque le vent souffle vers le S-E et inversement monte lorsqu'il souffle vers le N-E. Les courants se déplacent le long des isobathes vers le N-NE et le plus souvent vers le S-W. La composante perpendiculaire à la côte est toujours dirigée vers celle-ci. Les vitesses sont faibles, la variabilité importante et régies à -75m par la présence de la thermocline de mai à novembre.

CARACTERISTIQUES SAISONNIERES

Durant l'été 1981 l'analyse spectrale montre que l'énergie des courants est centrée sur des périodes de 2 à 6 jours. L'intensité du vent est très faible à Cap Ferrat et a un comportement impulsionnel à Cap Bear. Les principales oscillations du niveau de la mer sont reliées aux coups de vent. La corrélation entre le courant de surface parallèle à la côte et le vent qui lui est perpendiculaire est de signe positif faible mais significatif. Pour les courants de fond, le signe est négatif. Le modèle semblant le mieux adapté est celui d'un système à deux couches (CSANADY, 1982).

Durant l'hiver 1981/1982, la corrélation entre les composantes du courant parallèle à la côte est 0,72. La cohérence est significative à toutes les fréquences inférieures à un cycle par jour ; la corrélation entre composantes perpendiculaires n'est pas significative. Les oscillations de l'intensité du vent et du niveau de la mer, ont les mêmes périodes. Vents et courants ont un maximum d'énergie pour celles de 2 à 5 jours. La dynamique côtière est régie par un vent perpendiculaire au rivage. A ces périodes, variations du niveau de la mer et vitesse du courant sont corrélés.

Les conditions relevées au printemps 1982, diffèrent de celles des autres saisons et des autres années par le fait que l'intensité du vent au Cap Béar est dix fois plus faible qu'habituellement. La dynamique semble régie par un vent perpendiculaire à la côte observable que lorsque son intensité au Cap Béar dépasse un seuil estimé à une dyne/cm2.

CONCLUSION

Les fluctuations du courant les plus évidentes semblent liées à l'intensité du vent normale à la côte ; les faibles corrélations sont l'indication d'autres mécanismes de forçage : le passage des dépression les fluctuations thermohalines saisonnières.

Le printemps 1982 apparait comme exceptionnel. Le vent normal au rivage semble trop faible pour régir la dynamique côtière. La salinité augmente d'une manière importante, et est attribuée à un déficit de la quantité de pluie se répercutant sur la formation des eaux profondes.

Ces observations sont la conséquence d'un même phénomène météorologique intéressant, la Côte d'Azur, la Méditerranée nord occidentale et les Alpes par l'abri au vent qu'elles constituent pour les perturbations venant de l'Atlantique. Il est souhaitable qu'une synthèse de l'ensemble des relevés de météorologie et d'océanographie effectués durant les mêmes périodes soit élaborée.

La Direction de la Météorologie Nationale Française et le Service Hydrographique de la Marine ont communiqué les relevés de leurs stations . Qu'ils soient ici remerciés ainsi que nos collègues et l'équipage du N.O. "Ramoge" pour le travail en mer.

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Wind-drift current in the Kastela Bay (Middle Adriatic)

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Kaštela bay has been a kind of experimental basin for the Institute owing to the position of the Institute in the bay. In order to study the water exchange between the bay and surrounding sea the wind induced currents are of primary importance. The tidal currents due to its oscilatory character and the slow gradient current are less important. During the summer when the systems of drift currents are not developed, the case of high water pollution occurs (Marasović et Vukadin, 1982). The main feature of drift current systems from observation have been demonstrated by Zore-Armanda (1980). Assuming that the wind drift currents in the bay can be described by Ekman equation, the numerical model based on Heaps (1974) method is developed. Following the discussion of Nihoul et al. (1979) the model is posed as 2D+1D model instead 1D+2D proposed by Heaps. The vertically integrated model is treated separatly from model of vertically modes where the preassure gradient force is introduced as forcing. For the winter winds Bura (NE wind) and Jugo (SE wind) i.e. the most frequent winds over the bay the induced drift currents are presented . The array of integration is demonstrated in fig. 1. The surface and bottom resultant currents during Bura are demonstrated in fig. 2. and fig. 3. The same for Jugo is given in the fig.4. and fig.5. Considering the surface currents wee see the closed circulation cells in the midle of the bay like discussed by Zore-Armanda (1980). Circulation in the eastern part of the basin could be dynamically separated as discussed by Marasović et Vukadin (1982) from biological and chemical observations.

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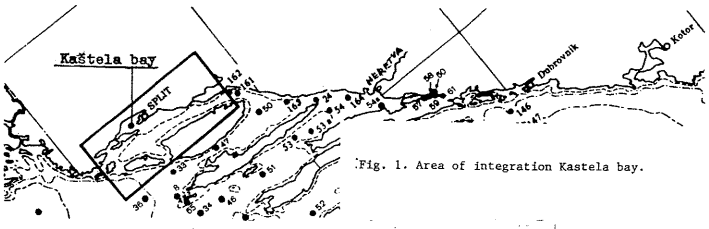

Fig. 1. Area of integration Kastela bay.

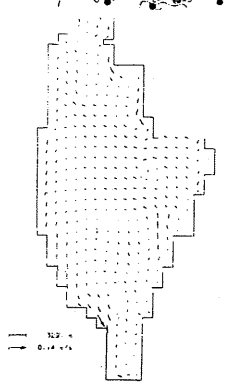

Fig. 2. Kastela bay, surface currents induced by bura.

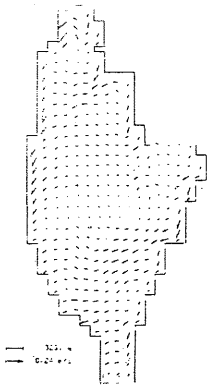

Fig. 3. Kastela bay, bottoms currents induced by bura.

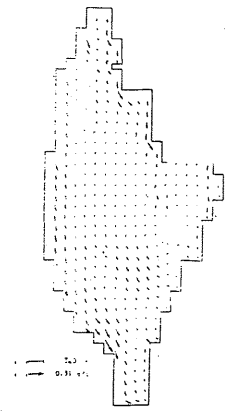

Fig. 4. Kastela bay, surface currents induced by jugo.

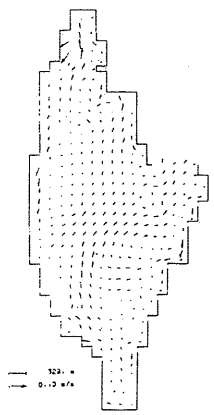

Fig. 5. Kastela bay, bottom currents induced by jugo.

O-III4

Air-sea interaction and the Alpine cyclogenesis

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A meteo-oceanographic event of interest for the understanding of the role of the sea on the cyclogenesis lee of the Alps is present and discussed. In particular, from the data set collected during the Medalpex, which is the marine counterpart of the Alpex, by the buoy ODAS-Italia 1 moored at about 27 miles off the Ligurian coast, we estimate heat and moisture fluxes at the air-sea interface in the occasion of the passage of intense atmospheric perturbations. Such analysis is completed on the whole Ligurian basin by processing NOAA-7 AVHRR satellite images. The Split Window Algorithm (SWA) is used both for correction of Sea Surface Temperature (SST) and to obtain the Water Vapour Content (WVC) of the air column. SST and WVC deduced by the buoy are then compared with averaged values, in an area of 20 km x 20 km around the buoy, obtained from the AVHRR images. This comparison allows a fine tuning of the SWA for both SST and WVC. Finally, by the use of the vertical temperature profile obtained by XBT probe, it is possible to implement a simple mixed layer model able to simulate the evolution of SST. Such model is then used to describe the noticeable decrease of the SST occurred during the period 22-24 May, 1982 as it results from particularly intense air-sea exchanges.

O-III5

Water mass dynamics on the Western Black Sea Shelf

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Owing to the concentration of the river runoff in the north-western part of the Black Sea, the characteristics of the water mass circulation on the western shelf are essential for the formation and evolution of the space distribution of all physico-chemical parameters.

For some areas where direct measurement series were available, regime circulations have been carried out to establish the peculiarities of the meridian flux (4). In order to investigate the current field structure over the continental shelf, the dynamic method (2) has been used for shallow water stations (1, 3).

In the present paper the same method is used for a 10 station hydrological network carried out seasonally during 1981-1983 in the outer shelf area. Due to the "levelling" of the stations (6) relative to the 50 dbar surface, only the results concerning the dynamics of the upper layer are presented.

In all the analysed situations the circulation pattern characteristics are different in the northern part as compared to those from southern part where the variability is higher. Owing to this fact, the overall current field has an intricate structure, with convergence and divergence areas.

The computed speeds are low, reaching only 0.11 m/s. For all the pairs of neighbouring stations of the network the meridian component is directed to south in 60% of the cases, while the zonal component has a westward direction in 80% of the cases.

The station in the southeastern corner of the network is the only deep water station and the vertical distribution characteristics for the specific volume anomaly have been computed (a continuous decrease of the average value from the surface to the 500 m depth and a sharp decrease of the standard deviation below 50 m depth) but these cannot be used in determining the deep water circulation.

For this problem, the data collected during 1978-1980 in a network including three stations located off the continental shelf carried out twice a year (5) have been used. The vertical density distribution characteristics in this three stations are similar to those of the previously mentionned station, but the differences between them rendered difficult the choice of a reference surface by the usual criteria (2). To overcome this difficulty, the 300 dbar surface, located below the lower boundary of the oxygen and used by other authors (7) has been chosen as the reference surface for all situations.

In three cases (February 1978, February 1980 and May 1980), the surface flow is oriented toward NNE, the meridian component reaching 0.15 m/s. In the first situation, the current has practically the same speed and direction down to 50 m depth, then the speed gradually decreases and the very weak zonal component changes sign at 100 m depth. In the other two cases, the current is constant only in the 0 to 10 m layer, but zonal component has in the last situation a value of 0.02 m/s down to 100 m depth.

In the hydrological situation existing in August 1978, the flow is directed toward SW with a speed of 0.17 m/s at the surface. The meridian component has practically the same value down to 75 m depth, while the zonal component slowly decreases, revealing an anticlockwise rotation of the deep current.

In February 1979, the very weak geostrophic currents (0.04 m/s) are directed toward SSE in the upper layer, having an irregular variation with depth.

As a conclusion, the dynamic method yields satisfactory results even for the hydrological stations located on the continental shelf as regards the current field pattern, but it is less reliable for the speed computation.

For the off shelf stations the results are significant if the reference surface is chosen below 150 m. The obtained circulation pattern often differs greatly from the general Black Sea circulation scheme, but when the western branch of the cyclonic gyre is detected, the currents are very stable down to great depths.

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Circulation and water masses : their implications on shore processes and pollutant transport in Abuquir Bay (Egypt)

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Abstract : Abuquir Bay is a shallow area (mean depth less than 10 meters) and affected by active coastal processes and significant sources of pollution. In this paper the water masses in the bay, the dissolved oxygen, total suspended matter and the circulation are discussed. In addition, the major characteristics of echosounder profiles in the area are presented, using a recent Summer (September, 1984) hydrographic survey, with about 40 stations.

The Summer results for Oxygen, salinity and currents show a strong outflow from Maadia outlet, which connect the bay and Idku lake, with a longshore current to the east extending up to mid - way between Rosetta head land and Maadia. Consequently, it is expected that pesticides and other pollutants from the lake Idku will disperse in the bay in the current direction. The density current plays the main role in the circulation of the bay. The high concentration of suspended matter may contribute to the residence of pollutants by adsorption on the particles surfaces.

The currents are strong enough to initiate the sediment movement on the bottom and to intensify the erosional processes. This sediment in motion could also transport the adsorped pollutants to the offshore area.

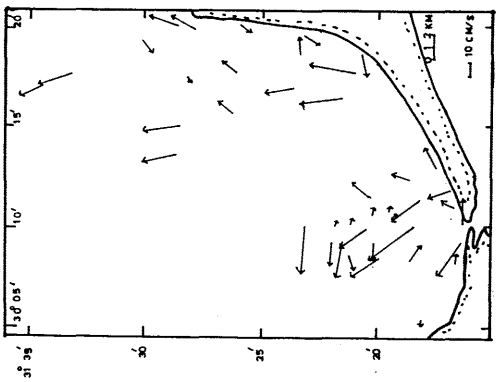

Fig. 1. Circulation pattern in Abuquir Bay at 5 meters immersion, Summer, 1984.

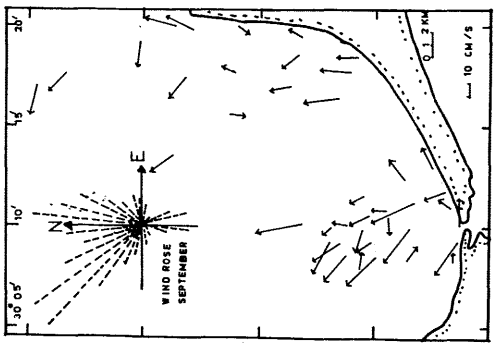

Fig. 2. Circulation pattern in Abuquir Bay near bottom, Summer, 1984.

On the dynamic features and the possible mechanisms of the vertical mixing in Abuquir Bay (Alexandria, Egypt)

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The hydrographic and current data collected in the shallow coastal zone of Abuquir and Rosetta (Egypt) with 27 stations in Autumn and 49 stations in Summer, are used to study the dynamic conditions and their relation to the vertical mixing mechanisms. The dynamics parameters estimation is based on semi-empirical equations and the values of vertical current gradient, stability and wind stress.

The results indicate that the vertical stability decreases in the offshore-ward with N^2 mean value between 0.8365×10^{-3} at 5 meters contour and 0.141×10^{-3} at 15 meters contour in Autumn and 1.2138×10^{-3} and 0.304×10^{-3} at the above mentioned contours respectively in Summer.

The effective vertical mixing coefficient was affected by the stability to have the mean values between 0.54 at 5 meters contour and 3.73 at 15 meters contour.

Richardson number and flux Richardson numbers indicated the dominance of turbulence in 50 % of the cases in Autumn and 10 % of cases in Summer. In the other cases both of turbulence and internal waves were important. The internal waves were dominating only in one case in Autumn and 5 cases during Summer.

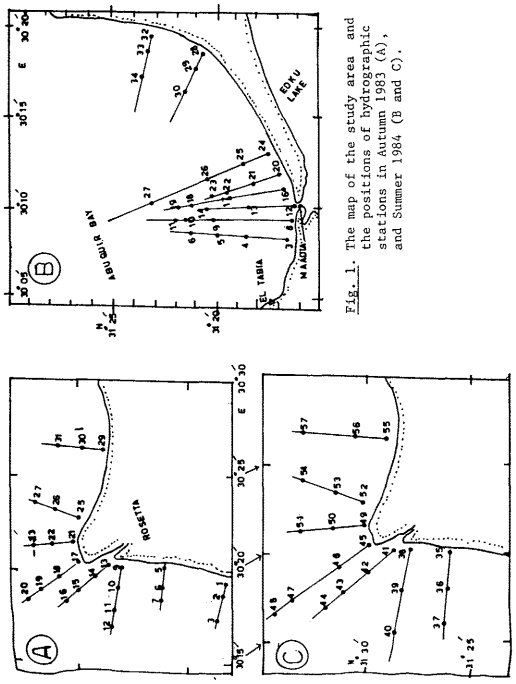

Fig. 1. The map of the study area and the positions of hydrographic stations in Autumn 1983 (A), and Summer 1984 (B and C).

O-III8

Lagrangian and Eulerian observation of inertial oscillations in the shelf break offshore the Ebro River Delta (Catalan Sea, NW Mediterranean)

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The shelf/slope region in the Catalan Sea (Northwestern Mediterranean) is characterized by a density front, mainly due to the salinity gradient between coastal and offshore waters. Along the front there is a permanent current that contours the continental shelf and can be considered the continuation of the Liguro-Provençal current downstream the gulf of Lions (Font *et al.*, 1987). This current is weaker than in the Ligurian Sea (usually less than 20 cm/s) and gives an adequate framework for the study of cross-front dynamics and frontal instabilities.

Near the Ebro river delta (41°N, 1°E) intensive hydrographic and currentmeter surveys have shown that the circulation, although dominated by the alongshore large-scale dynamics, has a complex structure strongly influenced by the topography and the buoyancy input from the river (Font *et al.*, 1988). In this area very energetic and rapidly evolving three-dimensional filaments have been observed in the frontal zone (Wang *et al.*, 1988), during a study on shelf/slope water exchange carried out in 1986 and 1987.

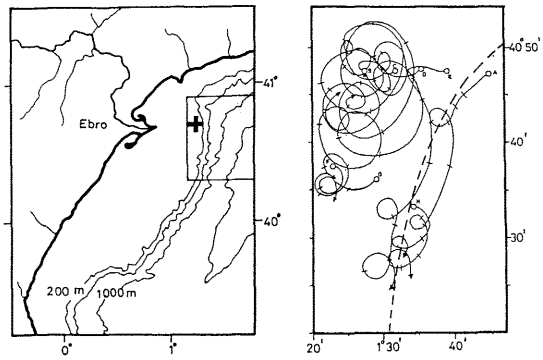

Figure 1. Experimental area (mooring and drifters) in June 1987, and drifter trajectories superposed to the mean surface location of the density front

In June 1987 an experiment took place, in the frame of the same project, on board the Spanish R/V García del Cid, envolving CTD casts, underway surface TS analysis, currentmeters and surface and sub-surface drift buoys tracked by radio (figure 1). Three Aanderaa currentmeters were deployed at 15, 50 and 100 meters depth (bottom at 165 m) in an oil drilling rig near the shelf break off the Ebro delta. Drift buoys were launched in the frontal zone (over a bottom of 1000 m) and in its continental side. The offshore drifters followed the southwards main current, in accordance to geostrophic calculations but with higher surface velocities (30 cm/s), while the others were trapped for the four days (7 to 11 June) in an area of 10 nautical miles around their starting point. One of them was picked up just in the same location where launched.

Spectral analysis of the currentmeter records indicated a dominating contribution of the inertial period (18.4 h in this latitude) in the upper layer. We observed that the successive positions calculated by triangulation for the onshore drifters, usually 6 h apart, showed mostly clockwise gyres. The corresponding straight-line trajectories between fixes had changes in direction coincident with a very small error (less than 5°) with a pure inertial motion. When the drifters were passing near Casablanca station, there was a good agreement between their direction and speed and the velocity recorded at the same time by the surface currentmeter. Consequently we re-calculated all the drifter trajectories, assuming that contiguous fixes were connected through an inertial motion. We obtained an image of the circulation in the surface layer with inertial oscillations superposed to a very slow southwestward motion, inshore of the front, and to a considerable alongfront displacement, in the frontal zone (figure 1). An important horizontal shear has to develop between both regions, just where strong salinity inversions had been observed in 1986, associated to the evolving filament.

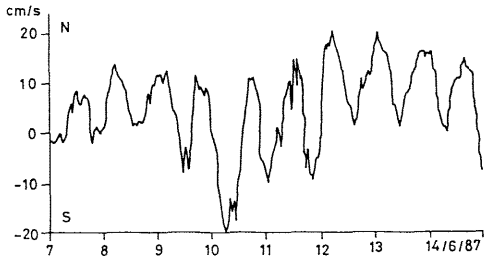

Figure 2. NS component of the velocity recorded at 100 m from 7 to 14 June 1987

The study of the currentmeter data indicate that the inertial oscillations are present in the whole water column, with decreasing, but not vanishing, intensity. Even at the level of 100 m the inertial period is clearly an outstanding feature (figure 2), what could indicate that there is no strong vertical shear on the shelf. Strong NW wind blows occurred in the first hours of 8 June (7.5 m/s) and of 9 June (12.5 m/s), with an effect of increasing the speed registered in the currentmeters (up to 41 cm/s at 15 m) and accelerating the drifters in their inertial motion (peaks of 70 cm/s in mean velocities between fixes).

The geographic characteristics of the area, wide continental shelf (45 km) and the narrow Ebro valley, allow the occurrence of NW wind jets acting in adecuate dimensions to originate fully developed inertial oscillations in the shelf down to at least 100 m.

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Font,J., Salat,J. and Julià,A. (1988) Marine circulation along the Ebro continental margin. Submitted to *Mar.Geol.*
Wang,D.P., Vieira,M., Salat,J., Tintoré,J. and La Violette,P.E. (1988) A shelf/slope filament off the Northeast Spanish coast. *J.Mar.Res.* (in press)

O-III9

On the formation of dense water over the shelf areas of the Northern Aegean Sea

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During the period from 27th February to 3rd March 1987, CTD data have been collected from a grid of 32 stations in the Northern Aegean sea (fig. 1), using an SBE-9 profiler on board R/V AEGAIO.

The observed low surface temperatures (10.83-13.85°C) was the main result of the predominant weather conditions, which cannot be characterized as catastrophic. The mean air temperature (2.2-4.1°C), during the sampling period, was much more lower than the 30 years average mean of February and March (Maheras, 1983). The prevailing winds over the eastern part of the study area were NE with speeds up to 17m/sec, while over the western part they had a significant eastern component and their speed reached 10m/sec.

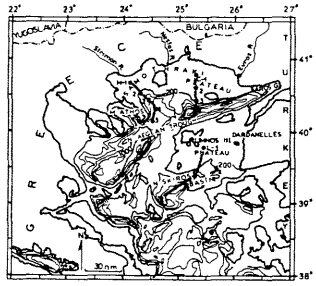

Fig.1. Bathymetric chart of the N. Aegean sea (depths in meters). Location of selected stations.

The dense water detected over the Limnos and Samothraki plateaux have different hydrological characteristics (fig. 2). This is due mainly to the different water masses participating in the formation processes. The relatively colder and less saline waters of the Black Sea, coming out from the Dardanelles and the warmer and more saline waters of Levantine origin form a strong thermohaline front to the east of Limnos island.

Over the eastern side of Limnos plateau the water column is characterized by the most dense water (σ_θ= 29.37, from 73 to 80 dbars), observed over the whole area of the N. Aegean. These density values are even slightly higher than those (σ_θ=29.35) of the waters found at the deepest part (1000dbars) of Skiros bassin.

Over the Samothraki plateau the profiles of temperature (fig. 3) and salinity show a rather disturbed water column, due to the complex mesoscale circulation and processes and the flow of dense waters formed over the shallow parts of the shelf. Lacombe et al.(1958) noted that the deep waters of the N. Aegean Trough, north of Limnos island, are probably renewed by the dense waters formed in the Gulf of Saros under the influence of continental dry and cold winds during the winter. The maximum densities (σ_θ=29.27) observed just above the bottom (50dbars), over the central Samothraki plateau, are equal to those of the waters found at 530dbars at the deepest station (1600m) of the N. Aegean. The minimum temperature value (10.99°C),near the bottom, is comparable to that (10.13°C) reported by M.Fieux (1974) for the plateau of the Gulf of Lions in the Western Mediterranean.

At the shallowest station of the westernmost part of Samothraki plateau the density reach the value of σ_θ=29.20 from 15 down to 100 dbars. The same density has been observed at 260dbars at the southern deep station of the respective basin (M. Athos).

Thus, over the western part of the Samothraki plateau, where the weather conditions were milder than those of the eastern part, the formed dense waters have the lowest density values (fig. 2).

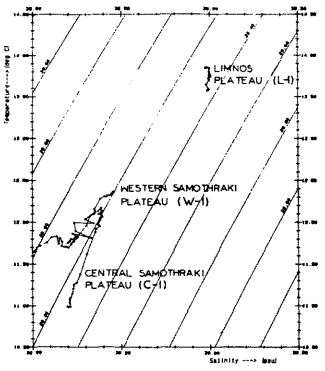

Fig. 2. T/S diagram.

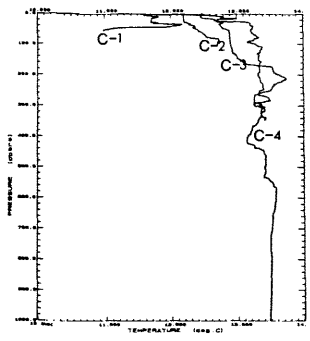

Fig. 3. Temperature profiles along the C transect.

The observed cold and dense waters which occupy the subsurface and/or the lower part of the water columns, have been formed evidently over the shallow regions of the shelf areas of the N. Aegean by vertical convection mixing during the winter. They tend to slide towards the respective basins, following the bottom topography and then along the respective isopycnals, contributing thus to the renewal of intermediate and deep waters.

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Empirical orthogonal function (EOF) analysis of temperature-salinity field in a small semienclosed bay (Kastela Bay)

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ABSTRACT An EOF analysis has been applied to the temperature and salinity data sets collected on a bi-weekly basis from a dense station network in the Kaštela Bay (Adriatic Sea, Yugoslavia) during the period 1953/54. Vertical EOF's have been determined at two stations in the Bay inlet, one station in its centre and one station in the shallowest part next to the mouth of the River Jadro inflowing into the Bay. The EOF analysis of temperature-salinity fields in the horizontal plane has been done at the surface and depths of 10 and 20 meters. Time-varying amplitudes of the most important horizontal and vertical modes of salinity have been correlated with the wind and water level data of the River Jadro integrated over consecutive time intervals prior to sampling dates (from one to eight days). Fresh water inflow contains strong seasonal signal which has been removed by subtracting daily values of the water level from the respective ten-year monthly means. Horizontal and vertical salinity modes have also been correlated between themselves. Horizontal temperature distribution is almost entirely represented by the first EOF which subtracts more than 98% of the total variance. Its time dependence shows that it is induced by the seasonal heating and cooling resulting in a simultaneous temperature increase or decrease over the entire Bay area. The percentage of the temperature variance explained by the first vertical EOF depends on the station depth; the deeper the station is the smaller is the percentage of the variance explained by the first mode. The first vertical mode as the first horizontal one represents seasonal temperature changes. Second vertical temperature EOF displays a zero-crossing at the thermocline depth and represents out-of-phase oscillations of the surface temperature with respect to that of thelayer below thermocline. Horizontal salinity decomposition in the surface layer results in the first mode explaining about 82% of the total variance. It represents in-phase salinity changes over the entire Bay. The second mode explains about 8% of the total variance and is related to those salinity changes which are out-of-phase in the shallow eastern part with respect to the Bay inlet and its centre. Similar distribution of the variance between different horizontal modes is evident at the depth of 20 meters while at 10 m depth almost 95% of the variance is contained in the first EOF. Vertical decomposition of salinity shows different behaviour from the temperature; the first mode represents the smallest portion of the total variance at the shallowest station near the river mouth. This is the consequence of the strong two-layer estuarine type of circulation in this portion of the Bay. Going towards the Bay inlet the percentage of the variance explained by the first EOF increases. The second vertical salinity EOF has again one zero-crossing which is situated closer to the surface than the zero-crossing of the second temperature EOF. This is probably due to the halocline being shallower than the thermocline. The second vertical EOF's of both salinity and temperature have largest time variations during the halo-/thermocline generation and destruction processes. The local wind averaged over three to six days prior to sampling dates is highly correlated with salinity changes represented by the first mode in the surface and bottom layers. In intermediate layer correlation is lower showing that wind induces vertically two layer circulation pattern. This is also supported by a relatively high correlation between the wind data and second vertical salinity mode while the correlation with the first vertical mode is rather poor. The two-layer vertical circulation pattern in the Bay is also generated by the fresh water inflow. A high correlation is evidenced between the river water level and first horizontal EOF's at the surface and 20 m depth. Also there exists a statistically significant correlation between the river water level and the second vertical mode at all stations except at the station next to the river mouth. In that relatively shallow part of the Bay (depth ≅ 10 m) the first vertical mode is closely related to the river water level showing that the fresh water influence at the surface, is rather quickly spread over the whole water column. The north wind component averaged over a week period seems to be responsible for the existence of the surface pattern of salinity changes which are out-of-phase in the shallow part of the Bay with respect to the Bay inlet and its centre. Therefore, it can be concluded that temperature changes in the Bay of Kaštela are mostly induced by the seasonal heating. On the other hand, salinity variations are due to the two-layer water exchange induced by the local wind forcing and by the river water inflow.

On the structure of inertia-period oscillations in the Adriatic Sea

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Oscillations of the inertia period have been detected in the Adriatic Sea during various summers. It has been found that these oscillations are marifested by considerable thermocline movements and current-vector rotations that change their phase across the thermocline. The oscillations have been modelled as transverse internal seiches in a rotating rectangular channel (Orlić, 1987).

Both empirical and theoretical approaches have had their shortcomings. The main drawback of various data sets collected in the Adriatic Sea has been the lack of synopticity, whereas the modelling of inertia-period oscillations has been limited to two dimensions. Logical next step then is to extend measurements to a network of synoptic stations, and to build a three-dimensional model. Here, an experiment, which has been inspired by the first of these goals, will be described.

The experiment has been carried out in the Northern Adriatic during May-June and August-September 1987. In the first part of the experiment currents and hydrographic data were measured at three stations along a profile parallel with the Yugoslav coast; in the second part same parameters were measured at three stations along a profile perpendicular to the coast (Fig. 1). Simultaneous meteorological data were available from the nearby coastal stations.

Preliminary analysis of the data shows that inertia-period oscillations were well developed during May and June (variance of band-passed current time series amounted to 356.9 cm^2/s^2 at station 107 and depth 6 m), whereas they almost disappeared during August and September 1987 (variance at the same station and depth went down to 27.9 cm^2/s^2). Comparison with the concurrent meteorological data shows that first two decades of September 1987 were very quiescent, without major perturbations in the wind field, and consequently no oscillations could be generated in the sea. Exceptionality of September 1987 manifested itself also in low-passed sea surface temperatures, which increased during the greater part of the month.

The inertia-period oscillations were characterized by current variations being smaller along the coasts than farther offshore, and by temperature variations which diminished with the offshore distance. Variances of band-passed time series clearly illustrate the point:

CURRENTS	TEMPERATURES
STATION 007 (8 m): 170.9 cm^2/s^2	STATION 107 A (7 m): 0.0365 $(^oC)^2$
STATION 107 (6 m): 356.9 cm^2/s^2	STATION 107 (6 m): 0.0053 $(^oC)^2$
STATION 209 (8 m): 329.3 cm^2/s^2,	STATION 107 B (4 m): 0.0018 $(^oC)^2$.

Along the vertical, temperature variations were greater at intermediate levels than close to the surface or bottom, pointing to the dominance of the first baroclinic mode.

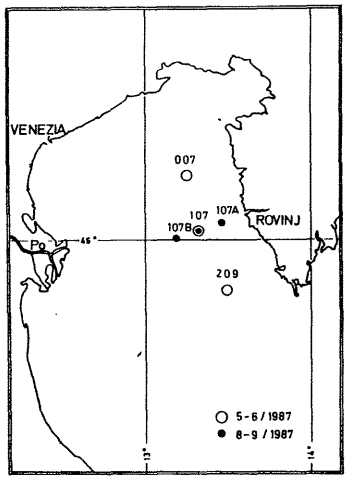

Fig. 1. Positions of sampling stations.

It can be seen that the structure of inertia-period oscillations in the Adriatic Sea is three-dimensional. Consequently, these oscillations, which have up to now been simulated as a two-dimensional phenomenon, should more realistically be interpreted in terms of internal Poincaré-type modes of the basin. An attempt should therefore be made to compute such modes for the Adriatic Sea, probably along the lines suggested by Schwab (1977).

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O-III12

Caractéristiques statistiques, à long terme, de la température à la surface de la mer dans la zone de faible profondeur de Constantza

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En vue d'obtenir des informations ayant un caractère plus général sur la température à la surface de la mer, dans la zone littorale roumaine de la mer Noire, nous avons entrepris l'analyse statistique d'une longue série de valeurs quotidiennes (8583 de 1959 à 1987) de ce paramètre, mesurées en un point fixe situé dans la zone littorale de Constantza.

La valeur maximale absolue relevée durant ces vingt-neuf années a été de 28,0°C, tandis que la plus inférieure était de -1,0°C, liée à certaines situations hydrologiques où l'agitation de la mer, due au vent, a empêché l'apparition du gel à -0,8°C, valeur de la température de cristallisation de l'eau de la mer Noire. Les moyennes mensuelles annuelles oscillaient entre -0,1°C (février 1972) et 24,6°C (août 1967) ; celles multiannuelles entre 2,7°C (février) et 21,7°C (août). Leur évolution révèle un retard des processus de réchauffement et de refroidissement de l'eau de mer d'environ un mois par rapport à l'évolution connue de la température de l'air. Aussi a-t-on préféré, pour l'analyse statistique, non seulement les sélections mensuelles, mais également trimestrielles plutôt que saisonnières. De plus, ont été analysées deux sélections semestrielles : "la saison chaude" de mai à octobre, et "la saison froide" s'étendant de novembre à avril. Il faut souligner que, dans le cadre de ces types de groupements, l'éparpillement des valeurs est moindre qu'en toute autre sélection.

Les paramètres statistiques, calculés pour chaque sélection, sont ceux usuels. Afin de définir les groupements, nous présentons la moyenne, la dispersion, l'écart standard, l'intervalle et le coefficient de variation. Pour caractériser les distributions de fréquences à l'intérieur de chaque sélection, sont reportés le mode, la fréquence modale, la médiane, l'excès, l'asymétrie, l'intervalle majoritaire ($M \pm \sigma$) et la fréquence des valeurs comprises dans cet intervalle. De plus, pour chaque sélection, nous avons indiqué le nombre de cas pour lesquels l'analyse statistique a été effectuée. Les résultats sont présentés dans les tableaux ci-après.

Tableau 1. Paramètres statistiques calculés pour les sélections mensuelles de la température (°C)

Mois	Nombre de cas	Domaine de variation	Moyenne(M)	Ecart standard (σ)	$\frac{\sigma}{M}$ (Cv)	Excès	Asymétrie	Mode	%	Médiane	$[M+\sigma, M-\sigma]$	%
I	659	-1,0-9,9	3,03	2,25	0,74	2,46	0,16	3,9	18,3	3,1	0,8-5,3	66,9
II	662	-1,0- 8,8	2,65	2,10	0,79	2,43	0,24	2,5	17,8	2,6	0,4-4,8	68,6
III	730	-0,8-10,4	3,96	2,39	0,60	2,46	-0,04	3,0	18,4	4,1	1,6-6,4	66,1
IV	728	1,6-16,2	8,81	2,33	0,26	3,11	0,19	7,9	25,8	8,7	6,5-11,1	67,5
V	710	5,5-23,0	14,35	3,18	0,22	2,56	0,00	13,0	21,3	14,4	11,2-17,5	63,7
VI	729	8,4-26,2	18,37	3,57	0,19	2,91	-0,56	19,7	25,5	19,0	14,8-21,9	67,2
VII	752	8,1-28,0	20,60	3,66	0,17	3,48	-0,92	22,5	22,9	21,3	16,9-24,3	73,9
VIII	703	10,2-26,8	21,76	2,29	0,11	5,34	-0,94	22,4	32,8	20,3	19,5-24,0	70,8
IX	723	10,0-25,0	19,14	2,34	0,12	4,05	-0,73	20,4	29,5	19,5	16,8-21,5	78,9
X	739	5,9-21,1	14,61	2,61	0,18	2,99	-0,32	15,7	27,6	15,0	12,0-17,2	65,9
XI	720	0,2-16,8	9,95	2,60	2,26	2,92	-0,12	10,7	25,0	10,1	7,4-12,6	65,7
XII	728	-0,6-12,0	5,64	2,54	0,45	2,71	0,03	5,0	19,5	5,7	3,1- 8,2	68,1

Tableau 2. Paramètres statistiques calculés pour les sélections trimestrielles et semestrielles de la température à la surface de la mer (°C)

Sélection	Nombre de cas	Domaine de variation	Moyenne(M)	Ecart standard (σ)	$\frac{\delta}{M}$ (Cv)	Excès	Asymétrie	Mode	%	Médiane	$[M+\sigma, M-\sigma]$	%
Trim.I	2501	-1,0-10,4	3,24	2,32	0,72	2,45	0,16	3,4	16,5	3,2	0,9- 5,6	68,9
Trim.II	2167	1,6-26,2	13,84	4,99	0,36	2,04	0,13	10,3	14,9	13,5	8,9-18,8	68,7
Trim.III	2178	8,1-28,0	20,19	3,04	0,15	3,73	-0,77	20,4	24,2	19,1	17,2-23,2	69,0
Trim.IV	2187	-0,6-21,1	10,09	4,49	0,44	2,21	0,01	10,9	14,3	10,2	5,6-14,6	66,4
S.c.	4227	-1,0-16,8	5,67	3,60	0,63	2,44	0,31	5,5	20,8	5,6	2,1-9,3	67,2
S.F.	4356	5,5-28,0	18,14	4,10	0,23	2,25	-0,30	19,5	26,6	19,0	14,0-22,2	70,1

O-III13

Flow characteristics in the Ligurian Sea during May-June 1985

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The second part of the PROLIG II cruise, in May 1985, was conducted over 9 CTD and Rosette sections across the Ligurian Current. The sections were roughly equally distributed around the Ligurian Sea between Nice and Calvi (CORSICA), with station spacing of ∿ 5 n.m. and with cast depths to 800 m. The survey was executed in less than ten days during particularly calm meteorological conditions that produced a storaged solar heating heating only within the upper 20 m layer. Excepted for this layer, the observations could be considered as synoptic. Dynamic topography and geostrophic velocity are presented and compared with earlier works that used larger grid scales. Comparison is also made with historical means. In addition, profiles of the baroclinic velocity are described with reference to the density field and water masses.

More information about the horizontal distribution of velocity under the thermocline is inferred from horizontal CTD tows in the same zones during the first and third parts of the Prolig II cruise, in May and early in June respectively. Frontal structure was observed in detail. The flow in the Ligurian Current was intensified along the front i.e. along the cyclonic side (offshore) of the current.

O

Heat content of the Mediterranean waters off the Egyptian Coast

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Detailed variations in the temperature and heat content of the Mediterranean waters off the Egyptian coast were studied during the period from August 1983 to July 1986. During this period eight cruises were carried out to the southeastern Mediterranean between long. 29°45'E and 33°45'E using the Egyptian R/V Noor Ya Nabi. Temperature and salinity were measured for discrete depths at 24 hydrographic stations located along eight sections extending perpendicular to the coast. Each section comprises three stations namely; coastal (<50 m), middle (50-100 m) and offshore (depth up to 200 m).

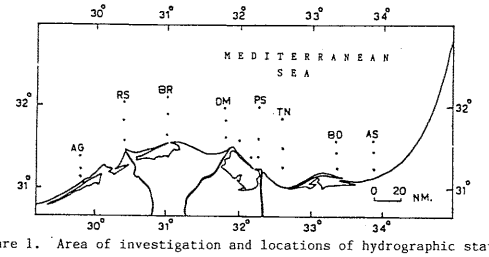

Figure 1. Area of investigation and locations of hydrographic stations.

Temperature was averaged for 25 m intervals from surface to 100 m and the heat content (expressed in units of kgcal.cm^{-2}) was computed using the formula described by Pattulla et al. (1969):

$$H = \sum_{n=1}^{4} \rho C_p T(\Delta Z) 10^{-3}$$

where H= heat content, kgcal.cm^{-2}
ρ= average heat of water in the nth layer
Cp= specific heat of water in the nth layer.
T= average temperature, °C, in the nth layer.
ΔZ= thickness of each layer, 2,500 cm.

The distribution of temperature in the surface layer of the area reflects the general distribution of heat supply from the sun.

The heat content in the upper 25 m layer of the all stations ranged from 41.80 kgcal.cm^{-2} in february 1984 to 73.06 kgcal.cm^{-2} in July 1985. The computed values of heat content from surface to 100 m for the offshore stations varied from 170.92 kgcal.cm^{-2} in February 1984 to 244.97 kgcal.cm-2 in July 1985 (Table 1). Station-to-station differences within zones were evident on all cruises but were small compared with time variations.

Examination of the heat exchange terms at the air-sea interface (Said, 1987) reveals that in the offshore waters, most of the seasonal changes in Oceanic storage is directly due to air-sea exchanges of heat. However, in the inshore area, other seasonal effects must be important. These other effects are most likely due to wind driven currents.

Table 1. Heat content, surface to 100 m, at the offshore stations. Values are listed in Kgcal.cm-2.

	1983		1984		1985		1986	
	August	Feb.	July	Oct.	April	July	Feb.	July
El-Agamy (AG)	-	171.18	-	216.58	173.08	207.95	177.88	216.53
Rosetta (RS)	203.61	172.80	208.03	203.64	178.93	220.06	181.30	219.09
Burullus (BR)	202.27	172.08	202.09	207.23	178.17	204.00	180.73	-
Damietta (DM)	205.78	170.92	196.40	203.17	179.94	207.39	182.92	207.15
Port-Said (PS)	-	-	221.95	211.00	178.75	219.20	185.12	201.58
El-Tina (TN)	216.27	-	217.59	209.33	175.24	209.65	182.59	207.05
Bardawil (BD)	-	-	204.57	-	178.75	244.97	-	216.55
El-Arish (AS)	-	-	198.93	-	-	-	-	208.07

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Caractéristiques thermiques des eaux marines sur le littoral roumain de la mer Noire, dans les conditions spécifiques de l'année 1987

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La période de janvier à mai 1987 a été, sur le littoral roumain de la mer Noire, compte tenu des conditions habituelles. Les moyennes mensuelles de la tem pérature de l'air à Constantza (44°10'N, 28°38'E) ont présenté des déviations négatives par rapport aux moyennes multiannuelles, entre 1,1° et 5,3°C. Celle du mois de mars (-0,9°) représente la valeur la plus basse enregistrée le long du littoral roumain depuis 1886, date à laquelle ont été effectuées les premières observations météorologiques systématiques.

La spécificité des conditions mentionnées a produit une influence très importante sur le régime thermique des eaux marines. Ainsi, à la surface, près de la côte, à Constantza, les moyennes mensuelles de la température de l'eau marine ont été (avec 1,6° jusqu'à 3,6°C) dans la même période (janvier-mai) plus basses que les moyennes mensuelles des années 1971-1986.

Les recherches saisonnières effectuées sur le profil Est Constantza (44°10'N) jusqu'à 30 Mm, révèlent que toute la couche de 0-50 m étudiée, a subi une influence tout-à-fait particulière. Les isothermes représentant les anomalies thermiques calculées par rapport à la période 1971-1986, mettent en évidence l'existence d'un fort processus de refroidissement de l'eau marine pendant l'hiver et une augmentation, très lente, de la température au printemps et en été (Fig. 1).

Durant le mois de février, les anomalies thermiques, toujours négatives, ont atteint 3° près de la côte. Au mois de mai, elles atteignent jusqu'à 5°, également dans la zone côtière. Pendant l'été, ont été signalées les plus grandes différences négatives, avec un maximum de 7° à la profondeur de 20 m, qui a représenté la limite inférieure de la thermocline en 1987. En novembre seulement, mois ayant présenté les moindres anomalies thermiques, dans la couche 40-50 m, les différences ont été positives.

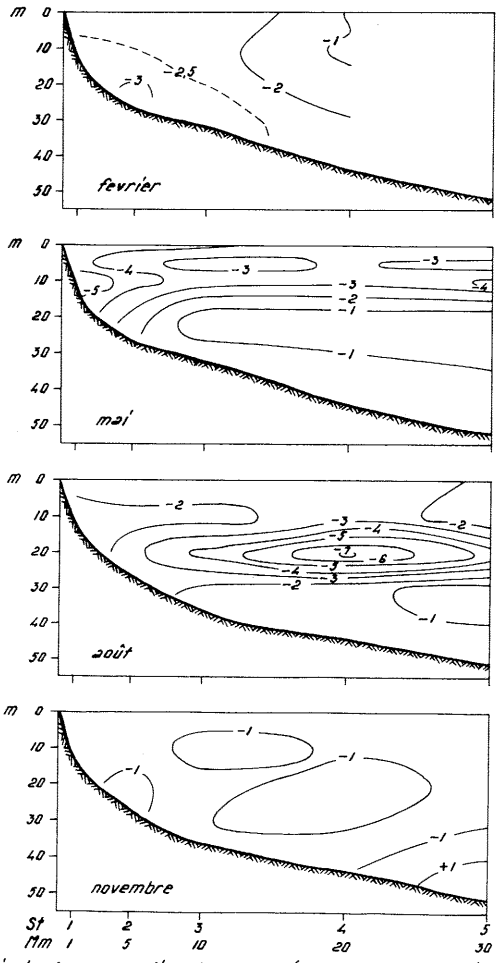

Fig. 1 - Les anomalies de la température de l'eau marine en 1987, en rapport avec la période 1971 - 1986, (profil 44°10'N)

O-III16

Circulation and water exchange between the Mediterranean Sea and the Nile Delta Lakes

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Most of the energy driving nearshore processes along the Nile Delta coast comes from the Mediterranean Sea, in the form of winds, waves and currents. During the flood tide, Mediterranean waters enter the lakes for some distance, mixes with the brackish water and return back during the ebb tide. Besides the tidal effect, the prevailing winds and the drainage waters which are poured into the lakes, plays an important role in the water exchange between the sea and the lakes.

The Nile Delta lakes include Idku, Burullus, Menzala and Bardawel. The water exchange between the Mediterranean Sea and the lakes, as well as the Rosetta and Damielta estuaries of the River Nile has been affected considerably during the last thirty years.

From the hydrographic and geological surveys taken in front of the Nile Delta coast, in particular at the mouth of the lakes during the period 1960 - 1983, a few remarks can be summarized:

1. The circulation pattern along the coastal areas in front of the lakes indicate that the current direction might be the main reason for the erosion process.
2. The pattern of the mean size distribution of sediment indicates the erosion and accretion areas at the sea - lake connection.
3. The water exchange between each lake and the Mediterranean Sea has a considerable effect on the lake sediment dispersion at sea.

One of the most important features of the circulation of the southeast sector of the Mediterranean Sea before 1964, was the effect of the annual Nile Flood. Before completion of the dam, during the flood period, estuarine circulation pattern was a two layer flow at the mouth of the two estuaries, Rosetta and Demietta.

The general oceanographic conditions in the offshore region beyond the continental shelf did not change noticeably before and after 1964. The hydrographic conditions over the continental shelf in front of the Delta showed considerable change after 1964. Also, since 1964, almost no sediment has been discharged from the Nile. This has produced an imbalance in the near coast sediment budget, increasing erosion at the two mouths of the river Nile and shifting sediments along the coast.

O-IV1

Levantine Basin circulation - An historical perspective

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The first map of the circulation in the upper and in the intermediate layers of the Mediterranean Sea is due to Nielsen (1912) who computed it from the data collected by the Norwegian ship Thor. In his data, the Levantine basin, investigated by the Thor in 1910, was represented by nine stations: four of them in the Cretan straits close to the shores of Cyrenaica and the other five across the basin roughly from Mersa Matruh to Rhodes. Thus, Nielsen's Levantine basin anticyclonic circulation, is based on continuity and geostrophic principles as well as on some plain common sense.

The Thor was followed by the American Atlantis in 1948 and by the French Calypso in 1956. The additional stations provided new details but, at least as far as the Levantine basin is concerned, the circulation is still depicted as generally anticyclonic and resembling Nielsen's description of almost half a century earlier. Thus, the Nielsen map became the established representation of the Levantine basin circulation and even as late as the end of the 70's one can find this map still quoted in the scientific literature.

Between 1959 and 1963, the Russian ship Vavilov carried out six detailed cruises in the Mediterranean Sea. Consequently, it was for the first time that the seasonal changes in the Eastern Mediterranean circulation were described. In particular, it was shown that the Ionian gyre reverses from anticyclonic in the summer to cyclonic in the winter. This reversal also appeared to induce a reversal in the current patterns in the Cretan straits. In the Levantine basin, the circulation in the upper layers is still depicted as cyclonic and with no significant seasonal changes. Finally, in the entire basin, the horizontal circulation in the deeper layers resembled closely that in the upper layers.

The validity of the cyclonic pattern of the circulation in the Eastern Levantine basin was supported by the tracing of the fresh waters of the Nile floods. These were shown to hug the Eastern Mediterranean coast and could be observed sometimes as far as Beirut. Nevertheless, some contradicting data began to appear. During the summer of 1963, the Sea Fisheries Research Station of Haifa began a series of detailed cruises in the Eastern Levantine Basin. To our surprise we found in the region a warm core edddy and anticyclonic currents along the coast of Israel. Towards the end of the sixties, S. Friedman from the IOLR, tried to determine the seasonal pattern of the currents over the Israeli continental shelf by tracing the paths of a series of free floating buoys. Acording to his reports, most of his buoys move persistently southward for a number of days. At the beginning of the seventies the IOLR carried out a long series of current measurements from current meters moored on the Israeli continental shelf. Once more we observed persistent southward flow although northward flow appears to be just as prevalent. Towards the end of the seventies, the IOLR started to carry out the MC cruises - a detailed investigation of the Eastern Levantine basin. Preliminary results indicated, once more, the presence of a warm core eddy south of Cyprus and subsequent southward flow along the Israeli coast.

At the beginning of the eighties, a group of scientists from various countries (Cyprus, France, Germany, Greece, Egypt, Italy, Israel, Turkey, U.S.A., and Yugoslavia) prepared a detailed plan for the cooperative investigation of the Physical Oceanography of the Eastern Mediterranean - POEM. So far five POEM coordinated cruises were carried out. During the first two - POEM01 and POEM02 - the Turkish ship Bilim and the Israeli ship Shikmona covered almost the entire Levantine basin with a dense grid of CTD stations. During those two cruises, the Shikmona augmented its data in the Eastern Levantine basin with even denser XBT casts. The objective analysis of this very dense set of measurements (Robinson et al., 1987) revealed a complex structure of mesoscale eddies, jets and filaments and indicated the presence of some larger features. Moreover, the analysis of a "coarse grid subsample" of this data set showed that the important features of this region can still be properly resolved. Thus, one could confidently apply the same methodology to the entire Levantine basin data set and expect meaningful results.

Subsequently, the data obtained by the Bilim and by the Shikmona were combined and objectively analyzed. The resulting maps indicate that the entire Levantine basin is populated by a wealth of mesoscale deformation. By and large, as previously stated by Ovchinnikov and his collaborators, there does not seem to be a significant difference between the summer and winter maps, and the surface features seem to persist throughout the deeper layers. Moreover, some features, such as the Rhodes gyre or the cyclonic circulation in the Cretan straits, resemble those described by the Russian investigators. On the other hand there are some features which differ significantly from any previous description. For instance, the flow in the Cicician basin appears to be far more meandering and disorganized than previously envisaged. Or, the large and intense anticyclonic gyre in the southwestern Levantine basin, near Mersa Matruh, which appears to have a smaller and weaker counterpart in the Russian maps. But, most of all, the intense anticyclonic eddy, or eddies, in the eastern Levantine basin, which appear to be the cause of southward flow along the coast of Israel. The eddies appear to be well established features both in the winter as well as in the summer. Between them they produce a general anticyclonic circulation pattern which appears to transport the Atlantic waters from the Cretan straits, through the center of the Levantine basin, southward along the coast of Israel and westward along the coast of Egypt, in the opposite direction to the one described in previous investigations.

Finally, before we replace one myth with another, we must realize that this description is based on incomplete information and that it is just one realization of the circulation pattern. In fact, objective analysis of the MC data base (Hecht et al, 1988) show occasional flow reversals and the presence of cyclonic edies close to the Israeli coast.

O-IV2

Mesoscale structures in the Algerian Basin

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In order to investigate characteristics of the mesoscale eddies and associated phenomena known to occur in the Algerian Basin (1,2,3,4,7), we combine the use of current meter data and satellite infrared imagery.

It has recently been shown (6), using the June 86 Médiprod 5 campaign data (5), that the movements suggested by the thermal images are coherent with the current in situ observations, consisting of drifting buoys trajectories, current meter records at 100m, hydrological transects, and ship drifts.

During the Médiprod 5 Experiment, 24 current meters were set in place on 8 moorings (6 along the Algerian coast and 2 offshore) at 100m, 300m, 1000m, and some at 2000m; recording lasted 9 months, from June 86 to March 87.

Up to December approximately, temperature stratification allows mesoscale structures to be significantly signed on the thermal imagery. This data set provides us with valuable information about the location of the structures with respect to the moorings points.

The propagation as well as the vertical extent of these structures are analysed with both data sets.

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O-IV3

A review of the distribution and persistence of Northern Levantine eddies : experiments of 1985-1987

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The circulation features are estimated from a number of recent experiments in the Northern Levantine Sea. Data obtained in a total of five seasonal surveys during 1985-1987 are reviewed and analysed to identify the areas of existence of major vortices, and their distribution and persistence.

Various eddies with different sizes and structures were identified, ranging from sub-basin scale gyres to sub-mesoscale vortices. The major cyclonic gyre to the southeast of Rhodes (the Rhodes gyre) is persistent in all surveys, although its horizontal extent and structure are modified by interactions with surrounding eddies and meandering jets. Persistent anticyclonic eddies of vaying size appear in the periphery of the Rhodes gyre and between this gyre and the coast. Occasionally, these eddies are of sub-mesoscale sizes. In all cases, the anticyclonic eddies are more coherent in the vertical and deeper in structure as compared to the cyclonic eddies. Due to the baroclinic nature of the circulation, the structures display slanted configuration with horizontal shifts in the eddy centers with increasing depth.

A persistent anticyclonic eddy appears between the Rhodes gyre and Antalya Bay, while the eddy variability to the south of Antalya Bay is significant. The eddies in the Cilician Basin are generally shallower and less organized.

The anticyclonic vortices trap the Levantine Intermediate Water (LIW) and occasionally both LIW and the Atlantic Water (AW), and high oxygen saturation values are demonstrated at intermediate depths within such vortices. Evidence for small scale features not sufficiently resolved by the station network are also found and often captued by coincidence.

The eddies are, in general, not isolated and are often in contact with each other near the surface. However, at the deeper levels anticyclonic eddies are persistent and have isolated centers.

O-IV4

Baroclinic vertical modes, energy content and distribution in the Northern Levantine, 1985-1987

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The vertical structure equation is solved to determine the vertical modal functions supported by the mean stability frequency disributions obtained from five general surveys in the Northern Levantine Sea during 1985-1987. The vertical structure functions are then fitted to the observed streamfunction distribution, to estimate the contribution of the modes to the circulation and energy distribution.

The vertical and horizontal distribution of energy components in the observed fields are calculated. The available potential energy is an order of magnitude larger than the kinetic energy and it increases at intermediate depths, while the kinetic energy has a maximum at the surface. It is generally found that the first baroclinic mode accounts for a large percentage of the observed motions.

The amplitude of motions in general decreases with depth. In summer, the motions are concentrated closer to the surface, while in winter the amplitude of the motions decay slower with depth. The typical first mode radius of deformation is on the order of 10-15km, with the larger values occuring in summer and the smaller radius found in winter.

O-IV5

The effect of the eddies on the inertial oscillations observed in the Otranto Straits

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Data collected from 12 Aanderaa shelf recording current-meters deployed in 5 moorings between 20/9 and 23/2/1979 have shown the existence of inertial oscillations in the Otranto Straits. Inertial oscillations have been observed and studied for the North Adriatic Sea, by Gacic and Vucak, 1982 and by M. Orlic, 1987. The defined shear zone, formed between the northerly flowing masses along the Greek coast and the southerly flowing masses along the Italian side (Ferentinos and Kastanos, 1988). The power spectra represent two broad maxima, one near the energy containing eddies and the other at the inertial frequency (Fig. 1). The observed inertial period was about 18.6 h and the radius of the inertial circles was about 0.9Km. The northerly travelling cyclonic eddies which have a period of about 10 days (Ferentinos and Kastanos, 1988), affect the inertial oscillations. The inertial oscillations are possibly generated by instabilities and equilibrium adjustment of the internal wave field (Kastanos and Ferentinos, 1988). The internal wave field appears highly energetic having a -1.74 mean slope, instead of the -2 universal power law. Assuming an f-plane, the vorticity field inside the eddies is positive (clockwise rotation), but in the region between the eddies the vorticity field changes to negative. The effective inertial frequency is then $f' = f + \frac{1}{2}(U_x - U_y)$, implying that $f' > f$ for the region

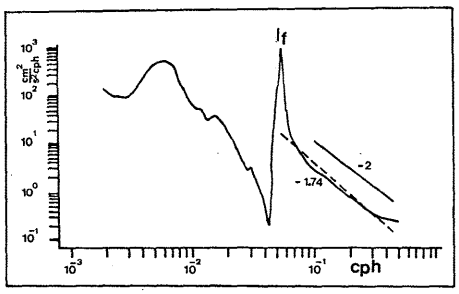

Fig. 1. Kinetic energy spectrum of a characteristic current-meter inside the shear zone

of positive vorticity and $f' < f$ for the region of negative vorticity. U_y and V_x stand for the horizontal derivatives of horizontal current velocity and f stands for the theoretically estimated local inertial frequency. According to Weller, 1985, intesification and trapping of inertial waves occur within regions of negative vorticity, whilst within regions of positive vorticiy the inertial loops are not allowed to be fully developed (Fig. 2).

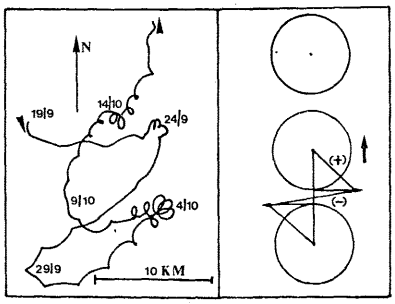

Fig. 2. The effect of the eddies on the inertial oscillations

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AVHRR/2
Imagery of the Levantine Basin

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Advanced Very High Resolution Radiometer (AVHRR/2) data from the satellite NOAA-9, archived at the University of Dundee has been chosen in order to study physical process in the Levantine Basin.

For the atmospheric and geometrical corrections as well as for the geophysical and radiometrical calibrations mathimatical algorithms have been applied to the "raw" data. Accurate line-by-line numerical models have also been used to simulate the "split-window" Sea Surface Temperature (SST) measurements (at ~ 10 to 12.5μm) of AVHRR/2.

Dynamical features, such as convection, mesoscale eddies, the formation of the Levantine Intermediate Water (LIW) and the location(s) of this process, as well as their seasonal variation and their correlations will be examined. The chosen data cover 1985 seasonally - five series of four consecutive days, enabling conclusions to be drawn about the seasonal (in)dependence of the physical processes mentioned above. For comparison one data set for each series has been chosen from 1986 and 1987.

Qualitatively, all the images are free from clouds and many dynamical features are recognisable.

Aspects of hydrology and circulation of the Northeast Ionian Sea

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Introduction

The Ionian Sea lies to the east of the Straits of Sicily, surrounded by Italy, Greece, Libya and Tunisia. It is the largest in volume sea ($10.8 \times 10^3 km^3$), of the Eastern Mediterranean, and has the greatest depth (5121m) southwest of Peloponnesus. To the north it joins the Adriatic at the Otranto Strait (75 km wide, sill depth 780 m). To the east it communicates with the Aegean through the three western passages of the Cretan Arc; whilst it merges with the Levantine via the Cretan Rise.

Data and Methods

CTD data were collected by R.V. "AEGAION" at 22 stations in the north-eastern Ionian Sea (Fig.1), during POEM-01-1986 Cruise (15-24 April 1986). The data were subjected to conventional methods of analysis, whilst an appropriate version of the so-called "neutral surface analysis" (1) was also employed.

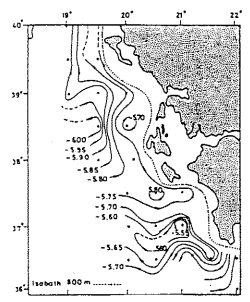

Fig. 1. Dynamic topography of the surface relative to 800 dbar (dashed extensions and closures of the isolines are conjectural).

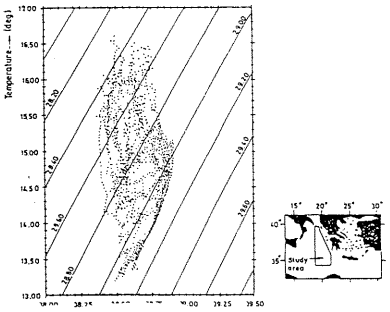

Fig. 2. Composite T-S diagram based on all T-S data of POEM-01-86 Cruise in the study area.

Results and Discussion

Analysis of the data proved the presence of modified types of Levantine Intermediate Water (LIW), North Atlantic Water (NAW), and Adriatic Water (2); and showed frontal but isopycnic encounter with interpenetrations between these water masses (Fig.2). This frontal zone assumes a northeast-southwest meander-like orientation, a pattern consistently manifested from the surface downwards.
At the northernmost part of the front, vigorous mixing processses occur, indicated by an impressive small-scale thermohaline variability and interleaving. At this location the front is nearly vertical, whilst water with characteristics ($T=13.224°C, S=38.642, \sigma_\theta=29.172$) pertinent to Eastern Mediterranean Deep Water occurs near the bottom.
The front remains inclined along its remaining length, separating heavier water in the centre of the study area from lighter water at its eastern part. Eddies both cyclonic and anticyclonic are probably related to this front. However, a meandering mesoscale anticyclonic eddy-like feature stands out at the southeasternmost part of the study area.
The patterns of geopotential topography of the surface relative to the 800 dbar level (Fig.1), as well as the topographies of the appropriate neutral surfaces (1), broadly reflect the bottom bathymetry, and taken in conjunction with the distribution of salinity on the neutral surfaces (3), indicate in addition to the aforementioned features, a meandering northward "flow", and also the extent of the influence of the NAW and LIW, as well as the nature of their interaction within the northeastern Ionian Sea, at the time of observations.

Conclusions

During late winter-early spring the hydrography of the northeastern Ionian Sea was found to be dominated by a meandering frontal zone created by the encounter of NAW, LIW, and Adriatic water; mesoscale eddy activity is probably associated with this frontal zone.
The circulation follows broadly the bottom bathymetry in the contra solem direction.

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O-IV8

The circulation in the Algerian Basin inferred from the Mediprod-5 current meters data set

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New hypotheses about the circulation of the Modified Atlantic Water (MAW), of the Levantine Intermediate Water (LIW) and of the Deep Mediterranean Water (DMW) in the Western Mediterranean have been recently put forward (Millot, 1985, 1987-a). Those about LIW in the Algerian Basin have already been supported by hydrological measurements collected during the Médiprod-5 cruise in June 1986 (Millot, 1987-b). Twenty-four Aanderaa current meters, set in place on 8 moorings at nominal depths of 100, 300, 1000 and 2000m, during more than 9 months and from ≈0° to ≈5°E along the Algerian coast, have provided us with definitive information about the hydrodynamical characteristics of the various water masses in that region (Millot, 1988).

It is obvious from the analysis of this data set that the circulation in a ≈40-60km wide coastal zone is characterized by the occurrence of a very turbulent surface flow, namely the Algerian Current, and of mesoscale young eddies, the structure of which is markedly variable with depth. In the interior of the basin, currents display, at least between ≈300 and 2000m, a marked barotropic structure which accounts for a major influence of old eddies extending roughly down to the bottom. As it was already noticed (Taupier-Letage and Millot, 1988), these old-offshore eddies can interact with the Algerian Current itself (Taupier-Letage et al., 1988).

As already shown by satellite images, young-coastal eddies are advected eastward at a few cm/s. Therefore, the coastal moorings have been crossed by several eddies, and specially by a very powerful one which was located at ≈0° in June-July, and at ≈5°E in November-December. This eddy has induced very spectacular and intense currents which were, at a depth of ≈100m and during more than 1 month, directed seaward with an averaged speed of ≈25cm/s. Such mesoscale phenomena obviously have tremendous consequences on the biological activity in most of the Algerian Basin.

The temperature measurements collected with these current meters have also provided us with very interesting information. It is first important to note that the averaged potential temperatures of the 10 records collected at 1000 and 2000m are in the range 12.85-12.87°C and in good agreement with the available hydrological data sets, which accounts for the significance of the absolute temperature values measured with such instruments. Considering that the nominal depth of 300m lies between those of the temperature minimum (≈200m) and of the temperature-salinity LIW maximum (≈400-500m) leads us to emphasize differences between the coastal and the offshore regions. Near the coast, the temperature time series at all points look like a plateau ploughed by furrows (anticyclonic young-coastal eddies propagating eastward depress the various isopleths) while offshore, they resemble a plateau with abrupt domes (due to lenses of relatively new LIW, probably advected from the Sardinian continental slope by old-offshore eddies). Maximum intermediate values recorded in the offshore zone (13.81°C ± 0.1-0.2°C) are relatively large when compared to the largest ones ever observed either in the Sardinian Channel (13.8-13.9°C, Guibout, 1987) or along the Algerian coast (≈13.2-13.5°C), supporting the previous results on the important role played by the algerian eddies.

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O-IV9

Measuring of mesoscale eddy processes in the sea

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Studing and modelling of mesoscale eddy processes in the sea are based on the measuring different types of physical values.

At the Institute of Oceanography and Fisheries in Split, automatic meteorological-oceanographical station are under development. In this phase, one station is installed in Kastela Bay, middle Adriatic Sea. The first results of testing give us satisfied results.

Automatic meteorological-oceanographical statin serves for measurement of various meteorological and oceanographical parameters at the open sea in all meteorological conditions. The main parts of AMOS are: measuring station with anchored buoy and measuring instruments, relais-station with microprocessor unit, and shore station with computer system (Fig. 1.).

The main parts of measuring station are instruments (the most of them are Aanderaa production), and buoy with electronics for receiving data from all measuring instruments, their controlling and sending to transmitting antenna.

Relais-station with receiving antenna, microprocessor unit, RS232C interface, and modem is located on the nearest land of measuring station. It receives data from measuring station, store them temporarily, and sends to computer in shore station using VHF -radio or PTT link.

In shore station, with computer system and appropriate software data are received from relais-station in real time or under remote control, and after checking and processing they are stored in data base for future usage.

Results of real time data processing using automatic meteorological-oceanographical station represents an important improvement for modelling and monitoring mesoscale eddy processes in the sea as well as weather forecast.

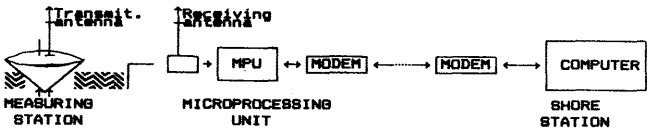

Fig. 1. Functional block-diagram of AMOS

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O

A numerical study of the interaction of various forcing mechanisms on the circulation of the Western Mediterranean Sea

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The circulation in the western Mediterranean Sea as viewed from in remotely sensed satellite data is complex and highly variable. Previous studies of the circulation based on surface and subsurface surveys (Allain, 1960; Ovchinnikov, 1966) have presented a rather simple and stable picture of the surface circulation of the western Mediterranean.

The primary physical forces exerting an influence on the circulation dynamics of the Mediterranean are surface wind stress, surface heat and mass flux, mass flux in and out via the Straits of Gibraltar and Sicily, and topographic constraints. While there are many features of the general surface circulation which appear to be directly related to one form of physical forcing or another, there many more which can not be easily identified with a particular forcing mechanism.

Numerical model experiments using one- and two-active-layer reduced gravity and two-layer finite depth, primitive equations models on a β-plane have been conducted to examine the effects due to the various forcing mechanisms. Experiments have been conducted using each forcing mechanism separately and then in various combinations. The nominal inflow transport of Atlantic water for the experiments examining the effects of mass influx was set at 1.6 Sv and the nominal inflow transport of lower layer water was set at 1.2 Sv. The wind stress data sets used included a climatological wind data set developed by May (1982) and wind data from the Fleet Numerical Oceanography Center's regional atmospheric forecast model for the Mediterranean region, the Naval Operational Regional Atmospheric Prediction System (NORAPS). The heat flux data set used was a climatological heat flux data set developed by May (personnel communication).

The model equations are solved using variant of the Hurlburt and Thompson (1980) model with two major modifications: 1) the ability to handle realistic coastline geometry and 2) the addition of a radiation outflow boundary condition patterned after a modification of the one presented by Orlanski (1976). The horizontal resolution of the model is 0.1° by 0.05°. The upper layer for all model variants was set initially at 250m. The second layer depth for the two-active-layer reduced gravity model was initially set at 250m while in the finite depth version it was set to the total depth minus the upper layer depth.

The results from the various experiments show that the dynamics of the western Mediterranean are extremely complex and that attributing observed features to a particular forcing mechanism is near to impossible. The effects resulting from the various physical forcing mechanism interacting with each other are strongly non-linear.

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Modélisation mathématique et numérique de la Méditerranée occidentale

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La Méditerranée occidentale est une mer presque fermée; elle se prête par là même particulièrement bien à l'étude de processus et à une modélisation numérique complète: d'une part, tous les phénomènes hydrodynamiques d'océans y sont présents (méandres, fronts, upwellings, ...) et d'autre part, la taille du domaine permet l'utilisation d'un modèle 3D élaboré

Le modèle utilisé est développé à partir des équations de conservation primaires. L'approximation de Boussinesq et l'hypothèse d'équilibre hydrostatique constituent une première simplification. Ensuite, le choix de la fenêtre spectrale à étudier nous oblige à un filtrage des équations non-linéaires. Ce faisant, nous introduisons les flux turbulents. La modélisation de ces flux turbulents s'inspire de la diffusion moléculaire et demande le calcul d'une diffusion turbulente. Du modèle (k,ε) généralement proposé, nous pouvons tirer une série de modèles hiérarchiques dont

** un modèle qui retient l'énergie cinétique turbulente k comme variable d'état, mais qui lie la dissipation visqueuse à une longueur de mélange empirique,

** et un modèle algébrique local.

Le modèle retenu est celui de la longueur de mélange imposée a priori mais modifiée par la stratification.

Les équations nécessitent la connaissance de conditions limites (non-linéaires) adaptées à la fenêtre spectrale choisie. Le calcul des flux à l'interface air-mer demande donc une attention particulière.

La résolution numérique des équations passe par un changement de variable verticale. Nous proposons une nouvelle version du changement de variables σ élaboré par Phillips, que nous appellerons changement de variables (σ', σ"). Celui-ci préserve les avantages du changement de variables σ , tout en éliminant certains défauts. Le fond de la mer devient une ligne du maillage et transforme le domaine en un domaine à profondeur constante, alors que le maillage vertical près de la surface est uniforme horizontalement dans l'espace réel et y permet une résolution accrue sans resserrement exagéré près des côtes.

La méthode numérique employée est une méthode de volumes finis avec un maillage variable sur la verticale de l'espace (σ', σ"). L'itération temporelle s'opère par la méthode du mode-splitting pour le mode barotrope et un schéma semi-implicite sur la verticale pour le calcul 3D. Une particularité du modèle est la discrétisation des termes d'advection qui détecte la présence locale de gradients importants et adapte le calcul des flux afin de bien représenter des fronts.

Une discussion détaillée du modèle et les références peuvent être trouvées dans
"Modélisation mathématique et numérique de la Méditerranée occidentale,
travail présenté en vue de l'obtention du grade d'Ingénieur Civil Mécanicien (Mécanique-Physique),
année académique 1987-1988
par BECKERS J-M., Université de Liège".

Equations du modèle :

$$\frac{\partial u}{\partial t} + \nabla \cdot (uu) + \frac{\partial}{\partial x_3}(u_3 u) + f e_3 \wedge u = -\nabla q + \frac{\partial}{\partial x_3}(\tilde{\nu}\frac{\partial u}{\partial x_3})$$

$$\nabla \cdot u + \frac{\partial u_3}{\partial x_3} = 0$$

$$\frac{\partial q}{\partial x_3} = b(T,S)$$

$$\frac{\partial T}{\partial t} + \nabla.(Tu) + \frac{\partial}{\partial x_3}(Tu_3) = Q^T + \frac{\partial}{\partial x_3}(\tilde{\lambda}^T \frac{\partial T}{\partial x_3})$$

$$\frac{\partial S}{\partial t} + \nabla \cdot (Su) + \frac{\partial}{\partial x_3}(Su_3) = Q^S + \frac{\partial}{\partial x_3}(\tilde{\lambda}\frac{\partial S}{\partial x_3})$$

$$\frac{\partial k}{\partial t} + \nabla \cdot (ku) + \frac{\partial}{\partial x_3}(ku_3) = \Pi^e + \frac{\partial}{\partial x_3}(\tilde{\lambda}^k \frac{\partial k}{\partial x_3})$$

$$\Pi^k = \tilde{\nu}\left\|\frac{\partial u}{\partial x_3}\right\|^2 - \tilde{\lambda}^b \frac{\partial b}{\partial x_3} - \varepsilon$$

$$\nabla = e_1 \frac{\partial}{\partial x_1} + e_2 \frac{\partial}{\partial x_2}$$

Variables d'état : u : vitesse horizontale
u_3 : vitesse verticale
T : température
S : salinité
q : pression généralisée
k : énergie cinétique turbulente

O-V3

A divergent quasigeostrophic model for wind-driven oceanic fluctuations in a closed basin

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The oceanic current and sea level fluctuations driven by the fluctuating component of a wind stress field are analyzed by considering a linear, deterministic, barotropic, quasigeostrophic model on the β-plane in a circular domain. Divergent and nondivergent forced solutions are obtained analytically and their structure in different frequency ranges is discussed. For parameter values roughly representative of the Mediterranean Sea, divergent oscillations with a clear boundary layer character are found in the range T<O(1 month) while a Rossby wave-like behavior can be observed for higher forcing periods. Finally, a comparison between divergent and nondivergent solutions reveals the inadequacy of the rigid-lid approximation for sufficiently high frequencies.

O-V4

Upwelling induced by periodic wind stress

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In this note we exhibit analytical solutions for the upwelling and the coastal currents induced by a periodic wind stress. We present solutions for an infinite deep ocean and for a shallow ocean. there is upwelling only when the period of the forcing is longer than the inertial period, i.e. $f > \omega$. When the period of the forcing is shorter than the inertial period, i.e. $f < \omega$, there is not upwelling but propagating waves. Application to the Mediterranean sea-land breeze regime will be presented.

O

Adriatic shelf response to Scirocco wind - A modelling inquiry -

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When Adriatic Sea upper shelf is forced by laterally and longitudinally uniform SE (scirocco) wind its topography responds with double-gyre structured field of vertically averaged currents. Spatial extent of the structure is asymmetrical: narrow anticyclonic gyre is formed along the Italian coast while broader cyclonic gyre covers rest of the upper shelf. It is important to elaborate further dynamic conditions that induce and maintain such a response, and particularly to identify empirical evidence that suggests the same or similar dynamics. In this paper we present a series of modelling experiments that address the first part of the problem exploring the role that (lateral) heterogeneity in the scirocco wind field can play in sustaining or destroying the double-gyre response.

The experiments were performed using a three-dimensional, linear, barotropic model. Details of the model formulation can be found in our previous papers (e.g. Kuzmic et al.,1985); an early application of the model to the whole Adriatic is reported in Kuzmic et al.(1986). Several groups of numerical experiments have been performed assessing various aspects of the forcing field variability. Major results of these studies are summarized in Fig. 1.

When the SE wind is laterally homogeneous a downwind flow is induced along the shallow Italian coastal strip contributing to the anticyclonic gyre (Fig. 1a). This particular flow pattern, also observable at other cross-sections, survives to various degrees when the stress is allowed to decrese linearly from the maximum on the Yugoslav side to 50%, 75%, and 100% lower values on the Italian side. It is totally destroyed, however, when the stress is allowed to drop to zero along the Italian coast (from a constant value over Yugoslav part of the basin, following a cosine function). In that case a single cyclonic gyre is formed over the upper shelf; a representative cross-section is given in Fig. 1b. Described schematized cases, as many others not presented, are useful for developing an insight, but eventually one has to address the problem of true wind field over the sea. In doing that we have relied on the work of Palmieri et al.(1976). They have used one-level primitive equations model to obtain wind field over the Adriatic, starting from known surface pressure field and taking into account orographical and frictional effects. We have used their particular prediction for February 21, 1966, 09 GMT , after appropriate preparation, to force our model. As Fig. 1c demonstrates a downwind flow along the Italian coast reappears at the selected cross-section, as does the anticyclonic gyre, although over reduced coastal stretch.

These simulations suggest that double-gyre structured field of transports is a rather robust feature of the Adriatic shelf; it has survived most forcing field variations in our model experiments. Further numerical experiments are in progress assessing the relation of the wind stress and eddy viscosity. But, of particular importance is empirical verification of presented modelling results.

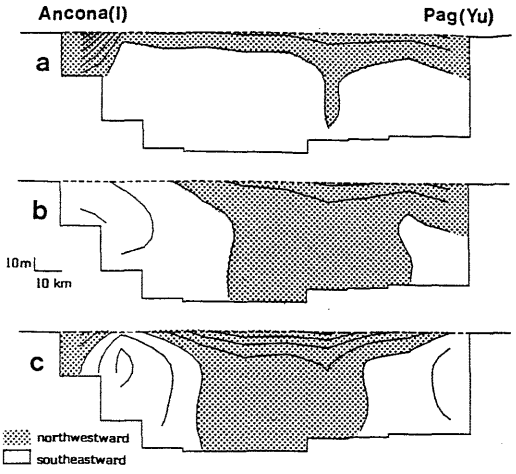

Fig. 1. Distribution of normal velocities in a section across the Adriatic for SE wind: a) laterally homogeneous, b) laterally decaying, c) quasi-empirical. Contouring interval is 10 cms^{-1}.

The coastal strip extending from the Po river delta down to the city of Ancona seems the most promissing area to offer such an evidence.

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Observations and modelling of upwellings in the Aegean Sea

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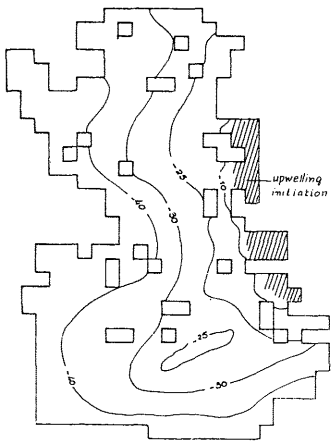
The combination of field measurements, satellite imagery and mathematical models for the investigation of the upwellings occurence in the Aegean Sea is the scope of the present study, of preliminary nature.

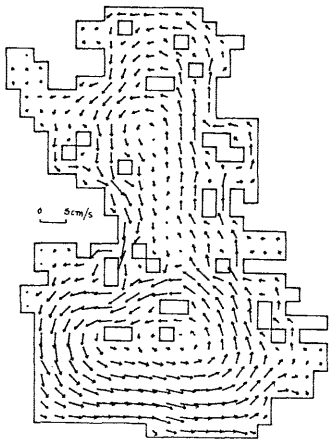
The field data were collected by the research vessel AEGEON of the National Centre of Marine Research during oceanographic expeditions within the context of the POEM and the Open Seas Research programs during the summers of 1986, 1987.

The temperature and salinity profiles recorder by CTD's and the deriving density profiles revealed that during summer distinct pycnoclines at depths ranging from 30 to 50 meters and $\Delta\rho/\rho$ values ranging from 2o/oo to 5o/oo appear along the basin. The whole area can be segmented in terms of the above two parameters in 5 distinct areas. The two layers system is a realistic hydrodynamic approximation for the basin.

Analysis of the characteristics of the water masses and satellite images indicate the occurence of strong upwellings during the warm season. Such a series of thermophotographs taken during summer 1986 by the AVHRR probe of NOAA satelite reveal intensive thermal features along the East part of the Aegean Sea. It was attempted here to explain the origin of that cold superfical water on the basis of in situ measurements of the thermal conditions of the upper layers, the prevailing meteorologic conditions and the use of a mathematical model.



Surface layer thickness after 80 hours of Etesian wind



Circulation in the surface layer under moderate wind conditions

From the meteorological information concerning the surface wind patterns it is concluded that during summer the pattern of the strong Etesian winds (of N-NE direction in the N. Aegean turning to NW-WNW in the south Aegean Sea) is typical. The mean frequency of that wind is 45% This cyclonic wind pattern influences the surface layer through the imposed friction.

The mathematical model used here was a reduced gravity model for wind generated circulation and evolution of the layer thickness. It was solved by a F.D. explicit scheme on a staggered orthogonal grid of mesh size equal to 20 km. The typical strong Etesian wind pattern was the forcing factor applied on the basin.

The model indicated that within 80 hours of wind application upwelling occured and extended along the East part of the basin with a cyclonic circulation pattern established along the basin. The fact that the cold, less saline Black Sea waters effluying from the Dardanelles straits enter a circulation pattern forming a westward coastal current along the coast of N and W Aegean Sea and the appearance of upwelling for the assumed realistic density stratification and wind patterns, lead to the preliminary conclusion that the thermal features revealed by the satellite imagery are indications of persisting summer upwellings along the East part of Ehe Aegean. Further investigation by models and tracers is proposed.

O-V7

A mathematical model to study tidal propagation in Patraikos Bay

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In this work, a mathematical model is applied to determine the tidal elevations and circulation associated with the main tidal constituents, in the bay of Patraikos at Western Greece.

Accepting the classic hydrodynamic theory with equations of continuity and motion, we approach the costal boundaries and bottom topography of the bay, by means of a reversed cone with ellipsoidal base. The explicit solution of the final differatial equation is given in this presentation.

Comparison of the results of this model to a monthly data set from four stations along the coast confirms the reliability of the model tidal prediction.

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O

P-I1

Some observations on eutrophication associated changes in phototrophic and heterotrophic pico- and nanoplankton assemblages in the Northern Adriatic Sea

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SUMMARY

The size class structure of the smaller than 20 µm plankton community was downshifted along a trophic gradient across the Adriatic Sea. Both phototrophic and heterotrophic picoplankton heavily dominated during the summer stratified period compared with the winter mixed period. Cyanobacteria dominated the phototrophs, especially in the eutrophic Po delta region.

The shallow northern Adriatic is under the eutrophicating influence of the Po and other northern Italian rivers, and strong evidence exists that anthropogenically increased nutrient input is increasing primary production causing eutrophication. Previous studies indicated that the eutrophication was reflected in increased plankton biomass, and downshifts in micro- and nanoplankton size class structure (the only size classes then analyzed). To extend our data set the nano- and picoplankton (both phototrophs and heterotrophs) were sampled along a trophic gradient created by Po River discharge, to determine if the eutrophication induced biomass increases and size class changes we previously observed in the microplankton would be reflected in the smaller nano- and picoplankton.

Samplings were conducted along an east-west trans-Adriatic trophic gradient between the Po River delta, Italy and the Istrian Penisula, Yugoslavia, and along a north-south trophic gradient toward the central Adriatic during stratified and mixed water column periods. Samples were collected throughout the water column to establish the physical/chemical characteristics, and to enumerate the smaller plankton elements. Plankton samples were preserved with both glutaraldehyde and Lugol iodine solution, and examined by autofluorescence, or after subsequent decoloring and staining with DAPI or FITC were enumerated using epifluorescence techniques. Organisms were classified as phototrophic and heterotrophic nanoplankton (2-20 µm), and phototrophic and heterotrophic picoplankton (0.2 - 2 µm).

Our previous analyses indicated that changes in the phototrophic community structure from a microplankton dominated community to a community with more nanoplankton occurred with the transition from a mixed to stratified water column, and that some microplankton heterotrophs showed a similar downshift in size class structure. The study reported herewith indicates a further downshift in size classes of both smaller phototrophs and heterotrophs and a relative increase in the biomass of the phototrophic and heterotrophic picoplankton at the western stations under stratified conditions.

The mean water column phototrophic picoplankton densities increased 2-4 fold at eastern and 10-20 fold at the western transect stations compared with winter lows. The average water column densities ranged from 25,000 to 10^6 ml^{-1}. The cell density increase of this component was particularly pronounced at the surface where the water column maximum usually occurred, in contrast to the eastern stations, where the maximum concentrations of this component occurred in the 20-25 m layer.

The phototrophic nanoplankton component increased about an order of magnitude from winter lows with average water column concentrations of 300 to 4,600 ml^{-1} at the eastern stations and 700 to 7,000 ml^{-1} at the western stations.

It is clear that Po river induced eutrophication increased the volume biomass in all phototrophic and heterotrophic pico- and nanoplankton components at western stations near the Po delta during both oceanographic periods. While the ca. 2-fold volume biomass increases in the nanoplankton components (both phototrophs and heterotrophs) along the transect are of similar magnitude, the picoplankton components (both phototrophs and heterotrophs) exhibited a marked 11-fold and 7-fold increases along the east to west gradient. Since the highest biomass was concentrated at the surface at western stations, the surface gradient was even more pronounced, 41-fold and 18-fold respectively. In that context, the south to north gradient becomes even more pronounced, with an average water column increase for each component of 2-3 times that observed on the east to west transect.

High concentrations of cyanobacteria occurred in the surface layers especially at the nutrient richer western stations, indicating that they can thrive in high light intensities given adequate nutrient supply. Their tendency to exhibit a deeper maximum at more oligotrophic stations, may reflect their ability to adapt to lower light intensity close to the depth of the nutricline, since the surface layers at those stations are usually nutrient depleted. The pronounced heterotrophic picoplankton (bacteria) increases at the more eutrophic sites under stratified conditions may reflect high water column temperatures, which increase growth rates, especially assuming an increased availability of dissolved organic matter in this high biomass region.

The observed densities of heterotrophic picoplankton were not sufficient to support observed ciliated protozoan populations, but it is hypothesized that the combined availability of heterotrophic picoplankton (10^5 to 10^7 ml^{-1}) and phototrophic picoplankton (10^4 to 10^6 ml^{-1}) represented a pool of particles dense enough to serve as the food source for the ciliated protozoans as well as the heterotrophic nanoplankton.

Changes in the phytoplankton community structure from microplankton domination to an increased abundance of smaller sized classes (nanoplankton) were previously observed to be associated with the transition from the mixed to a stratified water column seasons, which also downshifted the microzooplankton biomass structure toward the smaller size classes. These additional data clearly indicate that eutrophication associated increases in biomass, and downshifts in size class structure extend to the picoplankton, and further increase the biomass represented by the smaller size class components at the western stations.

CONCLUSIONS

- eutrophication causes a downshift in the size class structure of food webs along a trophic gradient across the Adriatic Sea
- the size class downshift was most pronounced in eutrophic regions off the Po delta, markedly increasing the cell densities and volume biomass of both phototrophic and heterotrophic picoplankton
- the size class downshift occurred primarily during the summer months when the water column was stratified
- the size class downshift mirrored a previously reported downshift in larger ciliated protozoans along the same trophic gradient.

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P-I2

The phytoplankton successions in the Gulf of Triest

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The week-to-week samplings of phytoplankton throughout one year demonstrated that the phytoplankton assemblages of the Gulf of Triest, Northern Adriatic, changed in time very abruptly within a week or two. The populations of one or two dominant species declined precipitously and became rapidly insignificant or even vanished from the samples.

In the studied year (March 1983 till April 1984) the diatom Chaetoceros affinis became dominant in mid-March, concomitantly with the vernal warming of the seawater. In April the bloom of Prymnesium parvum was observed, successively followed by flowering of diatoms: Ch. simplex, Nitzschia delicatissima complex, and Skeletonema costatum. In May the diacmic small-sized dinoflagellates occured, having the second annual pulse in winter. Gymnodinium simplex and G. paulseni co-dominated with Prorocentrum micans. Beside them the tiny cells, arbitrarily named microflagellates flourished in May. In terms of number microflagellates constituded 64% of the total year cell density.

Fairly stable and sharp thermocline in June probably induced phytoplankton to become stratified. In the upper layers microflagellates co-occured with Meringosphaera triseta, whereas the layers below 10 m depth were populated by the large-sized armoured dinoflagellates: Peridinium spp., Ceratium spp., Dinophysis caudata, D. sacculus, Goniaulax polyedra, that occured in deeper layers until October.

July is the month of diatom proliferation in the Gulf. In the year 1983 the populations of Rhizosolenia alata f. gracillima, Cerataulina pelagica, N. delicatissima complex, N. seriata complex and N. closterium developed in July and were replaced in August by the assemblage of Bacteriastrum delicatulum, Rhizosolenia fragilissima, Guinardia flaccida and again R. alata f. gracillima.

In August in the 20 m deep layer only an unusual bloom of the silicoflagellate Distephanus speculum was observed. The bloom lasted for two weeks.

The September peak was characterized by R. fragilissima, C. pelagica, N. closterium and Thalassiothrix mediterranea. Towards the end of the month the chlorophyte Chlamydomonas sp. could be distinguished among numerous microflagellates.

The second Chaetoceros spp. bloom occured in October. This time the dominant among ten chaetoceros species was Ch. compressus. At the end of October the fraction of large-sized dinoflagellates declined, but the unusual green dinoflagellate appeared in all the layers (Gyrodinium pavillardi) concomitantly with the increase of nutrients especially nitrates.

The cooling of the water and decrease of light intensity in November still did not inhibit the phytoplankton growth. Leptocylindrus danicus co-dominated with the microflagellates, and the modest pulses of the centric and pennate diatoms were observed at the end of the month. Among them the most abundant were: Rhizosolenia stolterfothii, R. styliformis, Ch. compressus, Hemiaulus hauckii, G. flaccida, Thalassiosira decipiens, N. closterium, N. delicatissima complex, T. mediterranea, Cocconeis scutellum and Navicula sp.

Finally in December the skimpy winter flora completed the year successions. Till March the coccolithophorids Pontosphaera huxleyi and Acanthoica aculeata co-dominated with small-sized dinoflagellates G. simplex and G. paulseni and with few tiny tychopelagic diatoms: N. closterium, N. tenuirostris and Amphora marina.

Structure des populations Phytoplanctoniques en Adriatique Septentrionale

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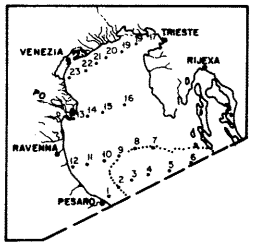
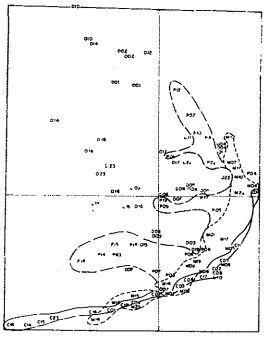
Afin d'évaluer l'organisation structurale des populations phytoplanctoniques de l'Adriatique Septentrionale en juillet 1976 (**figure 1**), nous avons utilisé la méthode des modèles mathématiques de distributions d'abondances de MOTOMURA, de PRESTON, de MAC ARTHUR et de MANDELBROT.



L'ajustement de ces modèles aux données observées a pu être apprécié par la mesure de la **distance de HELLINGER** dont la visualisation par la méthode de **l'Analyse en Composantes Principales** nous a permis d'avoir à la fois une vue objective et globale du modèle le plus performant.

Sur la **figure 2**, l'axe vertical est la première composante principale et l'axe horizontal la seconde. Plus la qualité de l'approximation visuelle des distances est meilleure, plus le pourcentage d'inertie expliqué par ces deux premières composantes se rapproche de 100.

La **figure 2** porte aussi un certain nombre de symboles dont voici la signification : O_n : représente la valeur observée ; D_n : correspond à l'ajustement au modèle de MANDELBROT ; P_n : correspond à l'ajustement au modèle de PRESTON ; M_n : correspond à l'ajustement au modèle de MOTOMURA ; C_n : correspond à l'ajustement au modèle de MAC ARTHUR.



La grande dispersion des points correspondants aux données observées par rapport à celles obtenues à partir des modèles, indique clairement qu'il est difficile d'ajuster à un seul et même modèle une communauté phytoplanctonique en voie de maturation.

Les points correspondants aux échantillons les plus perturbés du littoral occidental sont presque tous éparpillés dans la région supérieure du graphique (exemple: échantillons 10 et 14) et sont loin (en d'autres termes mal ajustés) des valeurs théoriques des modèles de PRESTON, de MOTOMURA et de MAC ARTHUR dont les points représentatifs forment des nuages se succédant dans la partie inférieure droite du graphique.

Tendent à se rapprocher de tels modèles, les échantillons intéressant les peuplements les plus équilibrés des eaux centrales et orientales de l'Adriatique (exemple : échantillons 3 et 7).

Les ajustements au modèle de MANDELBROT forment quant à eux des points épars surtout dans la partie supérieure du graphique et semblent indiquer que ce modèle s'adapte aussi bien à des peuplements d'un stade intermédiaire entre les stades 1 et 2 (stade 1') qu'à des communautés en fin de succession (exemple : échantillon 17).

Le modèle de PRESTON semble s'ajuster lorsqu'il y a dominance d'une ou de deux espèces par rapport à d'autres dont la répartition est plus harmonieuse (exemple : échantillons 9 et 16).

L'étude dynamique, basée sur l'ajustement des modèles des distributions d'abondances par la mesure de la **distance de HELLINGER**, nous permet de tirer les conclusions suivantes quant à l'évolution de la florule algale dans ce secteur nord de l'Adriatique.

A l'ouest, ce sont surtout les **Diatomées** et parmi elles plus particulièrement **Rhizosolenia alata** et **Rhizosolenia fragilissima** qui tendent à coloniser le biotope ce qui entraine une perturbation de l'écosystème et une baisse de la diversité. Cette tendance est freinée à l'est par le développement des autres phytoplanctontes notamment, les **Dinoflagellés** et les **Coccolithophoridés**. Ceux-ci deviennent plus fréquents et plus diversifiés au fur et à mesure que l'on s'approche de la côte yougoslave. En même temps, la compétition interspécifique s'atténue ce qui permet l'épanouissement et la coexistence de nombreuses espèces, lesquelles vont tendre vers le stade d'équilibre, équilibre atteint en général dans les eaux centrales et orientales.

Ainsi, d'ouest en est, les peuplements phytoplanctoniques ont tendance à atteindre leur maturité c'est-à-dire une complexité croissante de leur organisation. Ceci n'est rendu possible que grâce à l'épanouissement de divers groupes et organismes de la florule algale. La stabilité qui augmente corrélativement avec l'évolution du système algal, provient d'une résistance croissante, laquelle semble être la base même de la stratégie successionnelle dont le but est d'aboutir à des structures invulnérables aux diverses agressions du milieu environnant. Tout se passe comme si l'évolution croissante du système crée une certaine harmonie et une cohésion entre espèces grâce à l'importance des mécanismes biorégulateurs qui contrôlent la circulation des éléments nutritifs et amortissent les fluctuations et les perturbations d'origine externe.

Les quatre modèles (MOTOMURA, MAC ARTHUR, PRESTON et MANDELBROT) utilisés ne sont pas des constructions mathématiques abstraites. Ils permettent de caractériser les profils d'abondances, d'avoir une image des positions respectives des espèces les unes par rapport aux autres et d'en déduire donc le degré d'organisation du peuplement.

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Tuscan Northern Tyrrhenian microzooplankton : Autumn 1986

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During a cruise in the northern area of Tuscan Tyrrhenian Sea (fig.1) in the autumn 1986 we have sampled with a Niskin bottle 5 l of water at 33 stations (at three depths) to study microzooplankton populations.

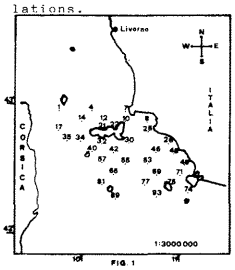

FIG. 1

Taxonomical analysis were carried out on the entire sample after filtration (on 20 µm mesh size net) and sedimentation, by using an inverted microscope (Utermohl method, 1958).

Microzooplankton populations in the whole area are dominated by Tintinnids, present with 74 taxa (67 species and 7 genera). 20 species are collected at every depht, among these Dadayella ganimedes, Salpingella rotundata, Steenstrupiella steenstrupii, Amphorella quadrilineata and Stenosemella nivalis prevail throughout all the layers. 16 species are only superficial (the more abundant is Salpingella glockentogeri, among the 8 intermediate (from 1 to 100 m dephts) Eutintinnus radix, Tintinnopsis lobiancoi and Xystonella longicaudata are widely spread; at last 14 are to be found deeper than 100 m (mostly Acanthostomella minutissima and Salpingella curta).

Copepods nauplius and little copepodits are often present in a large number and are the more abundant larval stages of Metazoa, while Ciliates other than Tintinnids are very scarsely present in high density near the coast. Other Protozoa are almost absent.

Density values range from a minimum of 3 at a maximum of 298 specimens • dmc, generally speaking the higher values are found at intermediate layers and in the central area of the sampling rectangle.

Basing on the Tintinnids populations we have separated the sampling stations in homogeneus groups by using an ordination method (clustering analysis on a distance matrix (option chord) (Lagonegro and Feoli, 1985). For every layer (0 m , 1 - 49 m, 50 - 100 m and 100 m) we find particular disposition of the sampled stations:
surface (fig.2) - 4 groups: the first (st.10, 22, 46, 75, 77, 49 a and 69) are strictly neritic, the second (st. 7, 25, 71, 30, 17, 26, 55, 89 and 48) has untill neritic characters, the third (st. 4, 12, 65, 40 and 81) with open waters characters and the fourth (st. 1, 42, 53, 21, 93, 14, 32, 34, 35, 74, 8 and 57) with "oceanic" characters.
1 - 49 m (fig. 3) - 2 groups: the first, homogeneus, with open waters characters (st. 14, 26, 74, 42, 49 b, 30, 32, 40), the second, less homogeneus, more neritic (st.7, 48, 8, 34, 17, 25, 21, 10 and 22), it is impossible to associated the station 49 a to any groups.
50 - 99 m (fig. 4) - the dissimilarity is very high, we can recognized only a good association among the neritic stations 4, 10, 7, 26 and 74; the other three groups identify the remaining stations whith less neritic characters.
⩾100 m (fig. 5) - 2 groups, the first with stritcly connections among the stations (42, 46, 55, 75 and 89) and other four groups with more "oceanic" characters (st. 1, 57, 77,40 and 93; 65, 81 and 71; 4 and 53; 12, 69 and 35)

At any rate, we can individuate three distinct areas: the first, comprising stations 7, 10, 22, 25, 46, 48 and 89 associated at each layers at neritic characters, the second (st. 1, 12, 14, 35, 40, 53, 57, 65, 81 and 93) with more oceanic characters, and, at last, the third that is constituted by remaining stations, wich belong to the central area of the sampling rectangle (except st. 17). They are grouped in a different way at each layers and that consequently we can consider "intermediate" with regards to their Tintinnids populations.

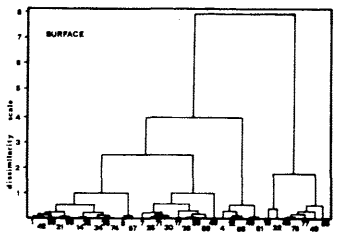

FIG. 2

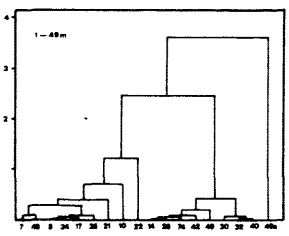

FIG. 3

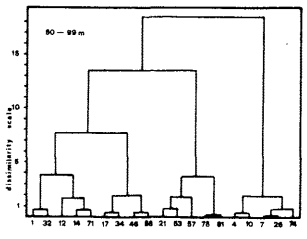

FIG. 4

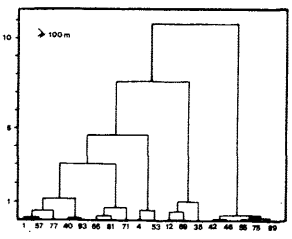

FIG. 5

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Supported by Tuscan Region (Progetto Mare)

P-I5

Les Ciliés planctoniques dans les eaux côtières Libanaises (Méditerranée orientale)

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Summary: Quantitative observations of planctonic Ciliates were carried out in the Lebanese coastal waters during 1987, at the surface water (Utermöhl's method). We note the presence of an annual cycle with a maximum density in April-June. The annual means of all the Ciliates are estimated around 763 (Amplitude=157-2530) and 660 (Amplitude=102-3404) animals per liter successively at two stations.

Introduction: Les Ciliés constituent un important maillon dans les chaînes trophiques marines et d'après les études antérieures de différents groupes planctoniques dans la région, couvrant un cycle annuel ou durant la poussée printanière (Abboud-Abi Saab, 1985; 1986), ces Ciliés sont assez fréquents dans le milieu et leur densité varie selon les saisons de l'année et surtout selon les méthodes d'échantillonnage. Les plus grandes densités sont notées dans les niveaux superficiels. Des travaux récents ont mis l'accent sur la nutrition de ces protistes et leur rôle dans l'épuration de l'écosystème néritique (Rassoulzadegan, 1982; Dive, 1973). Ce travail présente les variations saisonnières de de différents Ciliés dans une zone côtière.

Matériel et Méthodes: Les Ciliés ont été dénombrés mensuellement en surface durant l'année 1987 dans les échantillons d'eau de 1 litre,sur deux stations, situées dans la baie de Jounieh: J0 (à environ 40m du rivage par 5m de fond) et J1 au centre de la baie (à 2 km du rivage par 150m de fond).Les échantillons d'eau, destinés à l'étude microscopique ont été fixés immédiatement au lugol et le comptage a été fait suivant la méthode d'Utermöhl (1958) après sédimentation de plusieurs jours.

Résultats et Discussion: Les échantillons d'eau analysés ont montré que la totalité des Ciliés recencés appartenait à l'ordre des Oligotrichida englobant des espèces des sous-ordres: Oligotrichina et Tintinnina; dans les deux stations, les premiers sont souvent dominés par des formes de petite taille (20-30um) de détermination délicate. L'étude des échantillons de filet a montré la présence de Ciliés Péritriches durant certaines périodes de l'année: Vorticella marina Zaccharias, rencontré en épiphyte sur Chaetoceros coarctatum Lauder qui est commun en automne; Zoothamnium pelagicum Du Plessis, rencontré entre novembre et décembre en colonies ayant jusqu'à 100 zoïdes pédonculés.

L'analyse quantitative des Ciliés a montré la présence d'un cycle annuel (Fig.1). Les plus grandes densités de populations s'observent entre avril et juin avec un maximum en mai à J0 et en juin à J1; tandis qu'une légère augmentation de densité est observée en octobre à J1, un autre maximum assez important est noté en novembre à J0. Le minimum annuel est noté en mars dans les 2 stations et un autre en septembre à J0. Les moyennes annuelles et d'autres résultats figurent dans le tableau I. Ces résultats, comparés à ceux d'autres travaux en Méditerranée occidentale (Margalef, 1968; Rassoulzadegan, 1977) sont très faibles. En considérant les Ciliés totaux, on constate que la station J0,située à proximité immédiate de la côte est plus riche que J1, un peu plus éloignée; ceci est vrai aussi pour les Tintinnina; mais ces différences ne sont pas statistiquement significatives (Test de Student). Les Oligotrichina ont la même distribution aux deux stations.

Les moyennes des pourcentages des Tintinnina par rapport à l'ensemble des Ciliés dénombrés sont relativement élevées (42% à J0 et 34% à J1) et présentent des fluctuations très importantes (1,4 - 95% à J0 et 1,6 - 86% à J1); comparés à d'autres résultats en Méditerranée (Palau,1986), ces pourcentages sont élevés.Ceci nous fait penser à un rôle probable de la salinité, les Oligotrichina semblant être favorisés dans les aires côtières dessalées; ceci n'est pas la cas dans notre milieu de travail; les conditions nutritives sont les mêmes pour les 2 sous-ordres lesquels ont des dimensions comparables et peuvent constituer la nourriture pour les mêmes consommateurs et subir le même effet de grazing.

Groupe ou Taxa	Station	Moyenne (n = 12)	Amplitude (Individu/l)	Ecart-type	Coef. de variation
Ordre Oligotrichida	J0	763	157(déc.)-2530(mai)	860	113
	J1	660	102(avril)-3405(juin)		
Sous-ordre Oligotrichina	J0	494	17(sept.)-2288(mai)	680	138
	J1	492	42(mars) -2445(juin)	709	144
Sous-ordre Tintinnina	J0	269	3(oct.) -1388(juin)	371	138
	J1	166	8(avril)- 960(juin)	264	159

Tableau 1. Moyennes, Amplitudes, Ecarts-types et Coefficients de variations des Ciliés Oligotrichida dans les eaux côtières libanaises.

Il serait indispensable de mettre l'accent sur les facteurs qui régissent la nature et l'abondance des Ciliés ainsi que leur rôle dans la chaîne alimentaire comme intérmediaire entre les microflagellés et les omnivores d'autant que dans ces eaux oligotrophes, le nombre des maillons de la chaîne alimentaire risque d'être élevé ainsi que la perte en transfert d'énergie.

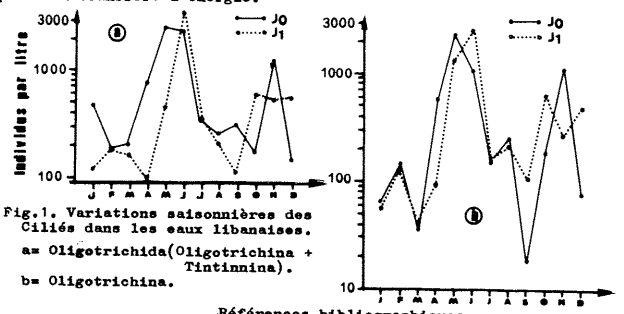

Fig.1. Variations saisonnières des Ciliés dans les eaux libanaises.
a= Oligotrichida(Oligotrichina + Tintinnina).
b= Oligotrichina.

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P-I6

Annual variations in the phytoplankton populations of the Northern Cilician Basin

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INTRODUCTION

Information regarding the phytoplankton of the Northern Cilician Basin is scarce (ÜNSAL; 1970a,b, GÖKALP; 1972), most of the existing studies in the Eastern Mediterranean Sea being restricted to the coastal waters of Libya (TUFAIL; 1981), Egypt (EL-MAGHRABY and HALIM;1965), Israel (KIMOR and WOOD; 1975, AZOV; 1986), and Lebanon (ABBOUD-ABI SAAB; 1985). It is the aim of our study to present an analysis of phytoplankton for this area of the Mediterranean extended to a complete annual cycle.

MATERIAL and METHOD

Phytoplankton samples were taken monthly, from November 1984 through October 1985, with a standard net of 55 µm mesh size, towing vertically from a depth of 75 meters to the surface. The material was collected from a station with a depth of 100 m, located approximately 3,5 nautical miles offshore, in the western part of Mersin Bay (36°31'N-34°18'E). The samples were fixed immediately with formaldehyde solution (4%) and examined under the inverted microscope using a Palmer-Maloney chamber.

RESULTS and DISCUSSION

A total of 35 genera including 126 species and varieties (70 diatoms and 56 dinoflagellates) were identified throughout the sampling period. Only two species, Hemiaulus hauckii and Rhizosolenia calcaravis appeared throughout the whole year (12 months). Other most frequently present species in our samples were Rhizosolenia alata (11 months), Ceratium horridum (11 months), Chaetoceros affinis (10 months), Thalassiothrix frauenfeldii (9 months), Thalassiothrix mediterranea (9 months), Ceratium macroceros (8 months) and Chaetoceros decipiens (8 months).

In the present study, the diatoms were found to be dominant both in terms of absolute abundance and in number of species for most of the year, while the dinoflagellates were dominant in species in June and July. In earlier studies, EL-MAGHRABY and HALIM (1965) found the similar results, except that the number of diatom species was lower than that of dinoflagellates only in June, being higher during the rest of the year. ABBOUD-ABI SAAB (1985) observed that the diatoms were predominant in cell density while the dinoflagellates were richer in number of species.

Diatoms were represented mainly by Chaetoceros and Rhizosolenia species. Chaetoceros were represented by 19 species and constituted 92 % of all diatom individuals. Rhizosolenia was also important in species number being represented by 15 species. However, it was less important in cell number and contributed only 1,3 % to diatom abundance. On the other hand, during the time the study was carried out, the Ceratium genus (with a total of 34 species) was dominating through dinoflagellates. Similar results were found by EL-MAGHRABY and HALIM (1965) in Alexandria waters, by IGNATIADES (1969) in Saronicos Bay, by ABBOUD-ABI SAAB (1985) off Lebanon coast and by AZOV (1986) off Israeli coast. Chaetoceros and Rhizosolenia species appeared to be abundant generally during the cold seasons (September to May). ABBOUD-ABI SAAB (1985) who has studied qualitatively and quantitatively the phytoplankton of the coastal waters of Lebanon found that Chaetoceros and Rhizosolenia were the most important genera of diatoms being represented by 33 and 16 species, respectively. AZOV (1986) showed that the diatoms were dominant species in neritic region of the oligotrophic waters of the Levant Basin. Also he confirmed the most abundant diatoms were Chaetoceros, Coscinodiscus and Rhizosolenia spp.

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P-I7

A comparative study of phytoplankton in S. Aegean, Levantine and Ionian Seas during March-April 1986

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Abstract.

The present investigation represents an attempt to study and compare phytoplankton populations from S. Aegean, Levantine and Ionian seas.

Sampling in the above mentioned areas (13 stations) was performed during March - April 1986. Water samples were collected from the upper 200m of the water column, preserved with Lugol solution and counted in an inverted microscope.

The dominant phytoplankton species from the examined areas are presented in table 1, while dominance indices for each sample (table 2) were calculated according to McNaughton formula (1967). Also phytoplankton species abundances were analysed by the truncated log - normal distribution (Cohen, 1959; Cassie, 1962; Bliss; 1967) which provided a reasonable fit to the data as indicated by the X^2 distribution (table 3). Finally a diversity index based on the log - normal parameters (table 3) was estimated (Edden, 1971).

Low values for phytoplankton abundances (from 1400 cells/l.st.76,200m to 25720 cells/l. st.58,0m both in the Levantine sea) and dominance indices (table 2) were recorded in all areas defining their oligotrophic character. Another interesting feature is that diatoms predominated in S. Aegean, dinoflagellates in Ionian and coccolithophores in Levantine sea.

High values of phytoplankton populations' diversities were estimated for all samples, while higher values of σ (table 3) that have been recorded at the upper layers of stations 13 (Aegean sea), 58 (Levantine sea) and 86 (N. Ionian sea) might be attributed to fluctuating conditions of the environment (Georgopoulos et al. 1986; Theocharis et al. 1986a,b, 1987).

TABLE 1. Dominant species in Aegean, Ionian and Levantine Sea (in alphabetical order)

1.Bacteriastrum delicatulum
3.Chaetoceros affinis
3.Chaetoceros decipiens
4.Chaetoceros sp.
5.Chilomonas marina
6.Coccolithus fragilis
7.Coccolithus leptoporus
8.Coccolithus pelagicus
9.Coccolithus sp.
10.Cryptomonas sp.
11.Cyclotella sp.
12.Emiliania huxleyi
13.Exuviaella baltica
14.Gymnodinium pygmeum
15.Gymnodinium sp.
16.Gymnodinium variabile
17.Gyrodinium pingue
18.Nitzschia closterium
19.Nitzschia seriata
20.Oxytoxum variabile
21.Peridinium sp.
22.Rhizosolenia delicatula
23.Scrippsiella trochoidea
24.Synedra sp.
25.Syracosphaera mediterranea
26.Thalassiothrix frauenfeldii

TABLE 2. Dominant species (as indicated in table 1) and doninance index (δ) in Aegean, Levantine and Ionian Sea.

AEGEAN SEA St.	Depth (m)	Dom.sp.	δ	LEVANTINE SEA St.	Depth (m)	Dom.sp.	δ
	0	18, 3	43		0	24,26	65
13	50	18,19	62		5	26,24	39
	200	22, 7	28	58	10	26,21	49
					20	19,26	35
50	0	26,25	50		50	24,26	37
52	0	26, 8	42		0	12, 9	31
				56	50	12, 8	34
	10	5, 6	47				
68	50	2,18	33		0	15,12	31
	75	4,18	40		50	15,12	34
				76	100	17,12	22
72	0	13,26	42		200	12, 1	25

IONIAN SEA St.	Depth (m)	Dom.sp.	δ
	0	9,14	59
83	50	14,20	51
84	0	10,14	25
82	0	12,23	25
85	0	10,16	38
86	50	10,14	40
	200	11,10	37

TABLE 3.Lognormal distribution parameters of phytoplankton species concentration in Aegean, Levantine and Ionian seas.

AEGEAN SEA St.	Depth (m)	N	μ	σ	$\hat{N}$	σ^2	D"	df	X^2
	0	25	1.7	0.7	42	0.5	5.2	3	0.8
13	50	24	1.1	0.9	85	0.8	6.2	4	5.4
	200	29	1.8	0.5	42	0.3	5.2	2	4.5
50	0	21	2.1	0.6	26	0.4	4.6	4	5.5
52	0	26	2.0	0.6	32	0.5	4.9	4	9.1
	10	21	2.1	0.5	23	0.3	4.5	3	3.8
68	50	17	2.2	0.4	18	0.1	4.1	2	2.5
	75	14	2.5	0.5	15	0.2	3.9	2	3.7
72	0	15	2.0	0.6	18	0.4	4.0	4	5.5

IONIAN SEA St.	Depth (m)	N	μ	σ	$\hat{N}$	σ^2	D"	df	X^2
	0	33	2.3	0.6	37	0.3	5.1	6	20.6
	5	28	2.1	0.6	36	0.4	5.0	3	0.3
58	10	21	2.1	0.5	25	0.3	4.5	3	7.0
	20	27	2.4	0.4	28	0.2	4.7	3	5.8
	50	27	2.3	0.5	28	0.3	4.7	4	9.0
	0	15	2.3	0.4	15	0.1	3.9	10	10.5
56	50	22	2.1	0.5	22	0.1	4.5	3	7.4
	0	26	2.1	0.6	37	0.3	5.1	5	2.3
	50	37	1.9	0.7	45	0.5	5.6	7	10.5
76	100	24	2.1	0.4	69	0.2	4.7	4	8.5
	200	11	2.0	0.5	12	0.1	3.5	2	1.9

IONIAN SEA St.	Depth (m)	N	μ	σ	$\hat{N}$	σ^2	D"	df	X^2
	0	23	2.2	0.5	27	0.3	4.6	4	11.3
86	50	32	1.8	0.9	51	0.8	5.4	5	9.6
	200	15	1.8	0.5	20	0.3	4.2	2	1.0
85	0	18	1.9	0.5	25	0.3	4.6	5	5.0
	0	15	1.1	0.7	60	0.5	5.7	2	1.7
83	50	25	1.9	0.5	35	0.2	5.1	2	2.1
84	0	26	2.3	0.4	27	0.2	4.7	5	6.9
82	0	19	1.9	0.4	33	0.2	5.0	2	3.3

N=total number of observed species, μ = log mean abundances, σ = log standard deviation, $\hat{N}$= total number of expected species, σ^2= variance, D" = log $\hat{N}$ - 0.3466 *σ^2(diversity), df = degrees of freedom.

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P-I8

Sewage nutrient enrichment and phytoplankton ecology in the Pagassitikos Gulf (Greece)

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The abundance, species composition and taxonomic diversities of phytoplankton has been studied in relation to sewage pollution in the north Pagassitikos Gulf, Greece (Fig. 1). Surface water samples were collected from a series of stations in July 1987. Samples were preserved, concentrated by settling, and the concentration of each species of phytoplankton enumerated in an inverted microscope. Water samples from the vicinity of the major sewer outfalls (Stations 1, 2 and 3) showed very high concentrations of nutrients, greater total concentration of phytoplankton, and a lower taxonomic diversity than samples remote from outfalls (Tables 1, 2 & 3).

Phytoplankton abundance and taxonomic diversity depend upon the supply of nutrients in natural waters, where abundance increases and diversity decreases with increasing nutrient concentrations (Table 4) in the Pagassitikos Gulf. A considerable variation in the occurrence of species and dominance occurred along the nutrients gradients (Table 3). Dinoflagellates were dominant in polluted waters, while diatoms dominated in cleaner waters (Table 2). From the dominance and relative distribution of the taxa along the nutrients gradient certain species of Gymnodinium emerge as indicator species of red tide pollution. These changes correspond to a typical degradation of a complex community to a less mature state by the inflow of nutrient-rich sewage (eutrophication) in the north Pagassitikos Gulf.

Table 1: Surface salinity(‰) and nutrients (μg-at/l).

St.	S	PO_4^{-3}	SiO_4^{-4}	NH_4^+	NO_2^-	NO_3^-
1.	34,6	0.91	14.65	0.98	0.24	5.87
2.	30.7	0.42	27.20	1.15	0.08	13.81
3.	22.2	0.49	34.35	1.30	0.07	17.86
4.	37.2	0.12	1.18	1.25	0.08	1.18
5.	36.6	0.10	4.74	0.74	0.07	2.18
6.	36.9	0.13	3.16	1.70	0.08	6.67
7.	36.1	0.10	7.20	0.76	0.08	3.47
8.	37.1	0.11	5.53	0.44	0.08	2.56
9.	37.0	0.13	2.69	0.58	0.07	1.26
10.	36.8	0.11	2.70	0.48	0.08	0.96
11.	37.0	0.13	2.98	0.41	0.08	1.06

Table 2: Taxonomic groups (cells x 10^3/l). Numbers in parentheses are the % ratios.

Taxonomic group. St.	1	2	3	4	5	6	7	8	9	10	11
Diatoms	282 (2.2)	48.4 (13.2)	13.8 (17.8)	16.3 (12.9)	19.5 (31.6)	11.2 (67.4)	23.2 (36.7)	22 (31.7)	10.6 (43.6)	31 (50.5)	12.9 (65.4)
Dinoflagellates	12145 (97.7)	316 (86.5)	57.4 (74)	106 (84)	41.1 (66)	3.9 (23.4)	39.4 (62.3)	44.3 (63.6)	12.4 (51)	27.2 (44)	5.6 (28.4)
Coccolithophores	- -	0.8 (0.2)	3.2 (4.3)	4 (3.1)	1.1 (1.7)	1.5 (9)	0.6 (0.9)	3.3 (4.7)	1.3 (5.3)	3.1 (5)	1.2 (6)
Silicoflagellates	-	-	-	-	-	-	-	-	-	4 (0.6)	-
Total microplankton	12427	365	74.4	126	61.7	16.6	63.2	69.6	24.3	61.3	19.7
μ flagellates	2184	38.2	173	113	199	124	24	37.5	110	42.1	31.4

Table 3: Dominant species, dominance (δ, McNaughton, 1967) and diversity (D, Margalef, 1967) indices.

St.	Dominant species	δ	D
1	Gymnodinium sp. Cachonina niei	94.1	0.49
2	Gymnodinium sp. Cachonina niei	83.4	1.37
3	Cachonina niei Gymnodinium sp.	68.1	1.93
4	Cachonina niei Gymnodinium sp.	73.4	1.87
5	Gymnodinium sp. Cachonina niei	60.2	1.77
6	Chaetoceros affinis Nitzschia closterium	28.9	2.77
7	Gymnodinium sp. Cachonina niei	55.5	1.89
8	Cachonina niei Gymnodinium sp.	51.2	2.28
9	Chaetoceros socialis Gymnodinium sp.	41.1	2.72
10	Gymnodinium sp. Chaetoceros socialis	31.9	2.69
11	Chaetoceros socialis Skeletonema costatum	32.4	2.81

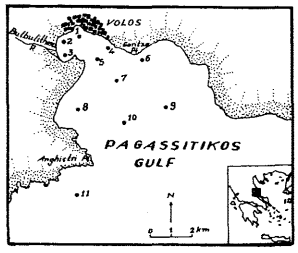

Fig. 1. Sampling locations

Table 4: Significant linear correlation between biological and chemical parameters.

Phytoplankton density correlated with :	Regression equation	Correlation coefficient
Phosphate	log Y = 2.70X+4.30	0.87* (n=9)
Nitrite	log Y =14.25X+3.66	0.88* (n=9)
Diversity of phytoplankton correlated with :	**Regression equation**	**Correlation coefficient**
Phosphate	D = - 2.20X+2.60	-0.80* (n=9)
Nitrite	D = -10.37X+3.01	-0.72**(n=9)

* Significant at the 99% level ** significant at the 95% level.

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P-I9

Fate and distribution of plankton in the Sea of Marmara

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ABSTRACT

In order to acquire a knowledge on the actual state and fate of marine plankton bimonthly water samples were collected from the Sea of Marmara, starting effectively in September 1985 till January 1987.

INTRODUCTION

There is a relative paucity of information concerning the composition and distribution of plankton in the near Bosphorus region. There exist some general background data on the phytoplankton species lists assembled by HRI (1974) for the Bosphorus region.

MATERIAL and METHODS

Plankton sampling was performed at 21 stations in the Bosphorus junction of the Sea of Marmara. Water samples were collected from three different depths (Surface, 10 and 30 m) with the aid of Nansen bottles and filtered on board through a net of 55 µm mesh size. Filtrates were then conserved using 4 % seawater-formalin solution. Enumeration and identification of planktonic organisms were made under an inverted microscope.

RESULTS and DISCUSSION

Remarkable variations both in the species composition and abundance of diatoms were observed throughout the research. Maximum diatom bloom observed in January 1986 followed by a second but relatively weak one in late summer during the first year. With the extension of sampling period to January 1987 a third but less abundant bloom than the first one was observed in October 1986. Among the three different sampling depths 10 m formed the most abundant layer in terms of diatom dominancy. In case of 30 m depth least abundant cells were found due to adverse affects emerging from the overlaying halocline.

Centric diatoms were found to predominate over the pennates (except in January 1986) throughout the sampling period. Relatively high levels of nutrients in the euphotic zone in January 1986 (BASTURK *et al.*, 1986) allowed *pennates* predominate over *centrics*. The marked reduction in phosphate (from 0.46 to 0.22 µg-at/l) occurred during January-March 1986 period associated with the concurrent diatom outburst. The relative contribution of centric diatoms to diatoms in general reached its maximum (92.3 %) in September 1985 and decreased to minimum (47.6 %) at surface in January 1986. Almost 75.7 % of the diatom species were found in their centric forms. Among the **constants** the two most important species were *Nitzschia seriata* CLEVE and *Rhizosolenia setigera* BRIGHT. For the vernal-serotinal species *Asterionella bleakeleyi* W.Sm., could be given. Among the **serotinal** species the major species were *Rhizosolenia fragilissima* BERGON and *R. styliformis* BRIGHT. In case of **hiemal** species *Rhizosolenia setigera* and *Nitzschia seriata* were found to be the most numerous and widely distributed species. In addition to the foregoing classification, *Chaetoceros affinis* LAUD., *Coscinodiscus centralis* EHR., and *Rhizosolenia stolterfothii* PERAG., can be given among the **autumnal** species.

Both the species richness **D** (Margalef's index) and species diversity **H'** (Shannon-Wiener diversity index) were found relatively high in March (2.30-3.06) and in October 1986 (2.23-2.97) whereas the proportional representation **J** (Pielou's evenness function) was found relatively low (0.96-0.91). In contrast, besides lower values of **D** and **H'** (1.33-2.56) a higher value of **J** (1.11) was obtained in November 1985.

Maximum levels of similarity were obtained in October 1986 between the depths of Surface-10 m (Jacc. coeff. = 0.8), 10-30 m (Jacc. coeff. = 0.78) and surface-30 m (Jacc. coeff. = 0.68). This phenomenon is also observed within adjacent water masses formed by the Sea of Marmara, the Bay of Izmit, Bosphorus and Golden Horn (UYSAL 1987).

Significant positive correlations (both of the variables exhibiting similar trends) were observed between phytoplankton - zooplankton ($P<0.05$) (as abundance), phytoplankton - plankton dry-weight ($P<0.01$), zooplankton - dry-weight, chlorophyll- dry-weight ($P<0.05$) and NO_2+NO_3 - $P-PO_4$ ($P<0.01$). Negative correlations were also found between chlorophyll - $P-PO_4$ ($P<0.01$) and $P.PO_4$ - humic matter ($P<0.05$). In addition to these, highly significant ($P<0.01$) negative correlations have been obtained for zooplankton (as abundance) versus $P-PO_4$ and NO_3+NO_2 with depth. It is also observed that temperature, salinity and dissolved oxygen display a major role in the vertical distribution of zooplankton in the region. Significant correlations were also observed in this sense.

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P-I10

A multiple regression model to determine abundance of Diatoms in a polluted area (Izmir Bay, Aegean Sea)

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ABSTRACT :

A density and nutrient based multiple regression model was developed to determine diatom abundance of polluted zones of Izmir Bay. The diatom abundance has been estimated by the model at 70 % success.

INTRODUCTION :

In pelagic ecosystems, variations in primary productivity basically depends on light, nutrients, water column stability and grazing by herbivores (BROWN and FIELD, 1986). However, when community structure of phytoplankters has begun to be affected negatively or positively by sewage and/or riverine inputs, the natural balance easily disappears.

Diatoms, which constitute an important portion of primary productivity and have been represented with many members in the groups of micro- and nanoplankton, often reach excessive amounts in favourable circumstances such as rich nutrient resources of eutrophicated areas and may cause secondary pollution by sedimentation of blooming materials especially in shallow bays. In such cases, increases of biomass in water body usually built upon a couple of dominant species. Interestingly, this situation has supplied an adventage for determining the relationships between diatom quantity and water quality parameters that are more pronounced than oligotrophic areas.

In the present study, the relationships between diatom biomass and physico-chemical parameters were investigated in a polluted area and a multiple regression model was developed to estimate the diatom abundance in certain conditions.

MATERIAL AND METHODS :

The samples examined were collected seasonally and vertically (down to 15 m., maximum depth of the sampling area) with a universal series water sampler from polluted zones of Inner bay between the years 1982-84 (FAO/UNEP,TR-7).

Temperature, salinity, pH, secchi disc, dissolved oxygen were measured in situ. The nitrogenous nutrients, phosphorus and silica were determined through use of the methods of STRICKLAND and PARSONS (1972).

Following species identifications and counts (CUPP,1943) product moment r and non-parametric Kendall's γ were estimated between cell counts and physico-chemicals. The multiple regression analyses were only applied to the parameters between which were found statistically significant relationships (SNEDECOR and COCHRAN,1967).

Tablo I : The results of multiple regression analysis.

i	βi	± 95 %C.I.	tcal	H1	Xi
1	-0.9217	0.2782	6.577	+	SIGMA-t
2	-0.6492	0.3074	4.192	+	lnN/P (µg-at/1)
3	-0.0221	0.0304	1.443	-	Si (µg-at/1)
n= 100		σ_y= 2.230		R^2 =0.708	
Y=lnDIA (cells/1)		$\sigma_{\hat{y}}$= 1.230		ttab (96 df)= 1.985	
α=37.3716		Fcal(reg)= 77.447		Ftab (reg)= 2.7	
SUCCESS= % 69.85		Fcal (R^2)= 57.481		Ftab (R^2)= 2.46	

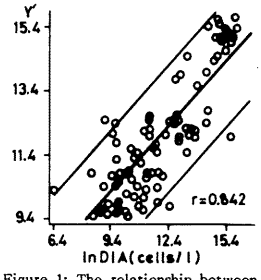

Figure 1: The relationship between observed and expected values (Y'= 0.708Y+3.536±0.203).

RESULT AND DISCUSSION :

Four minute diatom species, Nitzschia closterium (Ehrenberg) W.Smith, Leptocylindrus minimus Gran, Phaeodactylum tricornutum Bohlin and Thalassiosira rotula Meunier have played major role in the total biomass of diatoms at the polluted zones of Izmir Bay.

As summarized in Table I, there exist statistically significant linear relationships between treated nutrients, density and diatom quantity. In the model, σ_t, N/P and Si (may be neglected) may represent diatom abundance in the environment with 70 % success. The rest portion of 30 % most probably has changed with grazing by zooplankton and other unknown effects of pollution on the biota.

In Fig.1, deviations between observed and expected values to be obtained by the function of ln (Diatoms-cell/l)=-0.9217 σ_t-0.6492 ln (N/P)+0.0221 Si+37.3716 are plotted.

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P-I11

Sur la répartition quantitative du phytoplancton dans les eaux du littoral roumain de la mer Noire, dans les conditions de ses massifs développements estivaux

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La cartographie des quantités de phytoplancton pendant la période des poussées estivales des dernières années (1984-1987) met en évidence de grandes densités et biomasses dans toutes les zones du littoral roumain, supérieures surtout aux endroits où a lieu soit un contact modéré entre les eaux de mer et continentales, soit un intense impact anthropique direct sur le milieu pontique (fig. 1).

Un intérêt particulier revient au mode de distribution du phytoplancton dans l'espace du littoral roumain durant la période immédiatement antérieure au développement d'un phénomène de floraison dans les eaux côtières de Constantza, où la dynamique des processus est sous notre observations permanente. La carte de répartition (fig. 1A) met en relief la présence dans les secteurs de Portitza et Chituc, surtout à environ 15 milles à l'est de Portitza, de certaines quantités d'algues accrues par rapport aux autres secteurs. A cet endroit, le 10 juillet 1984, la densité et la biomasse du phytoplancton total ($13,4 \times 10^6$ cell.l^{-1}, 113,5 g.m^{-3}) étaient nettement supérieures aux valeurs enregistrées à une distance de 40 milles vers le sud-est, dans les eaux de Constantza (41×10^4 cell.l^{-1}, 2,3 g.m^{-3}); les espèces florissantes Prorocentrum cordatum et Cerataulina pelagica réalisaient leurs maximums pour la période respective au même endroit du secteur Portitza ($1,3 \times 10^6$ et $4,5 \times 10^6$ cell.l^{-1}, comparativement à seulement 10×10^3 et 12×10^3 cell.l^{-1} à Constantza). Après à peine trois jours pour Prorocentrum et quatre jours pour Cerataulina, les valeurs enregistrées le 10 juillet à Portitza étaient dépassées dans les eaux de Constantza, les développements des espèces mentionnées prenant, ici aussi, le cours de la floraison.

Les données présentées suggèrent que le foyer (ou l'un des foyers) d'initiation de la floraison de juillet 1984, se situe devant Portitza, où les fréquentes diminutions de la salinité de surface (de 15-16 à 9-11‰), ainsi que les différences entre les valeurs des différents horizons bathymétriques (presque 18‰ à 5-10 m) ont un effet stimulant pour le développement algal(3). Depuis cette zone d'influence danubienne - exercée par le courant cyclonal nord-sud, mais aussi par les écoulements du complexe lagunaire Razelm-Sinoe où débouche toujours le Danube -, les masses d'eaux dessalées et chaudes, riches en phytoplancton, ont été poussées par les vents prédominants du nord et du nord-est vers la côte de Constantza, au voisinage de laquelle les peuplements d'algues florissantes se sont développés aux dépens du stock important de nutrients.

La partie centrale du littoral roumain, comprenant les secteurs soumis à une dessalure modérée - Portitza et Chituc - apparaît sur plusieurs cartes de répartition du phytoplancton comme l'une des zones les plus riches en algues de notre côte (fig. 1 A - D). L'une des raisons majeures liées à ce fait étant la diminution de la salinité, notons que, comme nous l'avons déjà constaté (3), de nombreuses espèces marines et saumâtres, particulièrement euryhalines, se développent normalement dans les secteurs affectés par la dessalure, étant même intensément stimulées par ces conditions halines. Ce fait a été observé par d'autres auteurs, dans d'autres zones marines semblables (1, 4). Dans le cas des espèces qui vivent en mer Noire, cette caractéristique a été accentuée par les longs processus d'adaptation et sélection à la condition générale de salinité réduite, processus auxquels ont été soumises les algues planctoniques dès leur pénétration dans le bassin pontique, après la rupture du seuil bosphorique (3).

On remarque aussi que les températures élevées de la couche superficielle saumâtre sont stimulantes pour les espèces estivales, l'apport important d'éléments nutritifs terrigènes assurant le bon développement des algues.

Précisons cependant que les secteurs dessalés situés directement au voisinage des embouchures du Danube n'ont pas les mêmes caractéristiques car ces aires, malgré leur richesse en nutrients, ne sont pas les plus riches en phytoplancton. Les grandes quantités d'éléments solides apportés par les eaux fluviales, par leur rôle traumatisant et leur rôle d'écran pour la lumière, ont un effet destructif sur la microflore (2); de même les salinités, qui dans le proche voisinage des embouchures du Danube tombent quelque-fois au-dessous de 2-5‰, sont trop faibles pour permettre un bon développement des formes marines.

Un autre secteur favorable au développement maximal du phytoplancton est l'étroite zone située à 2-5 milles près de la côte de Constantza; ce secteur est fortement soumis à l'influence anthropique liée au voisinage urbain, portuaire et industriel (fig. 1B-D). Comparativement aux quantités de phytoplancton du sud de Constantza (et, bien sûr, du large), celles-ci sont nettement supérieures, ce qui concorde avec la teneur supérieure en nitrates et phosphates de l'eau de mer.

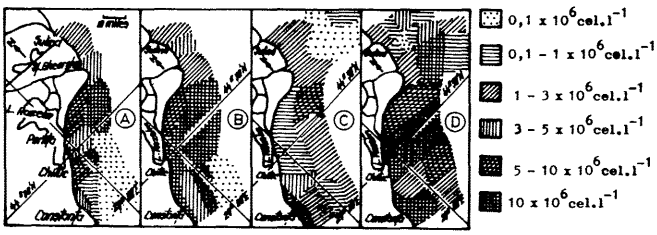

Fig. 1 - Distribution des valeurs de densité numérique pendant les périodes 3-11.VII.1984(A), 8-19.V.1986(B), 3-8.VII.1986 (C) et 17-30.VII.1987(D).

En résumé, l'étude de la répartition du phytoplancton de surface a permis d'observer de grandes quantités sur toute l'étendue du littoral roumain. Ces valeurs sont généralement les plus élevées dans la zone Portitza - Chituc jusqu'à environ 15 milles de la côte (effet stimulant des diminutions de salinité et des augmentations de températures favorisé par le contact modéré entre les eaux pontiques et continentales) et aussi dans la zone de Constantza, jusqu'à 2-5 milles de la côte (intense influence anthropique aboutissant à de grands stocks de nutrients).

En ce qui concerne la répartition verticale du phytoplancton pendant les périodes de développemnt massif estival, les quantités maximales se trouvent dans les couches supperficielles, les différences entre les densités numériques (cell.l^{-1}) du niveau 0 m et celles plus profondes pouvant être de 1-2 ordres de grandeur. La masse algale dense, produite à la surface constitue elle-même, par l'effet d'écran, le facteur limitatif majeur du développement algal en profondeur.

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P-I12

Sur le rôle des poussées de février-avril dans la dynamique multiannuelle du phytoplancton du littoral roumain de la mer Noire

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En raison des fluctuations des facteurs du milieu, le phytoplancton du littoral roumain subit d'amples variations quantitatives, d'une année à l'autre. On note des différences de densités, de biomasses globales, d'amplitude des oscillations des paramètres respectifs et des moments où celles-ci se réalisent. On note aussi des différences entre les nombres des poussées et les mois où elles se produisent. Enfin, le maximum annuel ne se produit pas toujours à la meme saison.

L'analyse de plus de 2000 échantillons de phytoplancton, prélevés mensuellement en 1972-1973 et 1975-1980 à l'est de Constantza (cinq stations permanentes situées à une distance de 1 à 30 milles de la côte), montre que les maximums annuels se sont produits pendant trois ans en février-avril, pendant trois autres années en juin-août, et au cours des deux autres années en septembre-octobre. Les maximums annuels enregistrés en février-avril ont été supérieurs à ceux des autres saisons.

La masse algale produite en février-avril est formée principalement de diatomées de petites tailles (Sceletonema, Chaetoceros, Detonula), capables de proliférer en conditions de température et lumière réduites et de profiter au maximum pendant la période donnée des maxima annuels de nutrients, réalisant, dans toute l'épaisseur de la couche d'eau, les poussées les plus persistantes de l'année. La durée prolongée de ces premières poussées de l'année (pratiquement ininterrompue de février à avril et quelquefois jusqu'en mai, comme en 1980), ainsi que leur extension en profondeur, contribuent au fait que la masse algale produite au cours des développements respectifs ait un rôle important sur les niveaux des quantités annuelles de phytoplancton. C'est la raison pour laquelle l'ampleur des poussées de février-avril se reflète plus ou moins sur la valeur des moyennes annuelles du phytoplancton (fig. 1). Ce fait a été observé aussi sur le littoral bulgare de la mer (4).

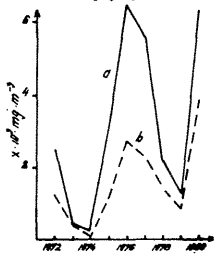

Fig. 1 -Dynamique des rapports entre les biomasses moyennes de fevrier-avril(a)et les biomasses moyennes annuelles (b).

L'importance des poussées de février-avril suggère que les variations quantitatives du phytoplancton total, d'une année à l'autre, dépendent en grande partie du niveau de ces poussées. Par conséquent, pour le déterminisme de l'évolution quantitative annuelle et multiannuelle du phytoplancton, l'important est la connaissance des causes majeures pour lesquelles les poussées respectives diffèrent en ampleur au cours des années.

Dans la série des facteurs du milieu qui agissent sur la production primaire, ce qui attire l'attention c'est la présence, pendant la saison froide, d'un facteur destructif de l'algoflore; intenses tempêtes d'hiver, dont la durée empêche le maintien d'un déroulement intensif du développement, tant par le transport des cellules algales vers le fond, que par leur destruction mécanique sous l'action des substances minérales en mouvement. On s'attend donc, pendant les hivers à fortes tempêtes, à ce que les poussées de février-avril soient plus réduites qu'en conditions plus calmes.

On a regroupé les années en deux catégories selon la durée des vents de vitesse minimale de 13 m/s: moins de 5 jours pendant l'intervalle décembre-mars, ou de 8 à 13 jours. En analysant ces catégories d'années par rapport aux principales données quantitatives du phytoplancton (tableau 1), on constate que, pendant les années où les hivers ont des tempêtes de courte durée, les maximums annuels sont enregistrés en février-avril; c'est au cours de ces mêmes années que se produisent aussi les plus grandes quantités annuelles d'algues planctoniques.

Tableau 1

Groupe des années	Années	Mois des poussées: Maximum annuel	Mois des poussées: Autres poussées	Densité (1000 cell.l^{-1}): Poussée de printemps (moyenne mensuelle)	Densité (1000 cell.l^{-1}): Moyenne annuelle	Biomasse (mg.m^{-3}): Poussée de printemps (moyenne mensuelle)	Biomasse (mg.m^{-3}): Moyenne annuelle
Années avec hivers	1976	III	VI,XI	6874	1203	11920	2787
à tempêtes de courte	1977	II	IV,IX	2554	531	9610	2302
durée	1980	IV-V	VIII	11192	1295	15870	3848
Années avec hivers	1972	VIII-IX	III	1021	408	5995	1231
à tempêtes de	1973	VI	II	268	161	517	400
longue durée	1975	VI	III,IX	601	419	5581	1124
	1978	IX	IV,VI,XII	289	142	4274	1421
	1979	X	IV	2033	775	2878	860

Certes, pour les valeurs annuelles des quantités de phytoplancton les poussées d'été, ni même celles d'automne, ne sont point négligeables, les floraisons estivales des péridiniens et d'autres flagellés de la couche superficielle étant extrêmement intenses (1). Les faibles valeurs obtenues sur le profil de Constantza tiennent peut-être en partie au fait que les divers prélèvements réalisés à un mois d'intervalle, n'ont pas permis d'observer certaines floraisons intenses mais éphémères. Les développements massifs de l'été, surtout ceux des péridiniens et des autres flagellés, se produisent dans une couche mince à la surface de l'eau, tandis que ceux des diatomées en février-avril se produisent pratiquement dans la couche photique. Les valeurs estivales, très importantes en surface, ne ressortent pas des données car elles sont masquées par les valeurs moyennes obtenues pour toute la couche étudiée (moyennes nécessaires à l'étude de la dynamique quantitative). Par contre, les moyennes de la saison froide correspondent pratiquement aux valeurs absolues car la répartition verticale est plus homogène. Cependant, les moyennes des mois où ont eu lieu les poussées estivales (des années 1972, 1975 et 1976) variant entre 1,2x 10^6 et 1,8 x 10^6 cell.l^{-1} pour la couche d'eau 0-50 m sur le profil est Constantza, sont nettement supérieures aux moyennes des années soixante pour la même couche d'eau (1); ce fait met en évidence aussi le renforcement du processus d'eutrophisation dans la partie ouest de la mer Noire pendant la décennie 8 (1, 2).

Nos constatations, concernant le rôle de la durée des fortes tempêtes d'hiver sur l'ampleur des poussées algales de février-avril du littoral roumain de la mer Noire, convergent pour l'essentiel avec celles de MASHTAKOVA pour le nord-ouest du même bassin (2). Elles permettent une meilleure compréhension des processus de la dynamique du phytoplancton, qui subit l'influence spatio-temporelle de nombreux facteurs, lesquels ne peuvent pas toujours être mesurés en totalité et interfèrent avec effet contradictoire, rendant difficile l'explicitation des phénomènes dans leur ensemble. La confirmation des constatations respectives, par la répétition des phénomènes signalés ci-dessus comme étant en interrelations causales, constituerait la base des prévisions de la production annuelle de phytoplancton, en fonction de la durée des grandes tempêtes d'hiver et de l'ampleur des poussées de février-avril.

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Dynamique du développement quantitatif de Noctiluca miliaris Sur. dans les eaux roumaines de la mer Noire

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L'évolution du développement quantitatif de Noctiluca miliaris Sur. a été étudiée d'après l'examen d'échantillons planctoniques recueillis pendant 23 ans (1959-1965 et 1970-1986) dans les eaux du plateau continental du littoral roumain de la mer Noire.

Plus de 1990 stations ont été prospectées dans cette zone marine, de l'isobathe de 3 m, jusqu'à 50 milles marines au large.

L'analyse de ces très nombreuses données nous a permis de mettre en évidence durant ce laps de temps une variabilité remarquable dans le déroulement du développement quantitatif de Noctiluca.

Entre 1958 et 1979 l'évolution de l'espèce s'est caractérisée par une croissance de son stock, continuelle et de petite ampleur. A partir de 1980 et jusqu'en 1986 on a assisté à un développement quantitatif explosif de Noctiluca, les valeurs moyennes multiannuelles de ses densités et biomasses étant 13 fois plus élevées que celles des années précédentes (1970-1974), (tableau).

Tableau. Moyenne des biomasses ($mg.m^{-3}$) et densités ($ind.m^{-3}$) de Noctiluca miliaris

Saisons	Années 1958 - 1959 ind.	mg.	1961 - 1965 ind.	mg.	1970 - 1974 ind.	mg.	1975 - 1979 ind.	mg.	1980 - 1986 ind.	mg.
Hiver	270	21,600	-	-	3838	307,005	3710	296,791	36675	2932,773
Printemps	2525	201,982	2357	188,573	7509	572,159	4318	344,823	9810	785,237
Eté	9120	729,608	4326	348,591	2104	168,169	4872	389,823	103086	8403,495
Automne	-	-	-	-	1705	136,365	1237	99,011	42229	3374,697
An	-	-	-	-	3794	296,425	3508	280,467	47776	3859,905

De même que dans d'autres aires marines soumises à l'influence des eaux fluviales (2), entre les années 1980 et 1986 la croissance rapide du niveau d'eutrophisation des eaux de la partie nord-ouest de la mer Noire (3), et l'accroissement du développement du phytoplancton (Sceletonema costatum Grun, Cyclotella caspia Grun, Exuviaella cordata Ostf et Eutreptia lanowii Steuer avec des densités entre 16 et 141 mil.cellules.l^{-1}), (1), ont eu des conséquences profondes sur l'écosystème pélagique pontique en général et sur Noctiluca en particulier.

L'étude des oscillations de l'espèce en 1980-1986 met aussi en évidence le phénomène d'augmentation des abondances saisonnières, par rapport à celles des années antérieures, exception faite le printemps où le développement de Noctiluca a été moins spectaculaire (quantités moindres en mars et avril). L'intensification de son développement commence au mois de mai, au moment des crues printanières du Danube dont les eaux sont riches en sels minéraux (phosphates et nitrates), en matières organiques et en d'autres substances allochtones provoquant ainsi les premières "floraisons" phytoplanctoniques dont Noctiluca se nourrit.

Le déclenchement de la poussée la plus intense de Noctiluca coïncide avec le début estival de l'échauffement des eaux de surface. Les valeurs moyennes minimales des biomasses et des densités ne sont pas descendues en juin 1980-1986 au-dessous de 2,1 $g.m^{-3}$ et 26.10^3 individus par m^3, tandis que les maximales ont atteint 42,2 $g.m^{-3}$ et 527.10^3 individus par m^3. Durant les années antérieures le stock de cette espèce a été une seule fois égal à 2,0 $g.m^{-3}$ et 25.10^3 (juin 1975).

Des valeurs élevées ont été trouvées pour Noctiluca pendant le mois de juillet de toutes les années entre 1980 et 1986. Si en 1981 ses densités et biomasses ont dépassé 203.10^3 $ind.m^{-3}$ et 16,3 $g.m^{-3}$, en 1982 et 1983 elles ont été de 140.10^3 $ind.m^{-3}$ et 11,2 $g.m^{-3}$, respectivement 183.10^3 ind. et 17,2 $g.m^{-3}$. En juillet 1986 le stock de Noctiluca a atteint les valeurs colossales de 582.10^3 ind. et 46,6 $g.m^{-3}$.

Le développement exceptionnellement grand de Noctiluca pendant les dernières années, dû aux apports en sels nutritifs fluviaux induisant la croissance du phytoplancton dont il se nourrit a eu comme résultat la croissance de la biomasse générale du zooplancton dans les eaux de la partie ouest de la mer Noire. Du point de vue pondéral l'espèce a dépassé fréquemment 90-95 % de la biomasse annuelle de celui-ci. Noctiluca a représenté en outre une source de substance organique qui, par le processus de décomposition a eu un rôle important dans l'apparition pendant ces dernières années des phénomènes d'hypoxie ou même d'anoxie des eaux de la zone côtière.

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P-I14

Monitoring on phytoplankton in Mussel culture area along the Bulgarian Black Sea Coast

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Highly mechanized technology for suspendet mussel (Mytilus galloprovincialis Lmk) culture was elaborated in Sozopol area where a model farm with annual production 200-300 t/a is under exploatation. At Nessebar another farm (300-400 t/a) is under construction. Collectors are submerget into the water in June ; spat attachment takes place in June-July(7). With the intensive summer and autumn growth it is possible to commence harvest in December when most of the mussels reach market size above 40 mm. Harvesting goes on until next May.
Bott grouth and physiological parameters of the culture are under regular control and checking for heavy metal concentrations and microbiological condition of the mussels is also made. The nutritive phytoplankton was surveyed and much attention payed to species suspected for toxicity.
Monitoring on phytoplankton in the mussels culture area was carried out monthly, while in the three-mile coastal belt between Cape Emine -Maslen Nos it was conducted seasonally.
Taxonomi phytoplankton similarity between the culture area off Sosopol(100%) and the three-mile zone off Cape Emine is higher for the diatoms(75%) and the dinoflagellates(77%) than off Maslen Nos(62% and 61% respectively) because the constant curents in the large Bourgas Bay unify the species diversity.
The percentage ratio for species and quantity characteristics of Bacillariophyta and Dinophyta (table 1) shows that in the period of intensive mussel grouth (summer-autumn) Dinophyta dominate in quality and quantity, especially in autumn 1985-1987 and in summer-autumn 1987 with high trophic impact on mussel grouth. The intensive bloom of not toxic dinoflagellate Exuviaella cordata and diatom alge Rhizosolenia fragilissima (6 and 9 g/m^3 resp.) in June 1986 delayed spat settlement but it stimulated mussel grouth by diminishing elimination of prymary settlement. The average mussel yield reached 12,3 kg/m of rope compared to 6,7 kg/m of rope for the period 1980-1985. The mean mussel length was over 50 mm. In this period(summer-autumn)occurrence of suspected toxic dinoflagellates could be expected though for the Black Sea flora only one toxic alge - the chrysomonad Prymnesium parvum Car. is known(2,4,6). High concentration of this species by the end of summer 1959 are cited from Varna lakes where all Invertebrata and fish died.
Until now we have no observations on other toxic phytoplankton displays. References exist that the Black Sea phytoplankton includes species that are toxic in other seas and oceans but not having, until now, toxicity in the Black Sea : Prorocentrum micans, Dinophysis acuminata, Peridinium(Heterocapsa)triquetrum etc.(1,3,5,8,9,10). By an effective monitoring on phytoplankton in mussel culture areas, even at toxic DSP(Diarrhetic Shellfish Poison)concentrations, those would be not dangerous, because, according to Kat M.(1) toxins are eliminated from mussels in about 4 weeks after "red tide" autbreak; the mussels can be consumed safely and harvesting resumed.
In harvest period(winter-spring, December-May) the percentage ratio of phytoplankton species and quantity shows winter dominance of diatoms (table 1) and co-development of diatoms and dinoflagellate in spring. At that time high abundance of suspected toxic species is rather doubtful. Attention should be paid to the dynamics of Peridinium triquetrum occurring in cold waters.

Table 1. Taxonomic (number of species in %) and quantity (mg/m^3 in %) characteristics of phytoplankton, mussel farm, Sozopol

year	1985				1986				1987			
season	win	spr	sum	aut	win	spr	sum	aut	win	spr	sum	aut
Bacillariophyta	100		33	20	67	27	55	50	50	50	42	28
	100		49	1	96	55	79	75	75	10	1	7
Dinophyta		100	55	80	33	63	33	50	40	50	58	72
		100	46	99	4	41	19	25	24	90	99	93
Chrysophyta Coccolithophorida			12			10	12					
			5			4	2					
Silicoflagellata									10			
									1			

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Influence of solar activity upon the Diatoms of Black Sea plankton

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The interest towards investigation of the interrelations in the system solar activity - magnetosphere - biosphere grew rapidly due to its possibility to serve for bioprognosis through statistical analysis of solar and geomagnetic activity upon biosphere.
Monitoring of the phytoplankton dynamics in the Bulgarian Black Sea economic zone has been performed annually since 1954 by standard expeditional scheme of up to 30-40 mile profiles in 3-month periods and 34-year repeatibility period in more than 1200 stations of up to 200 m depth. The results of more than 6000 samples have been collected in informative banks for cells number($10^6/m^3$) and biomass(mg/m^3)(6). Through the process of investigation we established 5-year cycles in the phytoplankton biomass dynamics but in our opinion these were connected with the hydrological conditions of seawater environment(4,5).
The subject of this investigation is the possible influence of solar activity upon the diatoms flora in the Black Sea plankton. The investigation of its dynamics within the period 1954-1987 completely coincides with three 11-year cycles of sun-spots : 19-21 cycle by the Zürich numeration.

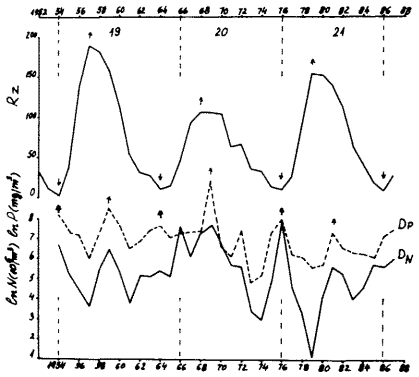

Fig.1. Variations of the average annual parameters - cell number (N $10^6/m^3$) and biomass($P mg/m^3$) of diatoms(D_N, D_p) compared to the variations of the sun-spots(Rz)

Within the temporal variations of the investigated parameters of diatom flora(fig.1) we observed peculiar dependency upon solar activity : throughout one 11-year cycle we found two clearly expessed peaks, the first being 1-2 years late in relation to the Rz sun-spots peak and the second coincides with the Rz minimum. This variation is very well expressed for a 5-year approximate period; the local diatom peaks occur at comparatively quiet conditions of solar activity as in 1972.
To confirm this period we used spectral analysis of the temporal lines in order to draw periodic amplitude graphs(1) at 3-month discrete interval. Basic periods in the interval investigated were 11,1 and 5,3 years for solar activity(2) and the periods 4,45 and 7,6 were considered to be amplitude modulation(fig.2). The analysis showed that the solar activity cycle for about 11,1 years was reflected in the dynamics of the diatoms by 10,5 - 10,8-years periods. In their temporal lines the variation of 5,5 - 5,6 years is basic while the accompanying periods T_1=6,65 and T_2=4,45-4,5 are results of amplitude modulation with modulation period of about 22 years. For its reliable detection within the spectrum we need mor data, however its presence in the solar activity is well expressed(2), especially in the solar corpuscular radiation and interplanetary magnetic field and the resulting geomagnetic field variations(3).

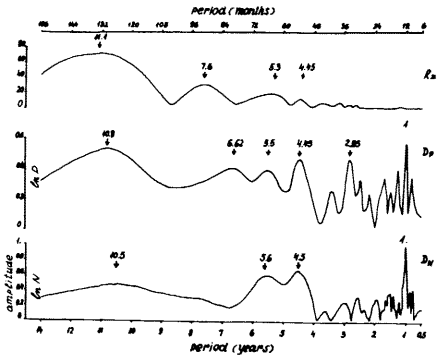

Fig.2. Amplitude spectra of the average annual temporal lines(ln N, ln P) of diatoms(D_N, D_p) compared to the same of sun-spots(Rz)

CONCLUSIONS : Solar activity influences diatom plankton flora through 5,5 - 5,6 years periods, exactly shown on fig.1 and fig.2 and through 11,1 years period(fig.2), and through 22-year period indirectly detected by complex demodulation(fig.2). The two-maximum diatoms' distribution provides possibilities for making bioprognosis about the maximums and the blooming in the following 22nd solar cycle. The Rz maximum is expected at the beginnung of 1990(7). We can expect minimal cell number and biomass in 1990 and the maximal is to be expected in 1991 - 1992.

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Approximation to Chlorophyll-a distribution in the Balearic Sea (Northern Mediterranean)

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An oceanographic project aimed at investigating hydrological conditions and production in the Western Mediterranean, which includes the so-called Balearic Sea, is in progress. Parameters directly related to phytoplankton primary production are presently being measured.

Chlorophyll-a levels were determined by spectrophotometric methods, using acetone as solvent. Concentrations were estimated with Jeffrey & Humphrey's (1975) equations. Preliminary results on measurements of primary production (ESTRADA, 1981) are also included.

This contribution discusses preliminary results on abundance and evolution of phytoplankton biomass expressed as mg chl-a/m3 of the photic layer (0-100m). Data are based on three samplings (March, May and September 1987) which correspond to clearly differentiated hydrographic situations. For each sampling a total of 30 stations were visited.

Variations observed in the distribution profile of the mean concentration of pigments for all stations in the three annual periods studied are represented in Fig.1.

The descent of the maximum of chlorophyll-a over time is a consequence of the stratification process, which results in an impoverishement of the layers above the thermocline. This phenomenon had been previously described (ESTRADA, 1985).

In March, prior to the formation of the thermocline, chl-a maxima are found between 30 and 50 m. When determining primary production a reduction of photosynthetic efficiency below the stated depths (Fig.2) is noticed, which is due either to the accumulation of biomass from above or as a result of low light intensity. As values for the ratio D430/D664 throughout the water column are similar, the second alternative is more probable. We should also point out that this increment in chl-a concentration may represent an increment in the concentration per cell rather than that of phytoplankton biomass.

Pigment distribution exhibits a marked seasonality imposed by the alternation of stratification and mixing periods. This variation in the distribution profile is quantitative as well as qualitative. Fig.3 represents increment in quantity of chl-a with increasing depth of the water column. Slope variations of the curve represent variations in the cumulative gradient of pigment distribution as a result of discontinuities of factors limiting production and phytoplankton biomass.

Variations observed in the distribution of weighted averages of chlorophyll concentration for a column of water between 0 and 75 m depth in the three annual periods studied (Fig.4), are a function of the vertical distribution of the limiting factors, which are themselves related to the season of the year, to the hidrographic situation of the different masses of water and to their thermohaline cycling.

As a result of the stabilization of the surface layers a displacement of maxima of chlorophyll abundance towards the SW of the Balearic archipelago can be observed, as well as a generalized impoverishment with reduction in chlorophyll related levels.

The slight increase in summer biomass values in this area may be attributed to the presence of waters of Atlantic origin which penetrate along the channels between the islands (FONT, 1986).

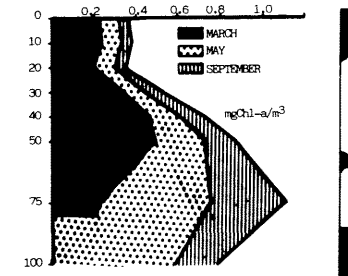

Fig.1. Distribution profile of the mean concentration of pigments (mg Chl-a/m^3).

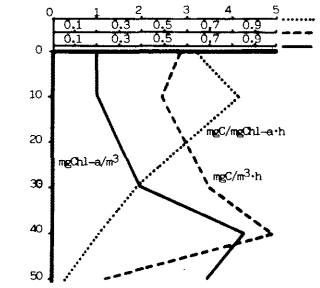

Fig.2. Distribution profile of photosynthetic efficiency in March.

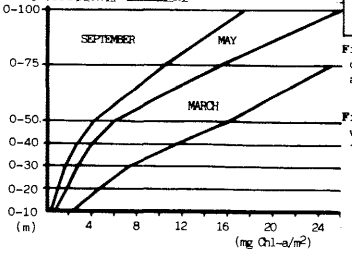

Fig.3. Increment in quantity of Chl-a with increasing depth (mg Chl-a/m^2) of the water column.

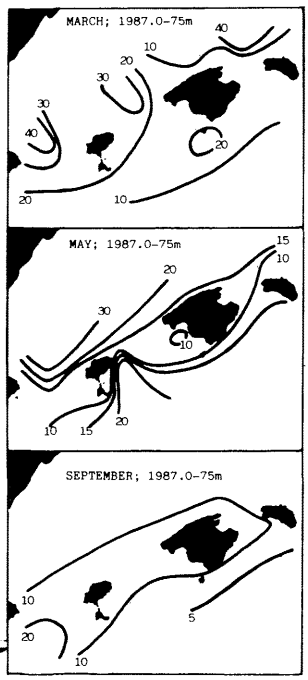

Fig.4. Distribution over time and space of pigment levels, expressed as mgChl-a/m^2 (0-75 m).

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P-I17

La biomasse phytoplanctonique en mer de Monaco. Distribution spatiale et variations saisonnières des teneurs en chlorophylle "a"

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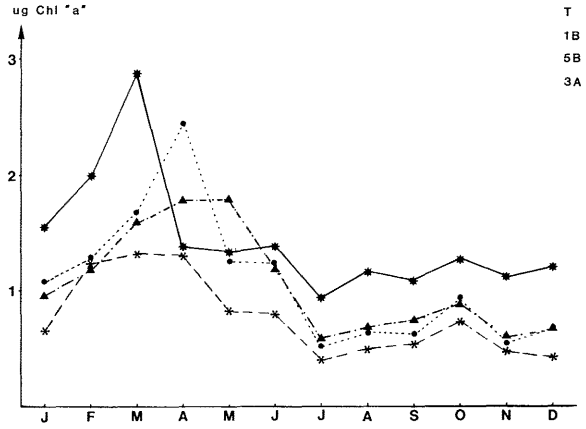
Le phytoplancton de la mer de Monaco a été étudié par NATHANSOHN, PAVILLARD, BERNARD & FAGE et BERNARD entre 1907 et 1914. Ils ont souligné l'effet des vents côtiers et de la pluie sur la fertilité superficielle à Monaco. On décrit dans ce travail les résultats obtenus en mesurant par fluorescence les teneurs en chlorophylle "a" et en pheophytine "a". Suivant la méthode de J. NEVEUX, l'étalonnage est réalisé avec de la chlorophylle "a" pure.

Les prélèvements d'eau ont été faits tous les quinze jours entre octobre 1978 et décembre 1983 aux profondeurs standards à quatre stations ; trois sur le plateau continental (IB, 3A, 5B) et une à 6,5 milles de Monaco, considérée comme Témoin (T).

Teneurs moyennes mensuelles en chlorophylle "a" sur cinq ans



A partir des mesures obtenues aux profondeurs standards, on a calculé par intégration linéaire la concentration en chlorophylle "a" contenue, à chaque station, dans une colonne d'eau de 1cm2 de section et d'une longueur égale à la hauteur d'eau échantillonnée, soit 50 m en 3A, 80 m en Ib et 5Bn 200 m au T.

Les cycles annuels moyens pour chaque station sont classiques, avec un pic de chlorophylle à la fin de l'hiver (mars) un minimum en juillet et un deuxième pic de très faible amplitude en octobre. Généralement, les teneurs en chlorophylle "a" au début de l'hiver (janvier) comme à la fin du printemps (mai-juin) sont du même ordre de grandeur qu'en automne. Le pic printanier de chlorophylle "a" est plus précoce au large qu'à la côte. Il dure un mois (mars) au large, 2 à 3 mois (mars à mai) à la côte.

Les pics printaniers observés chaque année, entre octobre 1978 et décembre 1983, diffèrent tant en importance qu'en durée. Ils sont nettement plus importants en 1980, à toutes les stations et en 1983, au large. L'observation la plus remarquable est les faibles teneurs mesurées au printemps 1981. Cette époque est caractérisée par une salinité anormalement élevée (N. Bethoux et al., 1983), conséquence du déficit en précipitation observé en automne et hiver 1980-1981 et de l'absence de neige. Ces fortes salinité pourraient donc être à l'origine d'une limitation du développement du phytoplancton.

La comparaison statistique des stations entre elles a d'abord été faite à partir des teneurs moyennes en chlorophylle "a" et phéophytine "a". Elle montre que pour les couples de stations T-1B et T-5B et à un moindre degré pour le couple T-3A, les moyennes sont significativement différentes au seuil 5%., mais que pour le couple 3A-5B la différence n'est pas significative. L'application du test de MANN-WHITNEY-WILCOXON, de la méthode des couples et du test T de WILCOXON conclut également à une différence significative entre la station T et les côtières.

Les stations ont été également comparées en calculant les coefficients de corrélation sur les contenus de la colonne d'eau en chlorophylle "a" et phéophytine "a". On constate une très bonne corrélation entre les stations 5B et 3A et 5B et 1B et une très faible entre les stations côtières et la station témoin.

L'étude des teneurs en chlorophylle "a" et phéophytine "a" en mer de Monaco a montré que :

- des différences significatives existent entre la zone côtière et une zone située à 6,5 miles de la côte. Au printemps ces différences s'observent aussi bien sur la date d'apparition du pic de chlorophylle que sur sa durée ;
- à la côte, l'inégalité des distances entre les stations explique les quelques différences observées.
- les pics printaniers diffèrent d'une année à l'autre. Deux maximums de biomasse phytoplanctonique ont été enregistrés en 1980 et 1983 alors qu'en 1981 la biomasse était minimum. Ce minimum est observé à la suite d'un automne sec et d'un hiver sec et sans neige.

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P-I18

Observations on the relative contribution of pico- and nanoplankton to the subsurface chlorophyll maximum in the Northern Adriatic Sea

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SUMMARY

A reconnaissance of the characteristics of the picoplankton depth distribution, along both east-west and north-south trophic gradients, indicated that while picoplankton were responsible for the increase in chlorophyll a with depth, that picoplankton cell densities were greatest in surface layers. Great caution is urged in inferring picoplankton biomass distribution from fluorescence data alone.

The northern Adriatic is a shallow region under the eutrophicating influence of the Po and other northern Italian rivers. Their influence cause pronounced east to west gradients in chlorophyll a concentrations. Vertical gradients also create a pronounced subsurface chlorophyll maximum. Two questions attract attention: are picoplankton responsible for the subsurface chlorophyll maximum, and are picoplankton more abundant in that maximum? Therefore, reconnaissance cruises were conducted in the Adriatic in 1986 and 1987 to evaluate phytoplankton size class contribution to the maximum. These data, herewith analyzed, preliminarily assess the relative contribution of phototrophic nano- and picoplankton to the subsurface chlorophyll maximum in the region.

Sampling was conducted at stations selected to sample decreasing trophic gradients eastward from the Po Delta, Italy to the Istrian Peninsula, Yugoslavia, and southward toward the Central Adriatic. Seawater for physical/chemical parameters, chlorophyll a concentrations, and cell densities was collected throughout the watercolumn. Biological samples were fixed with glutaraldehyde or acetic Lugol solution, some decolored and stained with DAPI or FITC, and after appropriate filtration enumerated microscopically at 640 X or 1000X by epifluorescence.

The data verified the presence of a subsurface chlorophyll maximum in the northern Adriatic under summer stratified conditions. The top of the maximum (2 X surface concentrations) occurred near 20 meters in the northern Adriatic and deepened to about 45 meters southward. The highest chlorophyll concentrations occurred well above the bottom at 20-25 meters at northernmost stations, and deepened to near bottom depths at the southernmost stations.

Increases in the vertical distribution of chlorophyll were associated with a nutricline which occurred at 15-20 meters at most shallow stations, deepened to 25-30 meters eastward, and to 35-40 meters southward. Significantly the nutricline was not closely associated with the pycnocline, clearly implicating autotrophic consumption in its formation. This is in direct contrast with the deep chlorophyll maximum of oceanic regions, where the nutricline is frequently associated with a decrease in vertical stability (e.g. Vandevelde et al., 1987).

The subsurface chlorophyll layer, (ca. 35 to 65 m at deep stations) resulted from increases in all three size classes studied, (>20 µm, 20 - 3 µm, <3 µm). But at all stations the picoplankton made the largest contribution to water column chlorophyll, ranging from a mean of 46% at northernmost stations to 75 - 85% at southernmost stations. Noteworthy, picoplankton made significant contributions to chlorophyll concentrations at all depths in contrast to the micro- and nanoplankton which were concentrated near the bottom of the water column. Increases in relative contributions to the subsurface chlorophyll maximum were inversely related to size at the deeper stations. Increases in picoplankton contributions occurred shallower than nanoplankton increases, which in turn were shallower than microplankton increases.

Since nutrients were non-limiting at the depths of the subsurface chlorophyll maximum, this distribution suggests that the relative increases of chlorophyll a in the three size classes were light controlled. This is contrary to the assumption that picoplankton are particularly adapted to growth at lower light intensities than nano- or microplankton.

The water column phototrophic picoplankton were predominantly chroococcoid phycoerythrin containing cyanobacteria, while the larger nano- and microplankton were predominantly eukaryotes.

The vertical distribution of chlorophyll concentrated in the picoplankton fraction, would imply that picoplankton dominated in the subsurface chlorophyll maximum. However, the data on phototrophic cell numbers, and derived total cell volume, established that this was not the case. In marked contrast to the vertical distribution of picoplankton chlorophyll a, picoplankton clearly dominated total cell volumes in surface waters at both shallow and deep stations. In direct contrast total nanoplankton cell volumes were always highest near the bottom of the subsurface chlorophyll maximum.

CONCLUSIONS

- the subsurface chlorophyll maximum, characteristic of the northern Adriatic under stratified water column conditions, is caused by increases in picoplankton chlorophyll a; however,
- picoplankton cell densities dominate in the surface layers, exceeding densities in the chlorophyll maximum layer;
- the difference between the vertical distribution of picoplankton chlorophyll, and picoplankton cell densities, results from depth differences in fluorescent intensity which bias epifluorescent enumeration;
- great caution should be exercised in interpreting the vertical distribution of phytoplankton biomass from pigment data alone ... confirmation from cell density is strongly urged;
- lastly, the subsurface chlorophyll maximum is dominated by nanoplankton with a mean cell size of 4 - 8 µm.

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P

Deep Chlorophyll maximum in the Adriatic

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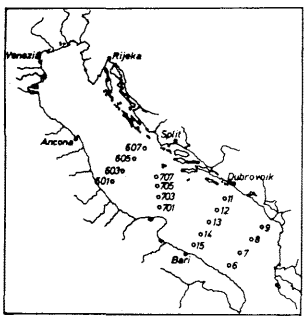
The data from several cruises in the open sea waters of the middle and southern Adriatic (Fig.1) showed that maximum chlorophyll a concentrations regularly occurred in the subsurface layer,most frequently between 50 and 75 m depth. This deep chlorophyll maximum DCM is a phenomenon, rather well studied in oceanic and mediterranean waters,but scientists have not yet agreed upon the mechanisms of its formation. Most of them hold the mechanism of its formation to differ according to local conditions.

The sampling period of our investigations covered three quite different dynamical situations in the sea, the time of vertical mixing (April, 1986 and 1987), the beginning of formation of pycnocline (May, 1987) and the period of very pronounced pycnocline (September,1987).DCM layer (Fig.2,3,4) was present in ail three periods, quite independently on the dynamical situation.DCM layer was better marked during spring phytoplankton blooms than in September when pycnocline was very strong. This led us to conclude that, in the Adriatic,the DCM arising is not caused by pycnocline formation,that is by cell accumulation on pycnocline.

The analysis of data on nutrients showed secondary nitrate minimum in DCM layer.This is indicative of the intensified consumption of nitrates in this layer,probably by phytoplankton for organic matter formation.This shows that growing cells were present in the DCM layer, not the relicts of some earlier blooms but living,active cells.

Greatest oxygen saturation was recorded from the layer above the DCM layer,below the pycnocline. This increased oxygen quantities are indicative of intensified biological activity in deeper layers.

Fig. 1. Station locations in the Adriatic

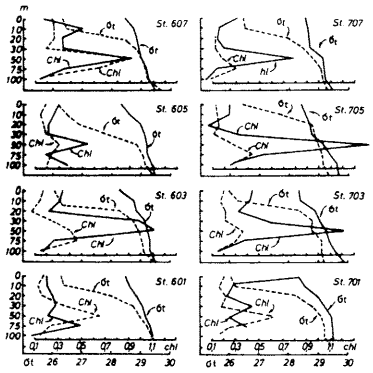


The analysis of phytoplankton biomass expressed as the number of cells showed that it was coincident with chlorophyll a biomass distribution at the major part of stations. Coincidence of these two parameters was better pronounced in September than in May.

In our attempts to explain the DCM formation in the open Adriatic waters, we came to conclusion that it was caused by an actual increase of phytoplankton biomass in this layer. At this depth the relationship between nutrient quantity and light,sufficient for photosynthesis, was probably optimum,so that cells were actively concentrated and growed in this layer.

Futhermore,the formation of DCM in the Adriatic is partly affected also by physiological adaptation of cells to reduced light(increased quantity of cell pigments). On the other hand,it may be assumed,that the most part of zooplankton feeds in upper layers, so that reduced grazing causes in a part, the arising of DCM layer.

Fig.2. Vertical profiles of chlorophyll a (mg m^{-3})and density in the middle Adriatic (------ May,1987) (------ September, 1987)



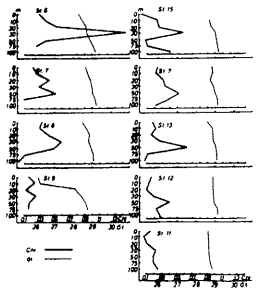


Fig.3. Vertical profiles of chlorophyll a(mg m^{-3}) and density in the southern Adriatic in April 1986.

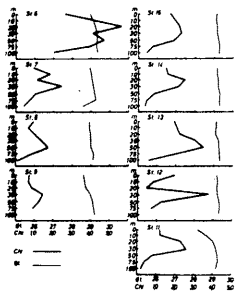


Fig.4. Vertical profiles of chlorophyll a(mg m^{-3})and density in the southern Adriatic in April,1987.

Indications d'eutrophisation des eaux du large de l'Adriatique Centrale

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L'analyse des données pluriannuelles sur la production primaire et sur d'autres paramètres de production dans les eaux du large de l'Adritique centrale a relevé, à partir de 1980 un mouvement de l'accroissement de la production que nous n'attribuons pas uniquement aux fluctuations naturellqs mais qui, à notre avis, inclue également les effets d'eutrophisation de provenance côtière.

La figure 1. présente les fluctuations de la production primaire brute dans la Baie de Kaštela et à Stončica (station du large) de 1962 à 1986. Les résultats sont présentés en moyennes mobiles de cinq ans, illustrant de manière correspondante le mouvement de l'accroissement de la production. On a analysé le rapport des taux de production entre les deux stations (Tableau 1). Dans les séries initiales des données, ce rapport est d'environ 2 pour dépasser peu à peu 4. Ces changements sont le résultat de l'accroissement de la production dans la région côtière alors qu'au large la situation reste invariable. A partir de 1977/81 le rapport de la production entre la Baie de Kaštela et Stončica diminue de nouveau ce qui, à notre avis, reflète l'eutrophisation des eaux du large.

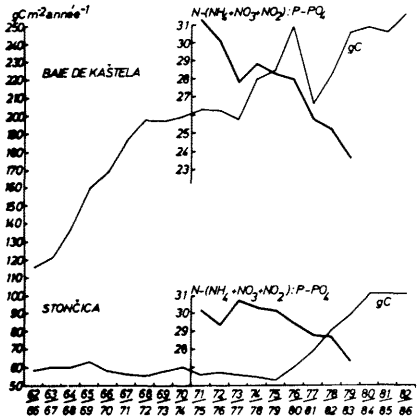

Fig.1. Fluctuations à long-terme de la production primaire et du rapport N/P

Tableau 1.

Rapport g C $m^{-2}an^{-1}$dans la Baie de Kaštela et Stončica (K:S)

Période	K:S
1962-66	2.0
1963-67	2.0
1964-68	2.2
1965-69	2.5
1966-70	2.9
1967-71	3.3
1968-72	3.6
1969-73	3.4
1970-74	3.3
1971-75	3.6
1972-76	3.5
1973-77	3.5
1974-78	4.0
1975-79	4.2
1976-80	4.1
1977-81	2.9
1978-82	2.7
1979-83	2.7
1980-84	2.5
1981-85	2.4
1982-86	2.5

Les données sur la biomasse (chlorophylle a) indiquent également que la concentration de la chlorophylle a est en croissance (Tableau 2).

Tableau 2. Fluctuations des concentrations de la chlorophylle a

	mg Chl a				
Baie de Kaštela	m^{-2}	m^{-3}	Stončica	m^{-2}	m^{-3}
1977-78	30.85	0.88	1977-78	17.67	0.17
1979-80	35.47	1.01	1979-80	18.30	0.18
1981-82	24.69	0.71	1981-82-83-84	20.64	0.20
1983-84	36.49	1.04			
1985-86	40.56	1.35	1985-86	20.47	0.20
1987	40.67	1.36	1987	29.90	0.30

La transparence de la mer a diminué au cours des investigations environ 3 m. L'augmentation de l'activité photosynthétique s'est reflétée sur l'accroissement de la saturation on oxygène. La saturation O_2% dans la colonne d'eau s'éloigne toujours plus de la courbe O_2% de la couche du fond (100 m) à Stončica.

Parmi les facteurs de la production, l'azote ammoniacal, nitreux et nitrique varie de 1971/75 à 1979/83 en proportion inverse à la production primaire. Les concentrations $P\text{-}PO_4$ relèvent, dans cette période, une diminution à peine notable (Tableau 3).

Tableau 3. Fluctuations des sels nutritifs

Période	Baie de Kaštela		Stončica	
	µ mol l^{-1}			
	$N\text{-}(NH_4+NO_3+NO_2)$	$P\text{-}PO_4$	$N\text{-}(NH_4+NO_3+NO_2)$	$P\text{-}PO_4$
1971-75	2.79	0.088	2.35	0.075
1972-76	2.55	0.084	2.17	0.074
1973-77	2.23	0.081	2.21	0.072
1974-78	2.15	0.076	2.09	0.069
1975-79	2.11	0.076	2.08	0.069
1976-80	2.13	0.078	2.06	0.070
1977-81	2.03	0.081	2.01	0.070
1978-82	1.91	0.078	1.92	0.067
1979-83	1.71	0.074	1.80	0.066

On a analysé la proportion entre les sels minéraux (Fig.1). En pleine Adriatique le rapport N/P est d'habitude haut et témoigne du rôle limitatif du phosphore pour la croissance du phytoplancton. Nos résultats se tiennent dans le cadre des valeurs obtenues jusqu'à présent pour cette mer. Cependant, nous tenons que la tendance de diminution du rapport N/P, observée au cours de la période examinée, est valable à noter (Baie de Kaštela de 31 à 23, Stončica de 31 à 27) parcequ'elle peut indiquer les débuts du processus d'eutrophisation. En tout cas, ces changements indiquent une consommation plus forte de l'azote par le phytoplancton.

P-I21

An unusual phytoplankton bloom in the open South Adriatic waters

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Summary. Exceptionally high phytoplankton cell density and volume biomass values, along with low Secchi disc transparencies and dark green water colour were registered in the south Adriatic, in April 1987

In the 14th to 29th April 1987 period, the oceanographic research was performed along 37 stations in the central and south Adriatic by RV "Andrija Mohorovičić" (Fig. 1). Temperature, salinity, transparency, water colour, concentration of oxygen and nutrients (P-, N-, Si-salts), as well as microphytoplankton (cells > 20 μm) and nanophytoplankton (cells 2 - 20 μm) population density and biomass (biovolume) were measured. Physical and chemical parameters were measured on board. Phytoplankton cell counts and cell morphometry were performed by means of inverted microscopy within two months after the cruise.

Unusually high cell density and volume values (9.0 x 10^3 to 9.7 x 10^5

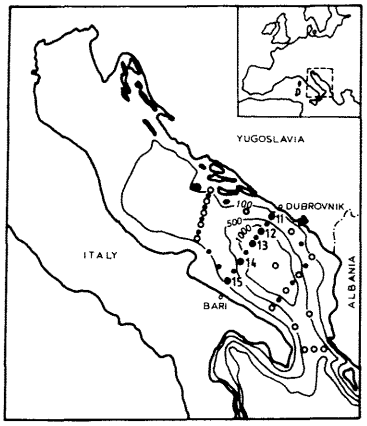

Fig. 1. Location of stations

cells l^{-1}, 1.2 x 10^7 to 5.9 x 10^9 μm^3 l^{-1} of microplankton; 1.1 x 10^5 to 1.5 x 10^6 cells l^{-1}, 5.0 x 10^6 to 3.7 x 10^8 μm^3 l^{-1} of nanoplankton) were recorded in the Dubrovnik - Bari profile, and the Strait of Otranto (in the 0 to 100 m layer). Maximum phytoplankton quantity was determined at Station 13 (Fig. 2), in the central area of Dubrovnik - Bari profile, in the layer between 20 and 50 m (9.7 x 10^5 cells l^{-1}, 5.90 x 10^9 μm^3 l^{-1} of microplankton; 5.98 x 10^9 μm^3 l^{-1} of total phytoplankton). Such an intensive phytoplankton bloom in the open south Adriatic waters has not been registered to date. Secchi disc transparencies ranged from 8 to 14 meters, presenting values nearly three times lower than the multiannual spring mean. Water colour values (according to Forel - Ule scale) ranged between IV and VII (from blue green to dark green colour), while the

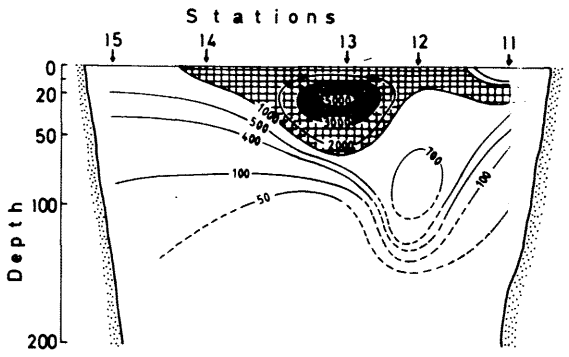

Fig. 2. Distribution of phytoplankton biomass (microplankton + nanoplankton volume, 10^6 μm^3 l^{-1}) at the Dubrovnik - Bari profile, April 1987.

multiannual spring mean did not exceed III. Surface stream-lines estimated on the basis of drift-card distribution, as well as the distribution of nutrient concentrations, showed a strong incoming current from the Ionian Sea throughout the whole transversal profile, excepting the narrow Italian coastal zone. A considerably strong transversal (south-westward) circulation in the Dubrovnik - Bari and Vis - Mt. Gargano profiles was observed as well. Such a dynamics of water masses resulted in a marked increase in salinity (S > 38.7 x 10^{-3}). According to the frequency distribution analysis of all disposable data, the April 1987 nutrient concentrations were slightly decreased, but in the range characteristic for southern Adriatic open sea waters.

P-I22

Photosynthetic assimilation ratios at the surface microlayer

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The relationship between photosynthetic rate (P) and chlorophyll a concentration (B), namely the P/B ratio, has been considered as a realistic index for characterizing the productive capacity of a phytoplankton population (Platt, 1975). Existing data on many aspects regarding this ratio are mainly collected from subsurface sea water whereas the surface microlayer has been received little attention (Hardy and Apts, 1984).

In this work, an attempt has been made to assess the variability in photosynthetic assimilation ratios at the surface microlayer (upper 3 mm) and associated subsurface water depths in the Saronicos Gulf, Aegean Sea.

Eighteen (18) experiments were performed during the period November-December 1987. Surface microlayers (upper 3 mm) were collected with a newly designed sampler (Ignatiades, 1987) and subsurface samples (1,10, 20, 30 and 40 m depth) with Van Dorn samplers. Photosynthetic productivity was measured by the ^{14}C-technique (Strickland and Parsons,1968) and incubation was made in situ for 2 hours. Spectrophotometric chlorophyll a estimations were also performed for each sampling depth.

Photosynthetic assimilation ratios (P/B) as a function of depth are shown in Fig. 1. The results fall in the range from 0.01 to 10.97 $mgC.mgChla^{-1}.h^{-1}$. All profiles follow the same pattern although the absolute values are different and they indicate the following:

1. Inhibition of assimilation ratios at the surface microlayer. Range of values: 0.46-9.00 $mgC.mgChla^{-1}.h^{-1}$.
2. Optimum photosynthetic capacity at 1 m depth. Range of values:2.63-10.97 $mgC.mgChla^{-1}.h^{-1}$.
3. Depretion of assimilation ratios at the lower light-limited depths. Range of values: 0.01-5.90 $mgC.mgChla^{-1}.h^{-1}$.

The pronounced surface inhibition of photosynthetic capacity occured regardless of the uniform quantitative vertical distribution of chlorophyll a and it was associated with the depression of photosynthetic rate at the surface microlayer. This depression might be due to the extracellular release of ^{14}C (Hardy and Apts, 1984) or injury of phytoplankton cells by the high levels of UV radiation (Calkins and Thordardottir (1980).

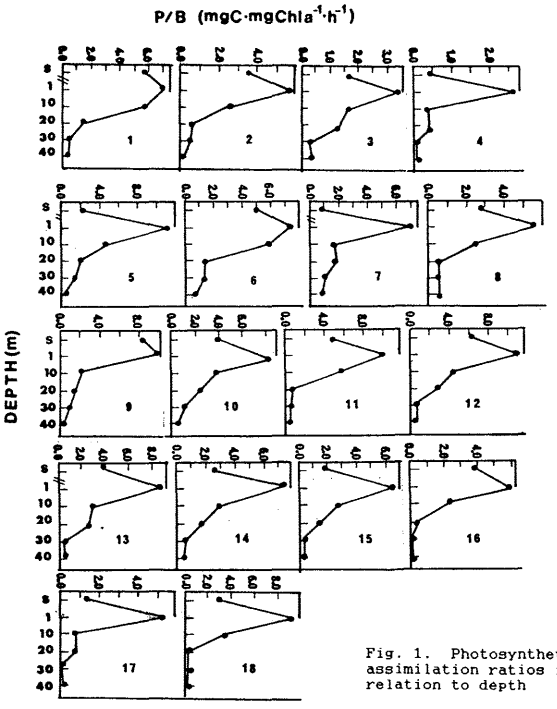

Fig. 1. Photosynthetic assimilation ratios in relation to depth

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P-I23

Multivariate analysis of Chlorophyll-a and zooplankton in Saronikos Gulf during January 1984 to December 1985

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Abstract : The zooplankton biomass and the chorophyll-a values were examined at five stations in the Saronikos gulf (Greece) during the period from June 1984 to December 1985. The classification and the ordination of these stations showed that the Elefsis Bay is separated from the rest of the gulf for both chlorophyll-a and zooplankton, while a relative discrimination was observed for the station near the sewage outfall area.

Introduction: The division of water masses in the Saronikos gulf has been described by Dugdale & Hopkins (1975). Sampling at stations, representing the different water masses (Fig. 1) was made from January 1984 to December 1985 in order to verify the existing hydrological model with biological investigations.

The present paper describes the distribution of chlorophyll-a and zooplankton biomass in the area of Saronikos gulf and makes an attempt to separate the stations (regions) on the account of chlorophyll-a and zooplankton biomass distribution.

Materials and Methods : Chlorophyll-a measurements were made according to Holm-Hansen et al. (1965) at the depths of 0, 10, 20, 30 and 50m. For the analysis the mean integrated values were used. Zooplankton samples were taken by double-oblique hauls (0-50 m) using a WP-2 plankton net equipped with a flowmeter. The zooplankton biomass was estimated by the dry-weight method (Lovegrove, 1966).

Multivariate analysis was based on the general strategy proposed by Field et al. (1982).

Results and Discussion: The dendrograms showing the station affinities concerning both chlorophyll-a and zooplankton are shown in Fig. 2. The stations S4,S6,S7 and S8 are grouped together while S1 represent another separate status at the level of 53 % and 60 % similarity for chl-a and zooplankton respectively, which to our opinion, is significant taking into account that the internal variation of some of the samples was never exeeding the 10%.The similarity for chlorophyll-a with station S4 is relative lower. The dissimilarities observed for both parameters for the station S1 (Elefsis Bay) should be the outcome of the distrophic character of this area. As far as the station S4 is concerned the observed lower similarity with the other stations, for chlorophyll-a, is probably due to the fact that station S4, being nearer to the sewage outfall of Athens, has unlimited source of nutrients and thus higher chlorophyll-a values and more phytoplankton (Pagou, 1986).

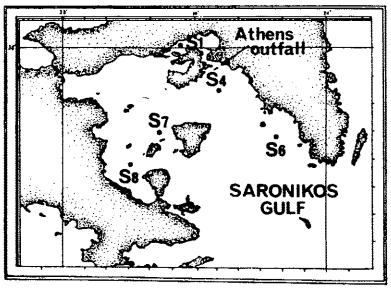

FIG. 1. STUDY AREA

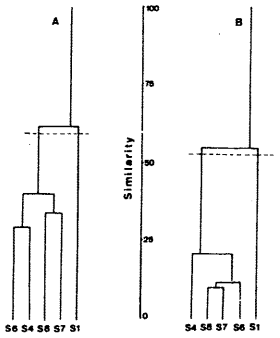

FIG 2. STATION AFFINITIES FOR ZOOPLANKTON (A) AND CHLOROPHYLL-a (B)

Thus, generally the grouping of these stations for chlorophyll-a and to some extend for zooplankton follows the division of water masses in Saronikos gulf (Dugdale & Hopkins, 1975).

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P-I24

Voies de dégradation de la chlorophylle dans des systèmes pélagiques. Mécanismes impliqués dans la dynamique des phéopigments

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Depuis Shuman et Lorenzen (1975) on a suggéré l'utilisation des phéopigments comme un indicateur de la consommation de phytoplancton par les herbivores. Dans ce sens, la concentration des phéopigments dans la colonne d'eau pourrait aider à évaluer l'importance relative des principales voies, c'est à dire heterótrophes versus phytodétritus, à travers lesquelles se canalise la majeure partie de la production générée dans les "blooms" phytoplanctoniques côtiers.

Dans ce travail on étudie quelques-uns des facteurs qui favorisent la formation ou l'élimination de phéopigments dans le matériel particulaire: 1) développement du phytoplancton en absence de lumière; 2) demande de phytoplancton par le microzooplancton et 3) photooxydation.

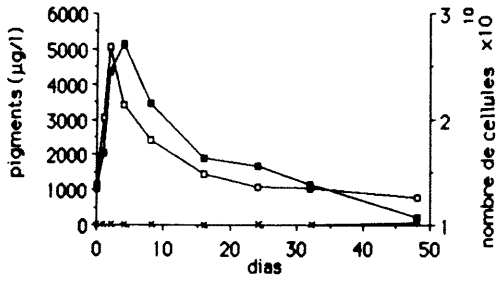

Figure 1

Dans le premier cas, on a utilisé des cultures uni ou bispécifiques d'algues de laboratoire que l'on a maintenues à l'obscurité pendant 48 heures après avoir atteint la phase de croissance exponentielle. La concentration de chlorophylle et le nombre de cellules descendirent exponentiellement après une courte période d'accroissements initiaux, cependant les phéopigments n'apparurent pas avant le jour 30 et toujours à des concentrations très peu importantes par rapport aux initiales de chlorophylle (Figure 1). Se confirment ces résultats quantitatifs avec ceux obtenus par chromatographie bidimensionnelle en couche mince. De cette manière, d'après Welschmeyer et Lorenzen (1985), les phéopigments ne semblent pas s'accumuler en cellules vivant dans des conditions d'obscurité, comme celles qui sédimentent en dessous de la zone euphotique.

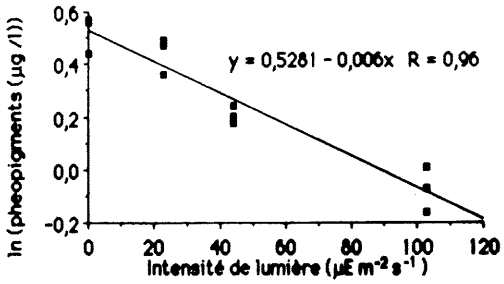

Figure 2

Dans le deuxième cas, le matériel incubé dans l'obscurité était de l'eau de mer naturelle filtrée à travers 20 µm et enrichie. Une fois atteinte la phase de croissance exponentielle, la durée de l'expérience fut de 340 heures. Les résultats montrent une diminution exponentielle de la concentration de chlorophylle et de l'abondance cellulaire, ainsi que l'apparition de concentrations importantes de phéopigments déjà à 220 heures d'incubation . Par conséquent, l'activité alimentaire du microzooplancton semble être la responsable de la formation de ces phéopigments.

Dans le troisième cas, les concentrations de phéopigments mesurées dans de l'eau de mer préfiltrée à travers 20 µm, diminuèrent exponentiellement quand on les incubait à des intensités croissantes de lumière pendant 12 heures (figure 2). De cette façon, la photodégradation peut être une source importante de diminution de la concentration des phéopigments du le matériel particulaire de la zone euphotique.

Dans le futur, des études plus détaillées des matiéres fécales du zooplancton en relation avec des mesures de pigments par HPLC, taux de production, vitesse de sédimentation, taux de décomposition, etc, aideront à mieux comprendre les équilibres

P-I25

Importance du nanoplancton dans les eaux côtières Libanaises (Méditerranée orientale)

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Summary: Estimation of the biomass of the marine nanoplankton is made for 2 stations using the Utermöhl settling technique. The importance of these small cells in the phytoplankton biomass is confirmed. All algal classes are represented and flagellates are dominant. The annual means of total number of cells are estimated around 9 x 10^6 (Amplitude = 2.8 - 16.4 x 10^6) and 6.7 x 10^6 (Amplitude = 1.7 - 15.5 x 10^6) cells per liter successively at two stations.

Introduction: Les nombreux travaux effectués dans des différentes zones climatiques, géographiques et dans les différentes provinces du milieu marin ont montré que la contribution du nanoplankton est supérieure à ce que l'on soupçonnait; elle représente de 80 à 100% de la production primaire et de la biomasse en certains endroits aussi bien dans les zones côtières qu'océaniques, bien qu'elle soit plus importante dans les zones côtières. En Méditerranée Orientale, Berman et al.(1984)notent que les organismes < 3µm étaient responsables d'une fraction importante de la chlorophylle et de l'activité photosynthétique. Sur la côte libanaise, l'étude du nanoplankton, durant la poussée printanière, a montré l'importance de cette fraction par rapport au microplancton et l'existence d'une corrélation très hautement significative, positive avec la température et négative avec la salinité et la profondeur (Abboud-Abi Saab, 1986). Ce travail a pour but de montrer les variations saisonnières de la biomasse nanoplanctonique dans une zone côtière.

Matériel et Méthodes: Le nanoplancton a été dénombré dans les mêmes échantillons (100ml) que ceux utilisés pour l'étude de l'évolution annuelle du phytoplancton, dans 2 stations côtières, situées dans la baie de Jounieh à 40m (J0) et 2km (J1) de la côte. Les échantillons d'eau ont été fixés immédiatement au Lugol. Le comptage a été effectué suivant la méthode d'Utermöhl (1958), après 48h de sédimentation, dans un diamètre à un grossissement approprié (x400), dans le délai d'une semaine après la récolte. Notons que la classification de Dussart (1965), qui considère le nanoplancton comme la fraction de cellules situées entre 2 et 20 µm, est adoptée. La biomasse a été estimée d'après des numérations cellulaires. En adoptant la valeur 324 μm^3 de volume cellulaire moyen des cellules phyto. situées entre 2 et 20 µm, proposée par Reid (1982), on a pu calculer ce volume. L'expression de la biomasse algale a été possible en appliquant la formule proposée par Strickland (1960) qui évalue à 8% la quantité de carbone algal par rapport au volume total de l'algue.

Résultats et Discussion: Les populations nanoplanctoniques sont surtout des nanoflagellés; elles sont dominées par des Xanthophyceae et des Cryptophyceae suivies de loin par des Prasinophyceae, des Haptophyceae et des Chlorophyceae; les Euglenophyceae, de grande taille, ne présentent d'ailleurs un effectif significatif que lors d'une baisse de salinité exceptionnelle de l'ordre de 35‰, et ceci durant les mois d'hiver. Les Coccolithophorideae sont surtout notés en été. Notons que l'identification au niveau des genres et des espèces est très délicate et demande un matériel vivant ou un microscope électronique.

La biomasse des cellules nanoplanctoniques, estimée d'après les numérations cellulaires, le volume cellulaire et la biomasse exprimée sous forme de carbone organique figurent au tableau suivant, avec d'autres résultats dans les 2 stations:

Paramètres mesurés	Station	Moyenne	Amplitude	Ecart-type
Nbre. de Cell./l	J0	9,1x10^6	2,8 - 16 x 10^6	4,45 x 10^6
	J1	6,7x10^6	1,7 - 15,5 x 10^6	4,62 x 10^6
Volume cellulaire (mm^3/l)	J0	2,94	0,92 - 5,3	1,44
	J1	2,18	0,55 - 5	1,59
Biomasse exprimée en carbone (mgC/l)	J0	0,235	0,07 - 0,425	0,115
	J1	0,17	0,044- 0,4	0,118

Les variations de cette biomasse au cours du cycle annuel sont représentées sur la figure 1. On constate que la contribution du nanoplancton est plus constante au cours de l'année dans la station côtière J0. A J1, la densité cellulaire présente des fluctuations plus importantes avec un maximum en juin suivi par une période de pauvreté en été. Comparés à d'autres travaux en Méditerranée, ces effectifs sont élevés. Connaissant l'importance du nanoplancton ainsi que la fraction des cellules inférieures à 3µm dans la région, on peut dire que cette fraction de population phytoplanctonique ne trouvera sa vraie signification qu'avec le développement d'une nouvelle technique plus appropriée que celle d'Utermöhl.Leur rôle dans la chaîne alimentaire sera mieux déterminé ainsi que les transferts d'énergie à travers cette chaîne.

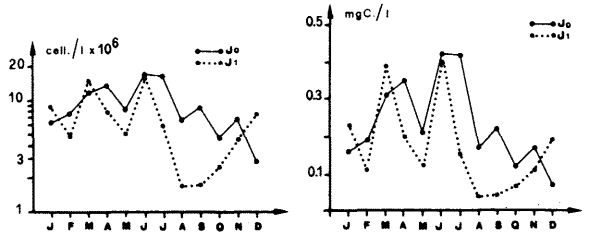

Fig.1- Variations saisonnières de la biomasse nanoplanctonique.
a = Enumération cellulaire (Cell./l)
b = Biomasse exprimée en carbone organique (mg C/l)

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P-I26

Toward biodynamical studies : the example of the MEDIPROD 5 Experiment in the Algerian Basin

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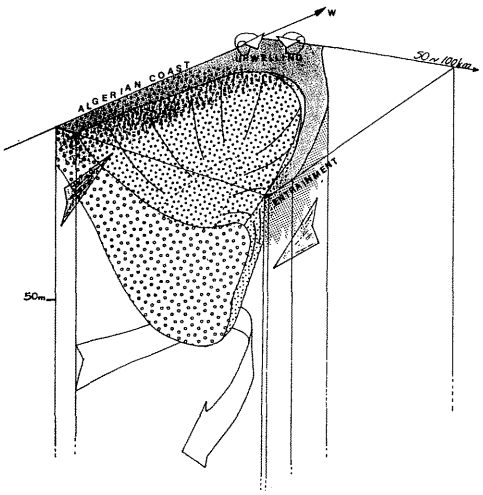
The instability of the Algerian Current generates mesoscale structures such as eddies and upwellings (2,3,5). These phenomena having characteristic space scales ranging horizontally from 50 to 200km and vertically from a few hundred meters to 2000m at least, and time scales ranging from a few weeks to several months (at least 5)(4,8), they induce intense and long-lasting biological activity. A preliminary analysis of visible and thermal satellite imageries has established that biological and hydrodynamical features were highly correlated (9). Therefore, studying physical processes such as the Algerian Current instability and associated biological phenomena requires a common sampling strategy.



DISTRIBUTION OF THE PHYTOPLANKTON IN A YOUNG ANTICYCLONIC EDDY OF THE ALGERIAN CURRENT.

During the multidisciplinary Médiprod 5 experiment in June 86 (5), we received on board in near-real time satellite-derived isotherms charts, from which we inferred the hydrodynamical situation, and then determined the sampling strategy. This allowed us to perform transects across a young coastal eddy as well as across an old offshore one. The results showed that, due to adequate sampling -stations 3 to 5 nautical miles apart, using sometimes a multiparametric continuous pumping system-, some widely accepted ideas such as for example the oligotrophy of the Algerian Basin, were to be revised: we frequently found chlorophyll concentrations as high as 1-2µg/l,up to 9µg/l locally (6,9). As well, we have been able to deduce from the comparative analysis of the distribution of the biological, chemical and hydrodynamical (satellite imagery and hydrology) parameters a first assessment of the biological response to these mesoscale features (9).

It is clear that the phytoplankton biomass distribution is determined by hydrodynamics (1,9), and so highly variable. Therefore, biological investigations require both a preliminary knowledge of the hydrodynamical characteristics of the area, and an actual knowledge of the present hydrodynamical situation, the sampling strategy being then determined by both biological aims and dynamical processes. Along with improved fine resolution sampling, efforts have also to be made in developing multiparametric continuous systems and moored equipments.

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Description et performances d'un prototype de pompe à phytoplancton

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Un prototype de pompe à filtration *in situ* de phytoplancton a été expérimenté jusqu'à 20 m à différentes profondeurs, (Fig.1).

Les échantillons récoltés ont été comparés à ceux obtenus en parallèle avec une bouteille "Niskin". Afin d'obtenir un maximun de paramètres définissant les conditions du milieu au moment du pompage, les sels nutritifs et l'oxygène dissous ont été mesurés sur les échantillons d'eau recueillie.

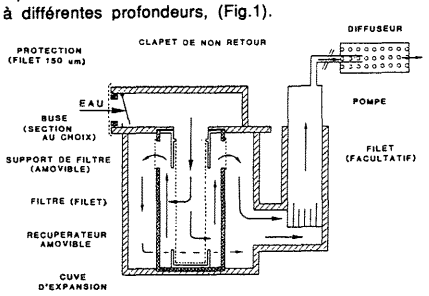

Fig.1 Schéma de la pompe immergeable à plancton.

Après modification des matériaux de construction, les résultats sont satisfaisants et permettent de considérer la pompe comme un instrument fiable pour ce type de prélèvement.

La comparaison des quantités de chlorophylle recueillies au cours de 3 séries de mesures, dont la dernière sur 40 échantillons (Fig.2),met en évidence la cohérence des résultats.

Le recensement des espèces montre une diversité plus grande dans les échantillons de la pompe, pour les Diatomées et surtout les Dinoflagellés (Fig.3).

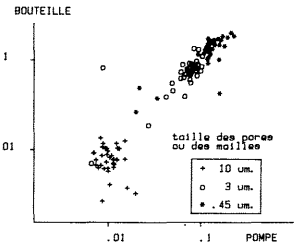

Fig.2 REPRESENTATION LOGARITHMIQUE DE QUANTITES DE CHLOROPHYLLES EN ug/l.

Le calcul des indices de diversité de Margalef (1957) (1) sur 90 couples de prélèvements confirme ces résultats (Fig.4). Il en est de même pour les valeurs de l'indice de diversité de Shannon-Weaver (1949) (2) calculé des Diatomées et Dinoflagellés.

La numération des cellules rapportée à l'unité de volume fait apparaître quelques résultats discordants chez les Diatomées du genre *Nitzschia* trouvées dix fois plus nombreuses dans les captures provenant de la bouteille.

Trois paramètres au moins semblent être à l'origine de ces différences : la forme en navette étroite des *Nitzschia* leur permettant de passer au travers des mailles de 10 µm. ,la pullulation des divers représentants du genre au momment des pêches acoompagnée d'une distribution hétérogène des individus fréquemment groupés en essaims.

Pour les Dinoflagellés la comparaison apparaît en faveur de la pompe. On constate en effet, pour chacune des espèces, pour la même colonne d'eau à différents niveaux, que certains prélèvements faits en parallèle avec la bouteille ne contiennent pas l'espèce considérée alors qu'elle est présente dans les pêches à la pompe.

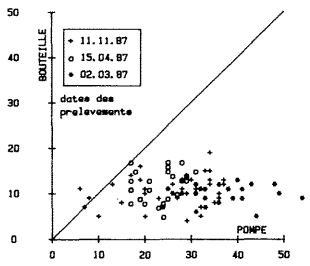

Fig.3 NOMBRE D'ESPECES PAR ECHANTILLON .

Le cas de *Prorocentrum micans* est discuté car ce Dinoflagellé en forme d'amande échappe en partie à la filtration quand il n'est pas dominant.

Une étude du sous-échantillonage actuellement en cours devrait permettre de lever certaines incertitudes et d'en améliorer la technique.

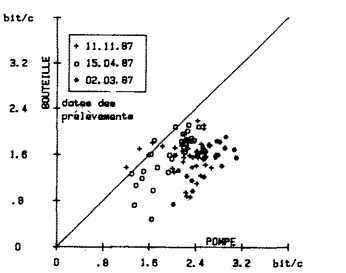

Fig.4 INDICE DE DIVERSITE DES DINOFLAGELLES (MARGALEF)

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Growth and mortality of Pelagia noctiluca (Forsskal, 1775) (Cnidaria) in the Northern Adriatic Sea

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Pelagia noctiluca (Forsskål, 1775), a pelagic semaeostoma scyphomedusa, often appears in high densities, especially in warm seas. Recently, (1976-86), large numbers have been recorded in various areas - coastal and offshore - of the Mediterranean Sea.

Measurements of the growth rate of P.noctiluca are rare while estimates of mortality and life expectancy are largely anecdotal and have mostly been guessed; yet this information is essential for explaining and predicting population fluctuations. Jellyfish have no detectable growth records and tagging is hardly successful, so "in situ" growth is difficult to measure. Besides, in contrast with other Scyphozoa which breed sexually during the medusoid phase but also have attached scyphostomae which undergo strobilation or/and budding, P.noctiluca lacks a sessile stage and seems to depend on sexual reproduction, spending its whole life cycle within the water column. So, the determination of the age structure of P.noctiluca is a troublesome objective to attain. In view of this, we used methods which were originally developed by fisheries biologists but have also recently been used by ecologists for determinations of growth and production of benthic invertebrates and freshwater zooplankton (Brey, 1986; Grant et al., 1987). The growth curve was fitted to a set of bell diameter-frequency data, assuming that the growth of P.noctiluca follows a seasonally oscillating von Bertalanffy growth equation:

$$L_t = L_\infty \cdot \left[1 - e^{-k(t-t_o)} + \frac{C}{2\pi} \sin 2\pi (t-t_p)\right]$$

where L_t = length (bell diameter) at time t; L_∞ = asymptotic diameter; t_o = intercept at L = 0; C = amplitude of growth oscillation; t_p = starting point of seasonal oscillation. We used a computer based method (ELEFAN - Electronic Length Frequency Analysis, Pauly & David, 1981) for the analysis of the diameter-frequency distribution which does not require information about the individual age of the animals.

The growth parameter values estimated from diameter-frequency histograms of P.noctiluca in the Northern Adriatic Sea are: growth constant k = 0.03; amplitude of oscillation C = 10; t_o = -110; and t_p = 100. These growth estimates suggest that during the period of seasonally accelerated growth P.noctiluca reach the minimal size at which they may spawn (30 to 35 mm) in about 150 days.

Mortality rates varied seasonally and showed a significant negative correlation (r = -0.57) with temperature. In addition, a positive correlation between survival and increased zooplankton biomass as carbon was established, except for the summer period.

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P-II2

Fishery and swarmings of Pelagia noctiluca in the Central and Northern Adriatic Sea : middle term analysis

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In 1984 a research project within MAP-UNEP programs was settled. The aim was to study the increase of Pelagia noctiluca (Forsskål) since 1976.

Researches were made on the various factors which might have caused the increase or decrease of Pelagia noctiluca swarmings such as food availability, meteo-climatic conditions, predator-prey correlation (UNEP, 1983, 1984, 1988; Rottini Sandrini and Avian, 1986).

As the phenomenon was known from already two centuries (Goy, 1984 a, b) one can not ascribe it directly to recent pollution. Fishery efforts of Pelagia noctiluca predator fishes were taken into consideration. Seven species of fishes, fresh and preserved (formaldehyde 7 %) were examined: Scomber scombrus, Scomber japonicus, Sprattus sprattus, Sardina pilchardus, Engraulis encrasicolus, Alosa fallax nilotica and Thunnus thynnus thynnus.

The statistic informations were given by Istituto Centrale di Statistica (ISTAT) from its yearly data from 1960 to 1985.

Monitoring data on all the Pelagia noctiluca aggregations in the Central and Northern Adriatic Sea since 1976 till 1987 (Piccinetti Manfrin and Piccinetti, 1983-84, 1986; UNEP, 1987) are based on plankton samplings made by the Laboratorio di Biologia Marina e Pesca, Fano, during seasonal cruises on ichthyoplankton of the Ministero Marina Mercantile Program.

During all swarm periods of Pelagia noctiluca, the following characteristics were observed on predator fishes: deep purple abdomen, iridescent; deep purple abdomen contents, sharp smell. Binocular observations of intestinal contents of fish revealed Pelagia noctiluca parts, more or less digested, and in particular oral arms. The identification of such pieces was made on the observation of cnidocysts almost always discharged. Esoscheletric parts of crusteceans were also present.

It was observed that: mackerels, tuna, bogues and mullets are predators of adults Pelagia noctiluca; sardines and shads are rather predators of larval and young stages.

Data of total fish of these species from 1960 to 1985 and n°/m³/10⁻³ jelly-fish present until 1987 are given in Fig. 1.

It appears that:

1976: beginning of the Pelagia noctiluca blooms.
1978: slight increment of population density.
1979-1981: stability of the population density on low values.
1982-1986: great increase of population, with great variations.
1987: population vanish.

It is possible to observe a correlation between decrease of Pelagia noctiluca predators due to overfishing and a decrease of this scyphomedusa mortality especially at larval stages. There is therefore a parallel relation between edible fish catch increase

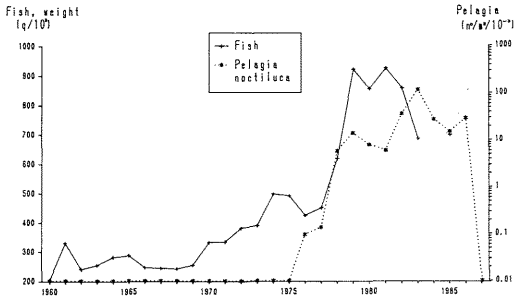

Fig. 1. Relation between fish catched (weight in $q/10^{-3}$) and Pelagia noctiluca ($n°/m^3/10^{-3}$; logarithmic scale).

and the increased presence of zooplankton here considered as food available and the Pelagia noctiluca decreased mortality. The reciprocal predation by Pelagia on the eggs and larval stages of fishes was studied by analyzing the gastrovascular contents (Giorgi et al., 1988). It does not seem to be a significant cause of the decrease in fish abundance observed from 1981.

The overfishing of Pelagia noctiluca predators from 1976 might therefore be one of the factors responsible for the increase of Pelagia population observed from 1976 up to 1986.

ACKNOWLEDGMENTS

We wish to thank Mrs. G. Piccinetti Manfrin and Mr. C. Piccinetti of the Laboratorio di Biologia Marina e Pesca, Fano (Italy) for their kind permission of use of the monitoring data of Pelagia in the Central and Northern Adriatic Sea.

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P-II3

Desmopterus papilio Chun 1889 en Méditerranée (Mollusque Thécosome)

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Le matériel analysé provient de la campagne océanographique Médiprod IV effectuée par le N.O. "J. Charcot" (15 octobre-17 novembre 1981), de la baie de Cadix aux côtes occidentales de la Corse et de la Sardaigne (fig. 1) : pêches verticales entre 200 et 0 m au filet WP2 standard (vide de maille 200 µm).

L'examen des Thécosomes s'est révélé intéressant. A côté des autochtones méditerranéens classiquement rencontrés en mer d'Alboran, dans le secteur sud-occidental et le secteur central (*Limacina inflata, L. trochiformis, Creseis conica = C. virgula conica, Cavolinia inflexa, Clio pyramidata, Peraclis reticulata, Creseis acicula* et *Styliola subula*, les 3 derniers ayant une répartition plus hétérogène que les autres), nous avons récolté, avec une fréquence surprenante, une espèce considérée comme très rare en Méditerranée, *Desmopterus papilio*.

Ce pseudothécosome n'avait jusqu'alors été signalé qu'en deux points de la Méditerranée : un spécimen à Alger (Franc, 1949) et deux mentions à Naples (Lo Bianco, 1903 ; Gegenbaur d'après Meisenheimer, 1905). Nous l'avons récolté sur près de la moitié des stations prospectées (fig. 1), chaque coup de filet ramenant de 1 à 5 spécimens (maximum de 9 individus dans 2 pêches) adultes pour la plupart mais parfois aussi très jeunes.

Les parapodies qui forment le plateau natatoire à 5 lobes (fig. 2) ont une largeur maximum de 1,70 mm chez la plupart des spécimens, valeur inférieure à celle que nous avons observée sur ceux du Cap Vert et de la mer Rouge.

Desmopterus papilio est une espèce largement répandue dans l'océan Indien y compris la mer Rouge et le golfe Persique (Sakthivel, 1972) ; on le trouve aussi dans le Pacifique occidental intertropical et dans tout l'Atlantique tropical et subtropical où ses mentions les plus septentrionales dépassent parfois 40° N. Sa présence en Méditerranée est vraisemblablement liée à celle du courant atlantique. En effet, comme d'autres Thécosomes largement répandus dans cet océan , cette espèce ne semblait pas coloniser la Méditerranée de façon permanente puisque, rappelons-le, nous ne l'avons jamais trouvée sur l'ensemble du bassin méditerranéen, en dépit du dépouillement de nombreuses campagnes océanographiques (Rampal, 1975). Sa fréquence dans ces prélèvements, depuis la baie de Cadix jusqu'à l'ouest de la Sardaigne, permet de la considérer comme une espèce transportée par le courant en provenance de l'océan, dont elle jalonne le parcours : mer d'Alboran et branche principale se dirigeant vers le nord-est du bassin occidental au large des côtes sardes. Elle est, certes, absente du détroit de Gibraltar mais cela reflète la rareté dans ce secteur de toutes les espèces pourtant communes de part et d'autre du détroit, à l'exception de *Cavolinia inflexa* , pauvreté déjà signalée pour d'autres groupes planctoniques (Goy, 1983).

C'est en baie de Cadix que se situe le maximum de variété spécifique ; en effet, à côté des espèces également trouvées en Méditerranée, figurent 3 Thécosomes atlantiques (*Limacina bulimoides, L. lesueuri* et *Diacria trispinosa*) qu'il est surprenant de ne pas avoir rencontrés en mer d'Alboran où, rares, mais relativement fréquents, ils sont tenus pour indicateurs des eaux océaniques (Rampal, *op. cit.*) ; cette remarque surprenante va de pair avec celle que constitue la fréquence de *Desmopterus papilio* considéré comme exceptionnel en Méditerranée. Il faudrait peut-être voir dans son absence du détroit de Gibraltar et de la proximité immédiate de celui-ci en mer d'Alboran, davantage un effet des perturbations hydrologiques occasionnées par la puissance du courant entrant en Méditerranée qu'une séparation des populations récoltées en Atlantique et en Méditerranée.

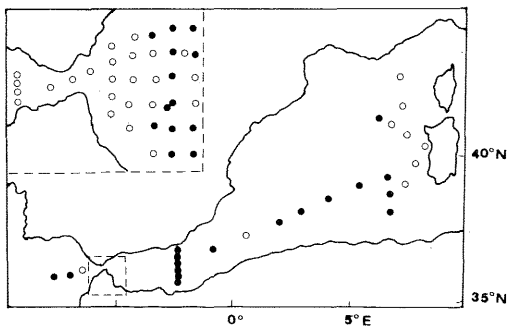

Fig. 1. - Carte de répartition de *Desmopterus papilio* CHUN 1889. • Stations positives ; o stations négatives.

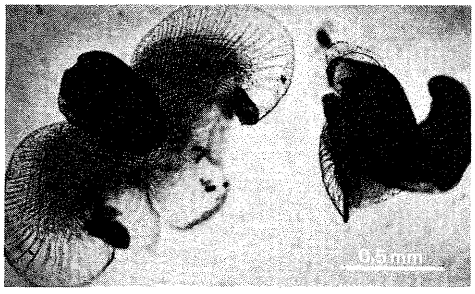

Fig. 2. - *Desmopterus papilio* CHUN 1889 : vue antérieure et de profil (spécimens récoltés en Méditerranée occidentale).

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P-II4

Abundance distribution and faunal composition of Pteropodal Shells from the recent sediments of the Cilician Basin : N.E. Mediterranean Sea

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ABSTRACT

Mapping of the combined abundance of the shells of thecosomata pteropods and heteropods evaluated in the coarser than 250 micron fractions of 95 surface sediment samples evenly covering the shelf and bathyal parts of the Cilician Basin between Cyprus and Turkey (Shaw and Bush, 1978, fig.2), showed that down to a depth of about 100m shelf sediments are generally poor in shells (Alavi, 1980). Their abundance is particularly low over those parts of the shelf under the direct influence of discharge from Rivers Seyhan, Tarsus, and Göksu. However, along the southern Anatolian margin to the west of River Göksu, where the shelf is narrow and no major river flows into the sea, most of the shelf sediments are richer in shells presumably due the greater influence of open-sea conditions on the neritic waters.

Slope (200-800m) sediments to the west of the Göksu delta are generally richer in shells except for areas of obvious sediment redeposition. At such localities finer sand fractions can still be rich in shell fragments. No evidence of significant shell dissolution could be found in the majority of the samples from the bathyal zone, and shell abundance continuously increases with depth reaching to as much as about 6000 shells per gram of the coarse fraction of sand at a depth of 2000 m.

The most common pteropod species is Limacina inflata (d'Orbigny), representing between 35 to 45% of the pteropodal shell assemblages from the bathyal zone. Other common species are L. trochiformis (d'Orbigny), Styliola subula (Quoy and Gaimard), and subspecific forma of Creseis virgula (Rang). Each of these species can account for 15 to 30% of the bathyal pteropodal assemblages. Less frequent but widely occuring forms are Creseis acicula (Rang), Clio pyramidata Linnaeus, and Hyalocyclis striata (Rang). Meso- and bathyplagic forms such as Diacria trispinosa (de Blainville), Clio cuspidata (Bosc) and C. polita (Pelseneer) occur rarely in some deep-water (1000m) samples. The last species is only known from the Recent sediments in the Levantine Sea (Almogi-Labin and Reiss, 1977 and Herman, 1981).

There are no detailed published data on the composition of the living pteropods from this region. L. inflata is recorded to be the most common pteropod species occuring in plankton tows from the offshore waters of the northeastern Levantine Sea. This form and L. trochiformis together can account for up to 40% of the total plankton catch in this region (Kimor and Berdugo, 1967, Kimor and Wood, 1975, and Pasteur et al., 1976). The composition of the fauna is also found comparable with those reported from other parts of the Levantine Sea (Rampal, 1968 and Almogi-Labin and Reiss, 1977), and generally similar to that of the tropical-subtropical, oligotrophic and saline gyre-centre water-masses in the open ocean (Be' and Gilmer, 1977).

The shells of various species of the heteropod genus Atlanta constitute between 10-15% of the total planktonic molluscan shells in the coarse sand fractions of the bathyal sediments. A. inflata Souleyet, reported oh be the most common species of the group in offshore surface waters from this part of the Levantine Sea (Kimor and Berdugo, 1967 and Kimor and Wood, 1975), represents the most widely occuring and abundant species in the basin. It has also been recorded in deep-sea surface sediments from the Ionian Sea (Geronimo, 1970) and known to be common in the Gulf of Naples (Richter, 1968).

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P-II5

The growth equation of Temora stylifera Dana

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The von Bertalanffy growth model has been introduced to describe the growth of cephalothorax of the copepod Temora stylifera DANA. Measurements have been carried out on adults only and the calculated parameters, for the male individuals, are: L_∞= 1.28 mm, k=0.38 and t_o=-0.67; the growth equation may be written as follows:

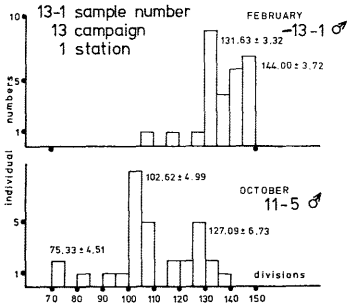
$$l_t = 1.28\ (1 - e^{-0.38\ (t+0.67)})$$

Taking into consideration the existing evidence, from the current bibliography, that the approximate generations interval, for Temora stylifera, is three to four weeks, the total time needed, for males to reach their maximum length, has been roughly estimated to five to six months.

*

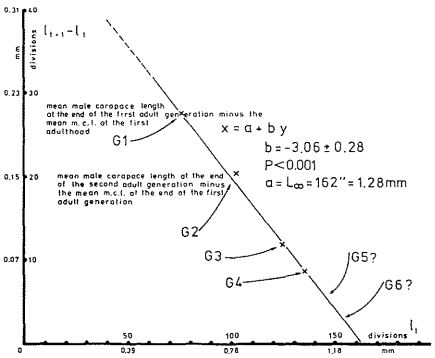
This study has been based on zooplankton samples, collected with a WP-2 nylon net, mesh size 0.24 mm, from a station grid of 14 localities, during a two and a half year period, from a certain area of the Aegean Sea, North Evoikos Gulf, on the course of 14 campaigns. The sampled vicinity can be considered as an enclosed one, almost isolated, and is characterized by the well mixed water masses, in the whole column, max depth up to 80 m., due to the strong tidal currents.

The attempt to determine the growth equation parameters has been based on the adult male cephalothorax measurements only in order to avoid the possible size diversion due to the different growth rates between males and females, plus the fact that males were more abundant during most of the sampling periods and the interference of the abdomen length variations. Preliminary calculations demonstrated a well known phenomenon, that, in both sexes, the total length of the copepod versus cephalothorax presents a better correlation than the total length versus abdomen.



Measurements have been performed on specimens obtained from one sample only for each sampling period, where an abundance of adult individuals had been noticed. Various methods, for the proper estimation of the cephalothorax length, have been applied but competent results were revealed by the use of a projecting device only, under a total magnification of 127 times. Less accurate approaches did not provide adequate length estimations in order to choose the suitable class range at the size-frequency histograms.

The forementioned methodology, exposed a repeatable size - frequency distribution, from all samples analysed. For each sample three cohorts were usually observed. An example of the revealed groups of sizes, based on the selected class intervals, is given in the histogram. It should be noted that 1 mm equals to 127 divisions and the measurements' accuracy is 1.0 division. It is believed that these size-frequency distributions are reflecting a sequence of generations because:



1) Specimens from one sample only, of such a peculiar area, must belong to the same patch. Each cohort includes individuals with corresponding growth rates, so, the different groups of sizes can be attributed to successive spawning periods. This implies also a regular and simultaneous spawning activity of all females.

2) The difference between the means of two successive cohorts of older generations, e.g. fifth and forth adult generations, is smaller but of the same, more or less, magnitude, for all sampling periods, than that from the younger ones, e.g. third and second. Consequently, the variations of the mean values can not be attributed to temperature influence only, since, during these periods, temperature presented increased or declined alterations.

A combination of the different data, provided the $Y = l_{t+1} - l_t$ versus $X = l_t$, plot, where l is the cephalothorax length and t the corresponding time.

The maximum adult male cephalothorax measured 1.22 mm and the minimum 0.50 mm, with corresponding total lengths of 1.61 and 0.89 mm. No adult specimens with smaller cephalothorax size has been noticed in our samples, therefore it is considered that around this min value, the integration of the adulthood occurs. From the figure, the approximate number of generations needed for the individuals to reach their max length can be estimated, from five to six or possibly seven.

The growth coefficient, k = 0.38, attains rather high values, probably due to the eutrophic character of the ecosystem studied.

The t_o growth parameter, calculated for the different generations, gives similar values, meaning that, in all cases, it has been almost equally underestimated a little more than half of a generation period.

P-II6

Parasitic infestations in coastal Mediterranean Pelagic Copepods

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Although descriptions of parasitic infestations of copepods by dinoflagellates date back to the last century, to date little information is available on the occurrence and incidence of parasitism in marine copepods. Most of the available information is contained in the monographs of Chatton (1920) and Sewell (1951). The vast majority of other papers contain only brief observations on the presence of internal parasites.

During the course of our studies on planktonic copepods in the Gulf of Naples, we have observed that most copepod species belonging to common genera such as *Calanus*, *Clausocalanus*, *Ctenocalanus*, *Centropages*, *Acartia*, *Oncaea* and *Corycaeus* are infested with internal dinoflagellate parasites and unidentified forms of protozoa, fungii and bacteria. Such infections can generally be grouped into two main categories including coelomic parasites that invade the entire body cavity of their hosts and parasites of the digestive tract. The commonest form of coelomic infection has been observed in *Paracalanus parvus* infested by *Syndinium* sp. that induces drastic changes in the external morphology of the host (Fig. 1a). This is the most devastating form of infection since it always leads to sexual castration (Fig.1b) and, most probably, death of the host. Ianora et al. (1987) report infection rates of up to 30% for this species.

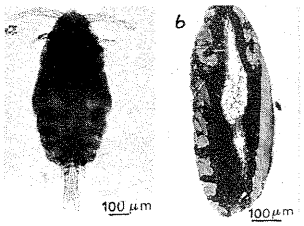

Fig. 1. *Paracalanus parvus* infested by *Syndinium* sp. (a) dorsal view; (b) histological section showing the complete destruction of the gonads.

Another common form of coelomic infestation is due to bacteria that do not induce any apparent changes in the external morphology. Internally, however, infection seems to lead to sterility since mature oocytes have never been observed in such individuals (Fig. 2a). Occasionally, copepods have been found infested by unidentified fungal and protozoan parasites (Figs 2b and 2c). In the former, the parasite is dispersed in the entire body cavity whereas in the latter case the parasite occupies most of the prosome having compressed the stomach onto the dorsal part of the carapace. In both cases, the gonads of the host are completely destroyed.

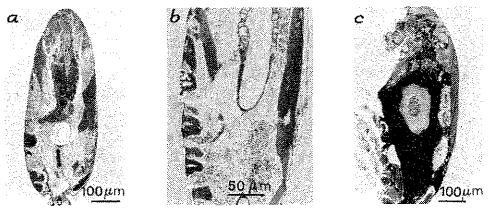

Fig. 2. Histological section of (a) *Clausocalanus furcatus* infested by bacteria; (b) *C.pergens* infested by fungii; (c) *C.arcuicornis* infested by a protozoan.

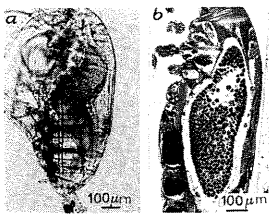

Fig. 3. *Clausocalanus lividus* infested by *Blastodinium* sp. (a) lateral view; (b) histological section.

The most common form of infestation by parasites that lie within digestive tract of their hosts is due to dinoflagellates belonging to the genus *Blastodinium* (Fig. 3a). Such infestations seem to be less devastating since, at the histomorphological level, the gonads contain oocytes in different stages of development (Fig. 3b). However, we have never observed mature oocytes in such individuals and specimens of different species maintained in the laboratory do not produce eggs.

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P-II7

Salinity a decisive factor in the length of Cephalothorax of Acartia clausi from three different areas (Greece and Ivory Coast)

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The purpose of this paper was to study and complete the data relating to the influence of environmental factors (primarly salinity) on the body size of *Acartia clausi* (Copepoda).
We thus, compared the length of cephalothorax of female adult *Acartia clausi* living a) in Greek waters and especially in Saronicos gulf with a common Mediterranean sea salinity, in Amvrakicos gulf (brackishwater area), source : Moraitou-Apostolopoulou *et al.* 1976 & 1986. b) in the lagoon of Ebrié - Ivory Coast (brackishwater area), source : Saint-Jean & Pagano 1984 and unpublished data.

MATERIAL AND METHODS:

Sampling was carried out at different periods during 1978-79, 1981 and 1983 for Greece and every month in 1981-82 and 1984-85 for Ivory Coast. Simultaneous measurements for temperature, salinity and phytoplankton were also performed. About 100 mature female *Acartia* were examined from each sample. In order to estimate the interacting influences of different environmental parameters we performed correlations and regression analysis between the length of cephalothorax and the three environmental factors.

RESULTS:

The ranges of salinity, temperature, phytoplankton and length of cephalothorax were:

	Salinity (‰)	Temperature (°C)	Phytoplankton	cephalotorax (m)
Saronicos	37.7-38.2	13.7-23.7	1 - 492 *	941 - 995
Amvrakicos	7.0-36.0	7.0-27.0	669 - 1634 *	919 - 950
Ebrié	0.0-30.0	25.0-31.0	2 - 128 **	604 - 933

* 103 cell/ml ** mg(chla + pheopig.)/m3.

The correlations between the length of cephalothorax of *Acartia* and the environmental factors are shown in table 1.

		Temp.(°C)	Sal.(‰)	Conc.(phytopl.)
GREECE	simple	0.520 NS	0.881 ***	-0.747 *
(n=7)	partial	0.450 NS	0.528 NS	-0.081 NS
IVORY COAST	simple	0.168 NS	0.795 ***	0.137 NS
Tot.(n=114)	partial	-0.055 NS	0.791 ***	-0.113 NS
S > 7‰.	simple	0.462 **	0.615 ***	-0.101 NS
(n=38)	partial	0.447 **	0.580 ***	-0.146 NS
S < 7‰.	simple	0.236 *	0.474 ***	0.407 ***
(n=76)	partial	0.011 NS	0.301 **	0.175 NS

Tab. 1.- Simple and partial correlations between cephalothorax and Temperature, Salinity & Phytoplankton concentration. NS no significant, * 95%, ** 99%, *** 99.99% significant.

The correlations prooved that, among the three environmental factors considered, salinity appears to be the primary factor influencing the formation of the body size of *Acartia clausi* for the three examined areas.

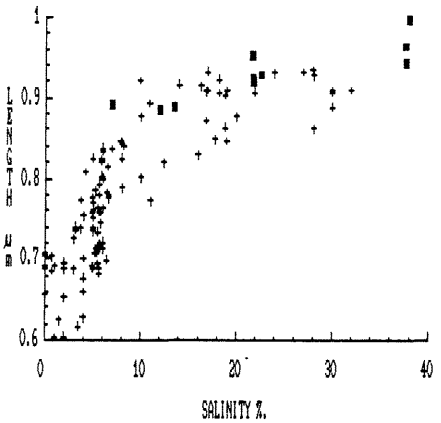

Fig.1.- Relationship length - salinity for Greece (■) and Ivory Coast (+).

For low salinities, between 0 and 7 ‰., the relationship length-salinity is expressed by an important increase; for higher salinities, 7-38.5‰., the increase is less important (fig.1).
There is no statistically significant (t-test) difference between the examined areas : linear models for S > 7 ‰. with slopes of 0.0034 and 0.0028 for the Ivory Coast and Greece respectively and intercepts of 0.86 and 0.82.

CONCLUSION :

From the study of the data the following were observed : a) increases in salinity leads to increased length of cephalothorax, b) temperature and phytoplankton concentration play a secondary role as opposed to what happens when salinity does not vary (marine environments).

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P

Joint effects of temperature and salinity on the mortality of *Tisbe*

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The study of the effects of the environmental factors on the physiology of organisms enables one to fix tolerance limits and to define the most favourable conditions for the optimal energy balance of the individuals.Among the marine metazoan species the most easily reared in the labaratory through a complete cycle,harpacticoid copepods of the genus *Tisbe* are the most interesting because of their tolerance to environmental factors ,their substantial reproductive capacity and their short life cycle.

In this study we examined the joint action of temperature and salinity on the mortality of *Tisbe* as these factors appear to play a predominant role in its natural biotope.We have tested three temperatures (14,19 and 24°C),four salinities (26,32,38 and 44%.) and all their combinations,in order to examine possible interactive or synergetic effects.

The experimental specimens came from labaratory cultures regularly enriched with individuals from the Gulf of Saronikos, in order to avoid inbreeding effects.A limited number (15-20) of fertilized females carrying egg sacs were isolated from the mass culture and placed in 50 ml glass containers.Immediately after egg hatching the parental females were removed from the containers,which were examined daily for 16 days.The counting was done under a binocular microscope by transfering individual nauplii and copepodites.

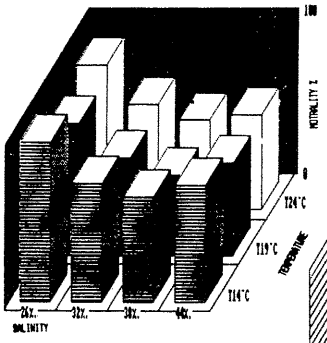

Fig.1.Histogram of mortality% at the 16th day to all the combinations of: S:26,32,38,44% T:14,19,24 C

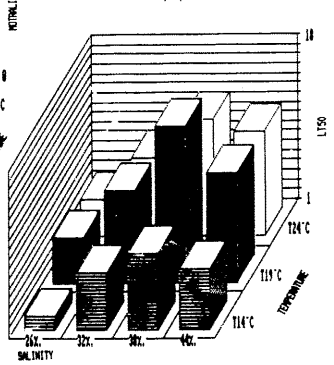

Fig.2.Histogram of LT50 to the combinations of: S:26,32,38,44% T:14,19,24 C

	b	m	r	LT50	MI
T24°C-S26%.	-0.601	31.86	0.9990	4.8	87.74
T24°C-S32%.	-0.972	23.31	0.9910	8.9	63.65
T24°C-S38%.	-3.091	20.82	0.9678	12.8	54.63
T24°C-S44%.	-4.939	22.44	0.9607	11.6	57.29
T19°C-S26%.	-0.166	28.95	0.9990	5.6	80.12
T19°C-S32%.	-1.939	22.23	0.9960	10.35	59.69
T19°C-S38%.	0.040	17.63	0.9999	17	48.91
T19°C-S44%.	-1.707	20.77	0.9980	12.1	55.87
T14°C-S26%.	27.960	24.88	0.9885	2.4	96.95
T14°C-S32%.	-0.041	26.07	0.9999	6.8	72.01
T14°C-S38%.	0.914	23.00	0.9999	8.75	63.87
T14°C-S44%.	-1.814	26.19	0.9976	7.2	70.86

Table 1.b:y-intercept, m:slope, r:correlation coefficient, LT50:time for 50% mortality, MI:mortality% for the 16th day, calculated the equation y =b+mlnx, y:mortality, x:day.

	MI	RES.	LT50	RES.
T24°C-S26%.	86.520	1.2295	4.442	0.3580
T24°C-S32%.	63.168	0.4818	10.157	-1.2473
T24°C-S38%.	54.152	0.4782	12.378	0.4323
T24°C-S44%.	59.471	-2.1805	11.103	0.457C
T19°C-S26%.	81.839	-1.7195	6.180	-0.5795
T19°C-S32%.	58.488	1.2918	11.895	-1.5448
T19°C-S38%.	49.472	-0.5618	14.115	2.9048
T19°C-S44%.	54.790	1.0798	12.841	-0.7805
T14°C-S26%.	96.600	0.3505	1.222	1.1980
T14°C-S32%.	73.248	-1.2382	6.937	-0.1373
T14°C-S38%.	64.232	-0.3618	9.126	-0.4077
T14°C-S44%.	69.551	1.2495	7.883	-0.6530

Table 2.Mortality%,LT50 and their residuals calculated with the multipe regression analysis.

Statistical analysis of the daily observed mortality%, caused by each experimental condition,indicated that the data followed a logarithmic curve,which can be expressed as y= b+m.lnx , y:mortality %, x:day.Table 1 shows the y-intercept(b),the slope(m),the correlation coefficient(r),the mortality% for the 16th day and the lethal time for 50% mortality (LT50),calculated for each combination of the tested factors,with the above linear equation.

At all salinities the mortality% decreased from 14° to 19°C and increased from 19° to 24°C. At all temperatures the mortality % decreased from 26%. to 38%. and increased from 38%. to 44%. (Fig.1).Temperature had a substantial effect on the mortality,although the action of salinity was more limited.The values of LT50 were low in low salinities and temperatures,while the lowest value corresponding to the combination of 19°C 26%. indicated a very rapid mortality of the nauplii (Fig.2).

The correlation between the mortality% on the 16th day,or the LT50,and the tested values of the one examined factor (temperature or salinity) can be expressed by the quadratic equation $y=a_0+a_1x+a_2x^2$.The trivariate data of the joint effects of temperature (y) and salinity (x) on the mortality or the LT50 (z) fitted to a multiple non linear regression are expressed by the following polynomial equations:

1.z=492.9135-15.0032x+0.1991x2-14.9786y+0.3888y2-0.023xy,z:M%,r=0.9976

2.z=-104.6186+3.5059x-0.0484x2+4.9615y-0.1342y2+0.0133xy,z:LT,r=0.9592

Table 2 shows the values of mortality% (for the 16th day),LT50,and their residuals,calculated with the above equations,for each examined combination.

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Les Copépodes des îles Baléares en rapport avec les masses d'eau

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On présente les résultats de l'étude des populations de copépodes prélevés dans des pêches verticales effectuées par paliers entre 0-50, 50-200 et 200-500 m., et de l'identification des masses d'eau présentes dans la mer des Baléares jusqu'à 1000 m. de profondeur.

Ces études ont été réalisées pendant les périodes d'homothermie (mars), de formation de la thermocline (mai) et de stratification des eaux (septembre).

COPEPODES

La distribution verticale du nombre des copépodes (ind./m3) montre que plus de 95 % de la population se trouve au-dessus de 200 m. D'après les chiffres obtenus on constate que cette population est relativement pauvre, présentant des densités plus hautes pendant la période d'homothermie que durant la stratification des eaux. Les basses valeurs observées en surface en mars s'expliquent par une plus grande compétition alimentaire en présence des grandes populations d'animaux gélatineux (Siphonophores, Méduses et Salpes).

Au total on a déterminé 116 espèces dont 16-18 (selon l'époque de l'année), représentent à peu près les 90 % de la population totale, tandis qu'une centaine atteignent difficilement les 10 % restants. Dans le premier groupe on y trouve les espèces pérennes, communes dans toute la Méditerranée. Dans le second il y a les espèces les plus intéressantes du point de vue hydrologique. Cet ensemble renferme le groupe qui réalise une forte migration verticale (tableau I) et un autre qui effectue seulement de petits déplacements.

HYDROGRAPHIE ET COPEPODES

Quelques auteurs dont BANSE, (1964), ont indiqué que les populations planctoniques sont liées aux masses d'eau où elles habitent et que la dynamique de ces masses peut expliquer généralement leur distribution.

En utilisant les valeurs de salinité et de température nous avons identifié les masses d'eau qui se trouvent dans la mer des Baléares.

On peut dire que la mer qui entoure notre Archipel est occupée, dans les niveaux superficiels (0-50 m.) par un mélange d'eaux dont la salinité à l'exception de la partie nord, n'atteint pas 38 % et dépend d'une plus ou moins grande influence de l'eau atlantique qui se manifeste au maximum pendant le mois de septembre.

Entre 50-200 m., nous trouvons les eaux septentrionales, spécialement dans les stations du versant nord, l'aire d'Ibiza et le canal de Mallorca. Avec des valeurs

TABLEAU I. - Valeurs moyennes du nombre de Copépodes/m³

Prof. (m)	Mars n	Mars %	Mai n	Mai %	Septembre n	Septembre %
0-50	391	60.3	253	64.1	291	71.8
50-200	235	36.2	125	31.0	103	25.5
200-500	22	3.4	19	4.8	10	2.6

TABLEAU II - Espèces subsuperficielles trouvées fréquemment à la surface pendant la nuit.

Calanus gracilis	Pontellina plumata
Scolecithricella dentata	Oncaea venusta
Euchirella sp. juv.	Lucicutia flavicornis
Pleuromamma gracilis	Vettoria granulosa
Pleuromamma abdominalis	Clytemnestra rostrata

de salinités au-dessous des normales, en mars (T = 13°C, S = 38,1 %) comme conséquence du mélange avec des eaux plus denses mais moins salées, de formation régionale, ou bien à la suite d'influences continentales (canal d'Ibiza) et, avec des valeurs très caractéristiques en mai (T=13°C, S = 38,2 %) moment où son épaisseur est plus grande. Finalement, pendant l'été océanographique (septembre), ces eaux montrent un processus de mélange avec les eaux orientales qui se trouvent au-dessous.

TABLEAU III. - Espèces très fréquentes dans les masses d'eaux observées dans la mer des Baléares. (Les valeurs entre parenthèses indiquent le pourcentage de l'espèce. trouvée dans chaque niveau considéré).

MARS		MAI		SEPTEMBRE	
0-50 m.					
Ischnocalanus plumulosus	(100)	Ischnocalanus plumulosus	(100)	Ischnocalanus plumulosus	(83)
Calocalanus styliremis	(91)	Calocalanus styliremis	(84)	Calocalanus styliremis	(94)
Calocalanus pavo	(89)	Calocalanus pavo	(84)	Calocalanus pavo	(88)
Clausocalanus furcatus	(?)	Clausocalanus furcatus	(78)	Clausocalanus furcatus	(98)
Diaixis pygmoea	(85)	--		--	
Centropages violaceus	(100)	--		Centropages violaceus	(94)
--		--		Candacia aethiopica	(100)
Candacia simplex	(100)	--		Candacia simplex	(100)
--		--		Acartia danae	(95)
--		--		Copilia mediterranea	(100)
Farranula rostrata*	(94)	Farranula rostrata	(82)	Farranula rostrata	(84)
50-200 m.					
Clausocalanus pergens	(?)	Clausocalanus pergens	(59)	Clausocalanus pergens	(62)
Aetideus armatus	(88)	Aetideus armatus	(97)	Aetideus armatus	(75)
Euaetideus giesbrechti	(69)	--		Euaetideus giesbrechti	(100)
--		--		Pleuromamma borealis	(100)
--		--		Pleuromamma robusta	(100)
Sapphirina sali	(100)	--		Sapphirina sali	(100)
--		Corycaeus furcifer	(65)	Corycaeus furcifer	(62)
200-500 m.					
Chiridius poppei	(100)	Chiridius poppei	(100)	Chiridius poppei	(70)
--		Scolecithricella abyssalis	(100)	Scolecithricella abyssalis	(100)
Spinocalanus abyssalis	(79)	spinocalanus abyssalis	(100)	Spinocalanus abyssalis	(96)
Pachos sp.	(100)	--		--	
--		Oncaea dentipes	(100)	Oncaea dentipes	(100)
Mormonilla minor	(100)	Mormonilla minor	(67)	Mormonilla minor	(66)

Entre 200 et 600 m. on y trouve l'eau orientale qui entoure les îles d'une façon très évidente (T = 13.2°C, et S = 38.5 %) pendant le mois de mars, spécialement dans la partie septentrionale de l'Archipel, canal d'Ibiza et de Mallorca. Dans cette période on observe que cette masse d'eau a une grande puissance. D'autre part en mai, malgré sa claire identité, son épaisseur semble être, dans certains endroits, comprimée entre l'eau septentrionale plus puissante à ce moment, et l'eau profonde. Leur présence devient moins claire en septembre par suite du mélange en profondeur avec les eaux adjacentes. De plus on observe que la température la plus élevée, est inférieure à 13.1°C, ce qui semble indiquer que ce mélange affecte toute l'épaisseur de la nappe d'eau. Sur les stations méridionales, dans lesquelles l'eau septentrionale se manifeste avec moins de puissance, l'eau orientale se trouve à des niveaux moins profonds.

Au-dessous de ces eaux, près du niveau de 600 m, nous trouvons les eaux profondes, pratiquement pendant toute l'année, et en été seulement ses limites s'estompent par des processus de mélange qu'on a déjà indiqués.

En relation avec les pêches verticales, effectuées pratiquement dans les masses d'eaux identifiées, nous trouvons un ensemble d'espèces qui sans être typiquement indicatrices, caractérisent les populations de copépodes qui y habitent.

De la comparaison de ces groupes on déduit que pendant la campagne de septembre, avec une grande importance des eaux atlantiques, nous trouvons une plus grande diversité spécifique. Calocalanus pavo, Centropages violaceus et Acartia danae avec les autres espèces citées dans le tableau III, se trouvent bien représentées dans la masse d'eau atlantique.

Les eaux septentrionales qui se manifestent clairement entre 50-200 m., présentent de notables affinités spécifiques dans les trois campagnes effectuées. Et en ce qui concerne le reste, la strate de 200-500 m., étant donnés les mélanges observés, nous pouvons citer seulement Chiridius poppei, Spinocalanus abyssalis (sensu lato) et Mormonilla minor, comme espèces les plus typiques des populations qui habitent les eaux orientales.

P-II10

Tuscan Northern Tyrrhenian netzooplankton Autumn 1986

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During a cruise in the northern area of the Tuscan Tyrrhenian Sea (fig.1) in autumn 1986 zooplankton was sampled with a WP2 net (200 um mesh size) at 24 stations, by vertical hauls from 50 m to surface. Taxonomical analysis were carried out on a significant subsample, ash free dry weight (A.F.D.W.) was obtained as indicated in Lovegrove (1966).

We found 43 species and 9 genera of Copepods, all of these, with the only exception of Diaixis pigmoea and Pseudocalanus elongatus, strictly coastal species, are considered by Scotto di Carlo et al. (1984) as typical epipelagic tyrrhenian zooplankter.

On the contrary there is not a good accordance with Vives (1967) data for the same area, probably because we have sampled only at surface layers.

Copepods prevail in the whole area: the most common genera are Oithona (O. helgolandica, O. plumifera, O. setigera), Clausocalanus (C. arcuicornis, C. furcatus), Temora (T. stylifera), Paracalanus (P. parvus), Corycaeus and Oncaea. Also the copepodits and the juvenile stages of all the Copepods are very abundant. Among the other zooplanktonic groups only Tunicata (with genera Oikopleura and Doliolum) and Chaetognatha (with genus Sagitta) show a relatively high density.

Density values (as individuals . m) range from a minimum of 163 (st. 32) at maximum of 1865 and 1545 ind. . m (st. 7 and 21); ge-

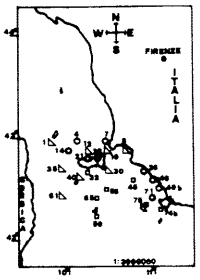

fig. 1

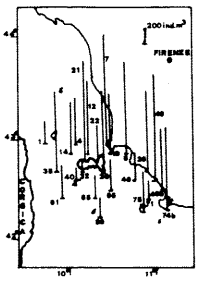

fig.2

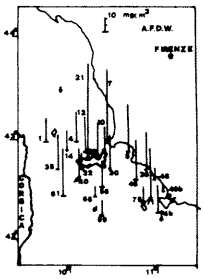

fig.3

nerally speaking, the higher values are found around Elba island and near the tuscan coast (fig.2).

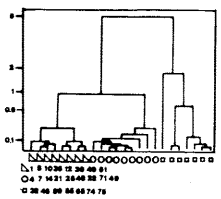

fig. 4 log dissimilarity scale

Higher values of A. F. D. W. were found at stations 21 and 7 (respectively 74.9 and 57 mg . m^3), the minimum at station 49 bis (3.6 mg . m^3). The A.F.D.W. values have a distribution similar (fig.3) to that of density values (as ind. . m^3), even if not perfectly corresponding. Differences are due to the composition of netzooplankton population and are stronger when the density of Protozoa, antomedusae, doliola and young copepodits are very high.

Based on the Copepod epipelagic populations we have separated the sampling stations into homogeneus groups by using an ordination method (clustering analysis on a distance matrix (option chord) (Lagonegro and Feoli, 1985) (fig.4).

So we can distinguish three areas (fig. 1):
the first, comprising stations 4, 7, 14, 21, 22, 26, 48, 49 bis and 71 strictly associated and characterized by neritic species,
the second (st. 1, 8, 10, 12, 30, 35, 40 and 61), also well associated and with a relatively good correlation with the first, wich we consider also influenced by neritic characters and, at last,
the third, constituted by stations belonging to the central area of the sampling rectangle (st. 32, 46, 55, 65, 74 bis, 75 and 89), with more oceanic characters.

To sum up, the tuscan northern tyrrhenian area is characterized by a relatively rich netzooplankton surface biomass both as regards its density values (as ind. . m^3) and A.F.D.W. values. The epipelagic Copepods prevail all around the sampling rectangle, only near the tuscan coast and Elba island do we find some typical low salinity species.

The stations' rank order, produced by cluster analysis, individualize two distinct neritic groups, located both eastward and westward of an oceanic central group.

Consequently we conclude that not only does the tuscan coast influence the netzooplankton surface distribution, but also that of Corsica and Elba islands.

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P-II11

Copepod community of the Maloston Bay (Middle Adriatic) as affected by natural eutrophication

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The paper decribes some results on qualitative and quantitative investigations of copepods in the Maloston Bay, unpolluted, but naturally eutrophicated area in the Middle Adriatic.

Since copepods, the best represented group of net zooplankton respond quickly, both by composition and quantity, to the changes of the environment they inhabit, the consequences of eutrophication on the copepod community of the Maloston Bay will be discussed here. Basic hydrographic parameters (T°C, Sal°/oo and density) showed that the whole area is under a very strong influence of the land (Vukadin et al. 1986). The influence of river Neretva is strong too, but of very short duration.

Material for these investigations was collected by a "Hensen" plankton net (73/100, silk No 3), from bottom to surface in the 1985/1986 period, and some results from 1980/1981 were used, too. Station 1 (25 m depth) is situated at the entrance to the bay, station 2 (20 m depth) in front of Klek, station 3 (20 m depth) in front of Neum, station 4 (8 m depth) at the entrance to the creek named Bistrina, and station 5 (75 m depth) in the Mljet Channel (Fig.1). A total of 40 species and 2 genera (with about 6 species) were recorded from the whole area of bay. Most of them are common neritic species, widely distributed in all inshore Adriatic areas. The dominant species were: Ctenocalanus vanus, Paracalanus parvus, Centropages typicus, Centropages kröyeri, Temora stylifera and Acartia clausi.

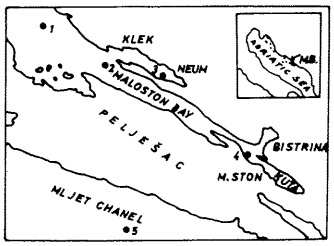

Fig.1. The study area

The occurence of Nannocalanus minor, Calanus tenuicornis, Clausocalanus pergens, Clausocalanus parapergens and some others, is indicative of some open sea effects, since they are predominantly pelagic. The biggest number of such species were found at station 5 in the Mljet channel (as it is under the strongest influence of the open sea), in winter or even in summer, depending on the system of currents in the Adriatic (Zore-Armanda et al. 1974).
Besides, we could not find either the seasons for the incoming of pelagic species to the bay, nor the seasons for the maximum number of species, as they were caused by some determined situations (direction of currents, winds etc.).

As the composition of copepods is very similar in the recent investigations to the previous data (Buljan et al. 1973), we can conclude that it has not been changed in the longterm period under the influence of eutrophication from the adjacent land.

Besides the composition the number of species, the number of copepods /m^3, the diversity indices were also studied. At Tab.1., the data from 1980/81 and 1985/86 period were compared for all above-mentioned parameters.

Tab.1. The number of copepod species, the number of copepods/m ^{3} and the diversity indices in 1980/81 and 1985/86 period

	The number of species		The number of copepods/m ^{3}		Diversity indices	
	1980/81	1985/86	1980/81	1985/86	1980/81	1985/86
Station 1	26	26 + 2	399	769	4.00	4.07
Station 2	22	22 + 3	421	959	3.47	3.50
Station 3	23	23 + 2	584	1266	3.45	3.36
Station 4	18+1	18 + 2	293	1595	2.29	2.58
Station 5	33+1	29 + 3	186	370	4.21	4.30

It can be seen that the composition of copepods- number of species, has not been changed in the five-year period inspite the influence of eutrophication from the adjacent land.

The values of diversity indices (Margalef, 1951) - as an impresion of the copepod structure - do not show any difference in 1985/86 year in comparison with these in 1980/81 year.

On the contrary, comparing the abundance of individuals, we found in the last period 2-5.4 times higher values in the whole investigated area. Such an evident increase in the five-year period, we could only connect with effects of eutrophication in the Maloston Bay area, that have caused the first step of changes in the copepod community. Besides, this increase was the highest at the station 4, situated at the creek of the bay, i.e. the most threatened area.

Summing all these results mentioned above, we can conclude that the increase of the copepod number in the Maloston Bay area is the only sign of natural eutrophication for the copepod community of the investigated area.

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P-II12

Zooplankton composition and distribution up to 3000 m depth in the NW Levantine Sea

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Among the few studies on the offshore zooplankton of the Eastern Mediterranean Sea, only three describe zooplankton composition below 200m in single scattered stations of the Levantine Sea.

During Spring 1986, zooplankton samples were collected in four stations of the NW Levantine Sea. Sampling was performed by vertical hauls of a WP-2 closing net and sampling layer ranges were chosen after profiles provided by a CTD-cast.

Maximum values of zooplankton density were observed in the upper layer, followed by a reduction with depth. Below 1000m, only 0.1 to 0.2 ind/m^3 were found. Comparison of our data with previous studies seems to be difficult because of different sampling methods. Zooplankton density does not differ significantly among Levantine, S.Aegean and Ionian Sea (Pancucci & Anagnostaki, 1987), varying between 27 and 90 ind/m^3 for the layer 0-500m. Results from the S.Mediterranean Sea (Porumb et al., 1981) showed higher values (310 ind/m^3) for the layer 0-400m. As the mean copepod percentage in the above areas was 80%, their density seems to be in agreement with Scotto di Carlo et al.(1984) for the layer 0-500m.

As far as the composition is concerned, a decrease of the number of the taxonomic groups was observed with the depth. Copepods were by far the dominant constituent, with percentages between 64% and 92%. Their importance generally increased with the depth except in some cases, where ostracods presented maximum percentage. The latter group was the second in abundance and occurred in higher values in the mesopelagic layer. Among the other plankters, chaetognaths were constantly present in relatively large numbers throughout the water column. Important contribution to zooplankton community of ostracods and chaetognaths was also reported for the Tyrrhenian Sea (Scotto di Carlo et al.,1984) and Levantine Sea (Delalo, 1966). Kimor and Wood (1975) also reported high percentages of ostracods between 3000 and 4000m east of Rhodos island. A total of 96 copepod species were identified, most of them being distributed in the two upper layers, while only 6 to 9 species were found in the layer below 1000m.

Copepod species can be distinguished in four groups according to their depth distribution : a) epipelagic species, like Corycella rostrata, Oithona helgolandica, Corycaeus typicus, Clausocalanus furcatus, Clausocalanus arcuicornis, Clausocalanus jobei, Paracalanus denudatus and Mecynocera clausi, with maximum abundance between 0 and 200m; b) Species abundant between 0 and 500m, like Oncaea media, Oithona plumifera, Oncaea mediterranea and a great number of copepodite stages of Clausocalanus; c) Subsurface and intermediate species, with max abundance from 150 to 700m : Lucicutia gemina, copepodites of Lucicutia, Scolecithrix bradyi, Pleuromamma gracilis, Scolecithricella spp.; d) Species abundant between 500 and 3000m, like Eucalanus monachus, Euchirella messinensis and Oncaea sp.

Our results are partly in agreement with Delalo's (1966) data for the layers between 100 and 500m. Zooplankton collected west of Rhodos Island (Siokou-Frangou, 1987) showed a similar specific composition. This similarity was mainly observed between the station 54 and the SE Aegean sea. Though, we could reenforce the hypothesis of Pancucci and Anagnostaki (1987) that a communication seems to exist between the Levantine Sea and the SE Aegean Sea through the Rhodos strait, confirming also the water circulation in the area.

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P-II13

Observations sur le zooplankton de la mer de Rhodos (NO mer du Levant et SE mer Egée)

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L'archipel des Dodekanèses est un milieu marin intéressant à étudier à cause des influences hydrologiques et biologiques qu'il subit, d'un part de la mer Egée- Sud et d'autre part de la mer du Levant. Des études de zooplancton ont été menées tant dans les eaux côtières de l'île de Rhodos que dans les eaux du large qui entourent l'île (SE mer Egée et NW mer du Levant). Certains points intéressants ont été rélevés, concernant la composition, la répartition et la structure du zooplancton de cette région.

Des échantillons de zooplancton ont été recoltés: a)par traits verticaux d'un filet WP-2, en Février et Mai 1984 sur cinq stations échellonnées le long des côtes de l'île de Rhodos (profondeur entre 50 et 350m); b)par traits verticaux en couches successives d'un filet WP-2 fermant, en Mars- Avril 1986 sur cinq stations (profondeur entre 600 et 3000m) dispersées en haute mer autour de l'île. Les niveaux d'échantillonnage ont été choisis selon les diagrammes de température et de salinité fournis par un CTD-cast.

L'étude des échantillons recoltés, tant dans les eaux côtières qu'en mer ouverte, a révelé une forte dominance des copépodes, pour la colonne 0-500m, les cyclopoides ont présenté des pourcentages importants (33 à 69%), correspondant à un grand nombre d'espèces des genres Oncaea, Oithona, Corycaeus et Corycella. Les espèces les plus abondantes ont été Oithona plumifera, Oncaea media, Oncaea mediterranea et les copepodites de Clausocalanus. En nombre important ont été trouvées Corycella rostrata, Corycaeus typicus, Mecynocera clausi, tandis que Clausocalanus arcuicornis, Ctenocalanus vanus, Euaetideus giesbrechti, Scolecithrix bradyi, Scolecithricella spp. y étaient fréquentes. Concernant la repartition horizontale des espèces, on remarque la plus forte abondance de Clausocalanus furcatus dans les eaux côtières, une abondance de Lucicutia gemina plus elevée en haute mer que près de la côte tandis que Lucicutia flavicornis présente une distribution inverse. Parmi les autres groupes les ostracodes et les chaetognathes ont révelé une fréquence relativement importante dans l'ensemble de la région; au contraire la présence minime des cladocères et du méroplancton a été remarquée.

Une ressemblance de la composition paraît exister entre le zooplancton côtier et celui de la haute mer. Parmi les espèces abondantes et fréquentes plusieurs sont océaniques et malgré l'abondance de l'espèce néritique C.furcatus, un caractère plutôt océanique pourrait être attribué au zooplancton des eaux cotières de l'île de Rhodos. Ce caractère est renforcé par la présence minime des cladocères et du méroplancton et par les hauts indices de diversité rélevés tant dans les eaux côtières (3,6 à 4,5 bits/ind.) que dans les eaux du large (3,8 à 4,4). L'influence de la haute mer sur les eaux côtières de l'île de Rhodes pourrait être due à l'intense circulation et aux échanges d'eau entre la mer du Levant et la mer Egée- Sud, ainsi qu'à l'étroitesse du plateau continental de l'île de Rhodos.

La présence, bien que rare, de Penilia avirostris dans la région en profondeur entre 100 et 1000m, paraît être intéressante parce que cette espèce n'a pas été citée auparavant ni en mer Egée- Sud ni en mer du Levant.En eau profonde au large de Villefranche- sur- mer elle a été signalée par Tregouboff (1963).

En mer du Levant des siphonophores ont été trouvés à une profondeur supérieur à 1000m fait cité par ailleurs par Kimor & Wood (1975). La présence des appendiculaires en eaux profondes pourrait être liée soit à leurs exigences trophiques, les eaux profondes de la région étant riches en coccolithophores (Bernard, 1967), soit à une contamination possible des échantillons profonds par le plancton de surface.

Un autre point intéressant est la dominance et la grande diversité des cyclopoides Oithona, Oncaea, Corycella et Corycaeus dans la région étudiée. D'après Raymont (1982) ces genres sont abondants dans les mers chaudes, comme la mer des Sargasses (Deevey, 1971).Kimor & Berdugo (1967) ont trouvé en grand nombre ces genres en été dans la zone 0-200m de la mer du Levant, tandis que Delalo (1966) y a remarqué leur diversité importante.

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P-II14

Description de quelques larves planctoniques appartenant à la famille des Calappidae (Crustacea, Decapoda, Brachyura)

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Des formes larvaires planctoniques appartenant à la famille des Calappidae sont décrites : l'une au stade I a été rapportée à Calappa granulata (L.) seule espèce connue de la province Atlanto-Méditerranéenne. Les autres, obtenues à différents stades dans le plancton des eaux jordaniennes (Golfe d'Aqaba), ont été rattachées à la sous-famille des Matutinae. Nos connaissances actuelles sur les larves de cette sous-famille ne nous permettent pas de les rapporter à une quelconque espèce adulte connue. En outre, nous suggérons de rattacher le genre Hepatus latreille à la sous-famille des Calappidae. Ce genre a été rattaché avec quelques autres dans une unité particulière (dite "parthenoxystomienne"), les Aethrinae, par GUINOT (1966, 1978). Les caractères larvaires ne sont pas concluants. Nous constatons qu'au sein des Calappidae, les larves présentent à la fois des caractères primitifs et évolués. Ceci indique que cette famille est loin de constituer un groupe naturel. D'après nos recherches, leur groupement au sein des Oxystomata semble être le fait d'une simple adaptation à un mode de vie ; le taxon morphotypal Oxystomata a été définitivement rejeté par GUINOT (1978).

Tableau 1 : Caractères larvaires de différentes espèces de Calappidae (Zoé I).

	Calappa lophos (Herbst)	Calappa sp granulata (L.)	Hepatus chilensis H.Milne Edwards	Hepatus ephelitticus (L.)	Matuta lunaris(Forskal)	Matuta planipes (Fabricius)	Matutinae sp Aqaba
Carapace épine rostrale épine dorsale épines latérales	présente " "	présente " "	présente " "	présente " "	présente " absentes	présente " absentes	présente " présentes
Projections postéro-latérales sur les segments 3-5	présentes et très courtes	présentes et courtes;celles du 5° sont bifides	présentes et courtes	présentes et courtes	présentes sur le 4° segment, larges ; celles du 5° sont très courtes	présentes sur le 4° segment, très larges ; celles du 5° sont courtes	présentes sur le 4° segment larges ; celles du 5° sont petites
telson	large,furca bien développée ; échancrure grande et arrondie ; 2+2 épines externes	large,furca bien développée ;grande échancrure arrondie, 3+3 épines externes	large, furca bien développée ;grande échancrure arrondie, 3+3 épines externes	large,furca bien développée, 2+2 épines externes	presque aussi long que large,avec 3+3 épines externes.	presque aussi long que large, avec 3+3 épines externes.	presque aussi long que large, avec 3+3 épines externes.
Antenne Exopodite	présent ; se termine par2soies inégales.	présent ; se termine par2soies inégales	présent, court; se termine par 2 soies inégales.	présent, court ; se termine par 2 soies inégales.	absent	absent	absent
Endopodite de la Maxillule	2 segments'; segment proximal sans soie ;segment distal avec 6 soies	2 segments ; segment proximal avec 1 soie ; segment distal avec 6 soies	2 segments ; segment proximal avec 1 soie ; segment distal avec 6 soies	2 segments ; segment proximal avec 1 soie ; segment distal avec 2+4 soies	2 segments ; segment proximal avec 1 soie ; segment distal avec 4 soies	2 segments ; segment proximal avec 1 soie ; segment distal avec 3 soies	2 segments ; segment proximal avec 1 soie; segment distal avec 4 soies
Endopodite de la Maxilla	2+2+3 soies	2+2+4 soies	3+2+3 soies	3+2+3 soies	2+2 soies	2+2 soies	2+2 soies
Endopodite de Mxp1	?	3+2+1+2+5 soies	3+2+1+2+5 soies	3+2+1+2+5 soies	3+2+1+3+5 soies	3+2+1+2+5 soies	3+2+1+2+5 soies
Endopodite de Mxp2	1+1+4 soies	1+1+5 soies	1+1+4 soies	1+1+5 soies	1+1+4 soies	1+1+5 soies	1+1+(1+5) soies

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Distribution saisonnière et répartition bathymétrique de Pasiphaea sivado (Crustacea, Caridea) à Villefranche-sur-Mer (mer Ligure)

J. SARDOU et M. ETIENNE

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140 traits de chalut pélagique Isaacs-Kidd 10 pieds ont été effectués tout au long de l'année 1982 par le N.O."Korotneff" à une station située à 8 milles du Cap Ferrat sur la radiale Nice-Calvi. Les pêches, d'une durée de 30 minutes à 2 noeuds, ont été faites à différentes profondeurs: la journée à 50m, 200m, 350m, 500m 800m et 1000m, et la nuit à 50m, 200m, 500m et 800m. Les animaux du macroplancton et micronecton ont tous été comptés, mesurés et certains pesés (poids humide et poids sec). 76 espèces ont été identifiées; la distribution saisonnière et la répartition verticale ont été étudiées pour les 23 espèces d'invertébrés les plus abondants. Tous les comptages ont été ramenés à un volume de 5000m3. Nous donnons ici les résultats concernant le crustacé décapode natantia Pasiphaea sivado.
Nombre total de spécimens récoltés: 1729 (844 dans les pêches de jour et 885 dans celles de nuit). Chaque mois, pour chaque profondeur le jour et la nuit, une valeur moyenne a été calculée pour un volume de 5000 m3.

Distribution saisonnière: elle a été établie à partir de l'ensemble des profondeurs prospectées chaque mois.
Si l'on étudie séparément les pêches de jour et celles de nuit, on trouve quelques petites différences dans la distribution saisonnière de P. sivado en ce qui concerne le maximum d'abondance; celui-ci a été trouvé en hiver dans les pêches de jour et en été dans celles de nuit. Par contre, dans les deux cas le minimum a été rencontré au printemps. La figure 1 montre la distribution saisonnière, en pourcentage, de l'ensemble des individus pêchés le jour et la nuit; on peut voir un maximum en été (53%), un minimum au printemps (6%), l'hiver totalisant 24% et l'automne 17%. FRANQUEVILLE (1971) et VU DO (1978) ont également situé le maximum d'abondance en été, ce dernier auteur précisant même juillet; il trouve le minimum d'abondance en mars-avril. Ces résultats concordent bien avec nos observations. On notera qu'en juillet ont été pêchées de nombreuses Pasiphaea sivado juvéniles (270 à 50m la nuit), avec une longueur de céphalothorax de 8-10mm.

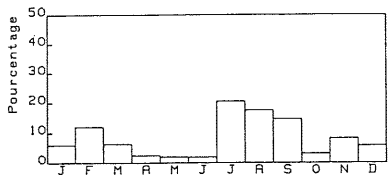

Figure 1.

Distribution saisonnière, en pourcentage, de Pasiphaea sivado, à Villefranche-sur-Mer, en 1982.

Répartition bathymétrique: pour chaque profondeur les moyennes annuelles pour les pêches de jour et pour celles de nuit ont été établies séparément, toujours pour un volume de 5000 m3. La figure 2 montre la distribution verticale en pourcentages. On peut constater que pendant la journée le maximum d'abondance est situé à 350m (55,4%) mais que nous trouvons encore des pourcentages non négligeables à 500m (16,7%), 800m (10,4%) et 1000m (12%). La nuit le maximum s'est renforcé et déplacé vers la surface: 74,6% à 50m, seulement 12,4% à 200m, et pour ainsi dire rien au dessous. On observe donc une migration verticale nycthémérale très nette. Ces résultats sont en parfait accord avec les observations de FRANQUEVILLE (1971), et de VU DO (1978) qui indique un maximum vers 300-400m, le jour. Pour ces deux auteurs, la nuit, il y a également remontée des animaux dans les 200 premiers mètres, dans la zone 0-50m surtout (VU DO). La répartition donnée par CASTELBON (1987) est sensiblement différente, mais il s'agit d'une espèce voisine, Pasiphaea tarda, le nombre total d'individus étudiés est très faible (13) et la période d'étude est très courte.

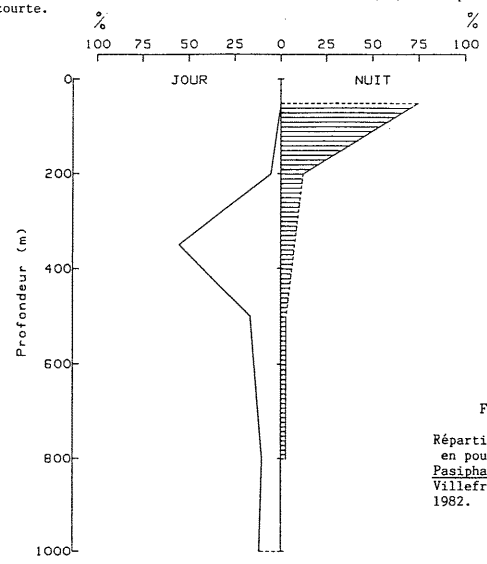

Figure 2.

Répartition bathymétrique, en pourcentage, de Pasiphaea sivado, à Villefranche-sur-Mer, en 1982.

Biomasse:
Le nombre d'individus rencontrés varie selon la saison, la profondeur et aussi le moment de la journée; la concentration maximale trouvée pour cette série de pêches a été de 51 individus pour 5000 m3 dans un trait de nuit à 50m le 20 septembre ce qui représente une biomasse (poids sec) de 6,30 g , soit 1,26 mg par m3. Nous avons rencontré certaines années, à d'autres stations plus proches de la côte (5 milles), des concentrations trois fois plus importantes.

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Distribution saisonnière et répartition bathymétrique de Sergestes arcticus (Crustacea, Penaeidea) à Villefranche-sur-Mer (mer Ligure)

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Le matériel provient d'une série de 140 traits de chalut Isaacs-Kidd 10 pieds effectués tout au long de l'année 1982 par le N.O."Korotneff" à une station située à 8 milles du Cap Ferrat sur la radiale Nice-Calvi, à différentes profondeurs, le jour (50m, 200m, 350m, 500m, 800m et 1000m) et la nuit (50m, 200m, 500m et 800m). Parmi les 76 espèces macroplanctoniques et micronectoniques recensées dans ces prélèvements, nous étudions ici le crustacé décapode pénéide Sergestes arcticus dont 2448 individus ont été capturés (1160 dans les pêches de jour et 1288 dans celles de nuit). Tous les comptages ont été ramenés à un même volume de 5000 m3. Chaque mois, une valeur moyenne a été calculée pour chaque profondeur, le jour et la nuit.

Distribution saisonnière: elle a été établie à partir de toutes les profondeurs prospectées chaque mois. La figure 1 montre cette répartitin saisonnière, en pourcentage, pour l'ensemble des captures de jour et de nuit. On observe un très net maximum en juin, juillet, août et septembre avec 72,7% pour l'ensemble de ces 4 mois, et un minimum pendant les 5 premiers mois de l'année (10,6%); octobre, novembre et décembre totalisent 16,7%. FRANQUEVILLE (1971) et VU DO (1978) indiquent, eux aussi, un maximum estival; le premier auteur trouve un minimum au printemps tandisque que le second le situe en hiver (janvier-février). Ces données correspondent bien à nos observations.

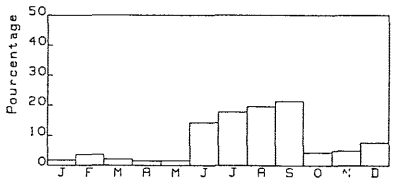

Figure 1.

Distribution saisonnière, en pourcentage, de Sergestes arcticus, à Villefranche-sur-Mer, en 1982.

Répartition bathymétrique:

Les moyennes annuelles, pour chaque profondeur, ont été calculées séparément pour les pêches de jour et pour celles de nuit, pour un volume de 5000 m3. La journée, dans la colonne 50-1000m, nous ne trouvons pas de Sergestes arcticus en dessus de 200m; le maximum se situe de 350m à 500m (37 et 32%), mais les animaux sont encore présents en nombre assez important à 800m (12,5%) et 1000m (14%) ce qui laisse supposer que la distribution s'étend largement au dessous de 1000m.

La nuit, les Sergestes arcticus ont migré vers la surface (82,8% à 50m) et la présence, en dessous de cette profondeur, est extrêmement réduite (il ne reste que 7% à 200m). La figure 2 montre cette répartition verticale, en pourcentage, le jour et la nuit, et met en évidence très nettement une migration verticale nycthémérale. Nos résultats sont en parfait accord avec ceux de VU DO (1978) et de ROE (1984) en ce qui concerne la répartition diurne, et très voisins de ceux de FRANQUEVILLE (1971) qui trouve, lui, un maximum très légèrement plus profond (vers 700m). Nos observations sur la répartition nocturne concordent parfaitement avec celles de ces 3 auteurs, mais diffèrent nettement de celles de CASTELBON (1987) qui trouve, la nuit, un maximum au dessous de 500m, et non pas la grosse majorité des individus dans les 150 ou 200 premiers mètres (mais son étude est limitée dans le temps et porte sur un moins grand nombre d'animaux, pêchés en 2 zones différentes).

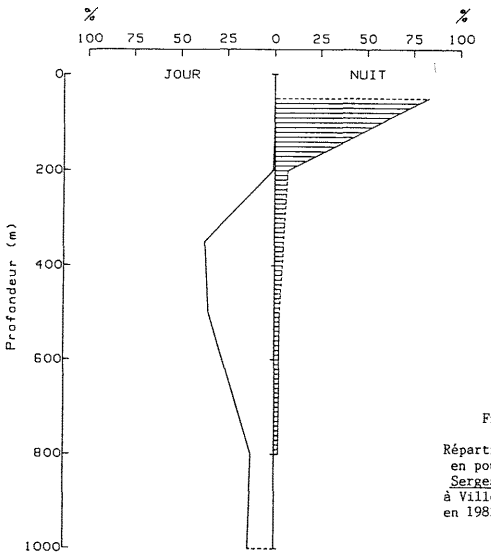

Figure 2.

Répartition bathymétrique, en pourcentage, de Sergestes arcticus, à Villefranche-sur-Mer, en 1982.

Biomasse:

Tous les animaux capturés ont été mesurés et pesés (poids humide et poids sec) ce qui permet de suivre la valeur de la biomasse au cours de l'année. La concentration maximale a été rencontrée dans une pêche de nuit, à 50m, le 20 septembre: 360 individus soit 109 pour 5000 m3; ceci représente une biomasse de 6 g, soit 1,2 mg par m3, identique à celle obtenue pour le décapode Pasiphaea sivado.

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Le méroplancton des eaux Libanaises : larves de Crustacés Décapodes

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Abstract. Composition and distribution of Decapod larvae were carried out from plankton samples collected in Lebanese coastal water during 1986-87. 106 types of larvae at different development stageswere identified belonging to 33 families.Annual cycle showed that summer season(June-September) are the richest period. The most important and frequent species were of the genera: Lucifer,Periclimines,Callianassa,Diogenes,Catapaguroides,Calcinus,Ilia,Neptunus and Acanthonyx.Two Indo-Pacific species were recorded for the first time and comparison with other Mediterranean ares was discussed.

Au cours des années 1986 et 1987,des traits horizontaux à différents niveaux(0,10, 30,50 et 100m) ont été effectués tous les mois en deux stations de la côte libanaise (35°30'E;34°00 N),une station côtière par 75m de fonds rocheux et une autre située au-dessus de 200m de fonds sablo-vaseux.Des filets de type WP2 de 200 et 500 microns couplés sur système Bongo ont été utisés pour les pêches planctoniques.Les prélèvements hydrologiques(T°,S‰) ont été effectués simultanément ;les données ont été rapportées ailleurs(Lakkis et Zeidane,1987).Cette étude sur les larves de Décapodes est la première qui est faite pour la région,mises à part les observations préliminaires que nous avons déjà effectuées(Lakkis,1983).Dans cet article,nous donnons la synthèse sur la composition et la distribution spatio-temporelle des larves de Décapodes qui constituent une fraction très importante du méroplancton levantin.Plusieurs sources de références ont été consultées pour les déterminations et les répartitions biogéographiques notamment quelques travaux de chercheurs méditerranéens tels queKurian (1956),Bourdillon-Casanova(1960),Seridji1971)et Fusté(1982).Par ailleurs,le travail de Holthuis et Gotlieb(1958) constitue la seule référence pour ce qui concerne les Décapodes adultes des côtes orientales de la Méditerranée.

COMPOSITION DES LARVES DE CRUSTACES DECAPODES. Le peuplement larvaire des Crustacés Décapodes des eaux libanaises est richement diversifié, sur les quatre groupes présents dans nos eaux(Macrura Natantia, Macrura Reptantia,Anomura et Brachyura) , ainsi que les Stomatopodes,106 types larvaires ont été déterminés appartenant à tous les stades et comprenant 81 espèces,2 sous-genres,11 genres et 9 familles.

I-MACRURA NATANTIA: Solenocera membranacea,Aristeus antennatus,Aristaemorpha foliacea, Gennadas elegans,Sicyonia carinata,Parapenaeus longirostris,Penaeus kerathurus,P.japonicus,P.semisulcatus,Penaeidae spp.,Sergestes robustus,S.vigilax,S. sargassi, Lucifer typus,L.hanseni,Acanthephyra sp.,Nematocarcinus ensifer,Leptochela sp., Palaemon adspersus,P.elegans,Periclimenes sp.(s.g.Harpillus),Periclimenes sp.(s.g.Periclimenes),Palaemonidae spp.,Athanas nitescens,Alpheus glaber,A.macrocheles,Synalpheus gambarelloides?,Alpheidae spp.,Eualus sp.,Hippolyte inermis,H.longirostris,Lysmata seticaudata,Spirontocaris sp.,Thoralus cranchii,Processa edulis,P.parva,P.nouveli?, Processa spp.,Plesionika sp.,Pandalidae spp.,Philocheras bispinosus,P.echinulatus, P.trispinosus,Pontocaris cataphracta,Stenopus hispidus,S.spinosus.

II-MACRURA REPTANTIA: Scyllarus arctus,Jaxea nocturna,Callianassa laticaudata,C.subterranea,Upogebia sp.

III-ANOMOURA: Clibanarius erythropus,Calcinus ornatus,Diogenes pugilator,Dardanus arrosor,Pagurus cuanensis,Catapaguroides timidus,Anapagurus chiroachantus, A.breviaculeatus,A.hyndmanni,Galatea intermedia,G.dispersa,Porcellana platycheles,P.bluteli, Albunea carabus.

IV-BRACHYURA: Dromia personata,Homola barbata,Phyllodorippe lanata,Ethusa mascarone, Ebalia cranchii,E.tuberosa,Ebalia spp.,Ilia nucleus,Phylira globulosa?, Leucosiidae spp.,Cancer pagurus,Pirimela denticulata,Carcinus mediterraneus,Macropipus spp.,Neptunus sp.,Thia polita,Xantho incisus granulicarpus,Xantho sp.,Xanthidae spp., Pilumnus hirtellus,Eriphia verrucosa,E.spinifrons,Goneplax rhomboides,Pachygrapsus marmoratus,Planes minutus,Brachynotus sexdentatus,Lambrus massena,Maia squinado,M.verrucosa,Eurynome aspera,Acanthonyx lunulatus,Achaeus spp.,Herbstia condyliata,Pisa spp.

LARVES DE STOMATOPODES: Squilla mantis,Lysiosquilla sp.

DISTRIBUTION ET REPARTITION.

1)Distribution saisonnière. Les Penaeidae,notamment les espèces du genre Penaeus,ainsi que des Caridae tels que Hippolyte inermis,Processa edulis et P.parva sont abondantes au printemps et en été avec une tendance mésopélagique. Chez les Anomoures,les formes printanières les plus communes sont:Clibanarius erythropus,Anapagurus breviaculeatus,Galathea intermedia,Porcellana bluteli et Calcinus ornatus. Parmi les Brachyoures les plus abondants au printemps-été,signalons Ilia nucleus,Macropipus spp.,Neptunus sp.,les Xanthidae,les Grapsidae,les Majidae ainsi que Squilla mantis. Les formes hivernales les plus fréquentes entre décembre et mars sont:Callianassa subterranea,Gennadas elegans,Sergestes robustus,S.sargassi,Lucifer typus,Ebalia tuberosa. Plusieurs types larvaires sont perannuels avec toutefois des fluctuations saisonnières d'abondance,parmi ceux-ci citons Leptochela,Plesionika,Periclimenes(Harpillus),Alpheus ruber,Diogenes pugilator,Catapagurus timidus,Processa sp.,Upogebia deltaura,Neptunus pelagicus,Spirontocaris.

2)Répartition verticale. Parmi les formes superficielles les plus fréquentes nous avons des Alphaeidae,Upogebia,Diogenes,Calcinus,Ilia,Phylira, Macropipus,Pilumnus,Pachygrapsus,Brachynotus et Acanthonyx. Les types larvaires profondes sont aussi variées et fréquentes surtout durant l'homothermie hivernale et parfois au delà de la limite de la thermocline estivale.Signalons parmi elles Lysmata,Spirontocharis,Processa spp.,Callianassa laticauda,C.subterranea,Catapaguroides,Anapagurus breviaculeatus,Porcellana platycheles et Squilla mantis.

3)Répartition géographique. Le peuplement larvaire de Crustacés Décapodes des eaux libanaises et levantines,appartient à la faune tempérée méditerranéenne;la majorité des espèces sont signalées en Méditerranée occidentale et en Adriatique. La situation géographique de cette région et surtout l'émigration de formes indo-pacifiques et érythréennes à travers le canal de Suez,enrichissent le peuplement planctonique local en espèces tropicales et subtropicales qui sont devenues pour la plupart des formes endémiques.En effet 16 types larvaires la plupart d'origine indo-pacifique et qui sont présents régulièrement dans les eaux levantines n'ont pas encore été signalés en Méditerranée occidentale.Parmi ceux-ci signalons Parapaeneus,Lucifer hanseni,Nematocarcinus,Leptochela,Periclimenes(Harpillus),Phylira,Xantho sp.,Planes minutus,Processa nouveli,Stenopus hispidus,Pagurus cuanensis et Anapagurus hyndmanni. Par ailleurs,plusieurs de ces fromes larvaires,entre autres,n'ont pas été signalées à l'état adulte par Holthuis et Gotlieb;ce qui laisse penser que l'émigration des formes larvaires à travers le canal de Suez est quasi permanente, alors qu'elle est plus difficile pour les formes adultes.Ainsi ce phénomène d'émigration qui enrichit la faune planctonique levantine,suscite par ailleurs des problèmes d'ordre écologique et biogéographique qu'il s'agit d'étudier.

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Répartition du Chaetognathe Spadella birostrata dans la Province Atlanto-Méditerranéenne. Sa place dans l'écosystème bentho-planctonique

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La mise en évidence d'un peuplement varié de Chaetognathes bentho-planctoniques, jusque là insoupçonné, m'a permis de décrire, récemment, une dizaine d'espèces nouvelles, parmi lesquelles deux *Spadella* dans les parages de Gibraltar (Casanova, 1987), vivant sur des fonds compris entre 150 et 555 m.

Afin de poursuivre les recherches à ces profondeurs, j'ai obtenu du matériel de J.-C. Sorbe* (Station biologique d'Arcachon), qui a mis au point et décrit (1983) un traîneau muni de quatre filets rectangulaires, destiné à l'échantillonnage quantitatif de la faune suprabenthique néritique.

Les six premiers prélèvements étudiés ont été effectués au sommet du talus continental (300 m), sur une station en face d'Arcachon. Ils proviennent des deux filets inférieurs ayant échantillonné la couche d'eau entre 0 et 50 cm du fond; en voici quelques caractéristiques : 0,13 m2 d'ouverture utile, 3 m de longueur et 0,5 mm de vide de maille.

Hormis la présence accidentelle d'espèces pélagiques (*Sagitta tasmanica* et *Eukrohnia hamata*), une seule espèce benthique figure dans ces récoltes, *Spadella birostrata*, que j'avais décrite de la mer d'Alboran et du détroit de Gibraltar, à partir de 24 spécimens.

Cette espèce est régulièrement présente et abondante, comme l'indique l'inventaire ci-après :

Date	Jour ou Nuit	Eau filtrée (m3)	Nombre de spécimens
30/09/1984	J	49,73	158
13/10/1984	N		102
19/04/1985	N		151
" "	J	147,27	214
15/07/1985	J	25,97	166
28/09/1985	J	71,29	233

Ces premières données quantitatives sont à affiner; il faudra, notamment, comparer ces nombres bruts à la surface parcourue par le traîneau si l'espèce est strictement benthique, ou au volume d'eau filtrée si elle est plus ou moins bentho-planctonique. L'examen du contenu des deux filets supérieurs de l'engin, échantillonnant la tranche d'eau comprise entre 50 et 100 cm au-dessus du fond, apportera vraisemblablement une réponse.

On pourra également connaître la limite bathymétrique supérieure de l'espèce, puisque des récoltes ont été faites jusqu'à 25 m, là où commence le domaine de l'espèce commune *Spadella cephaloptera*, ainsi que son cycle saisonnier. En revanche, cela sera plus difficile pour la limite inférieure. En mer d'Alboran, il apparaissait que son niveau préférentiel se situait plutôt vers 500 m; si cela se vérifiait aussi dans le golfe de Gascogne, cela voudrait dire que des récoltes à ce niveau seraient encore plus productives et que cette Spadelle aurait un rôle non négligeable dans l'écosystème bentho-planctonique.

Quoiqu'il en soit, on peut d'ores et déjà affirmer que *Spadella birostrata*, qui n'était présente à l'ouest de Gibraltar que sur une seule station influencée par l'écoulement d'eau méditerranéenne profonde dans les nombreux chalutages de la campagne Balgim (Fig. 1), est par contre bien représentée dans le golfe de Gascogne, où elle constitue un élément permanent de la faune du sommet du talus continental et où elle atteint ses plus grandes dimensions (10 mm).

Il serait maintenant intéressant de savoir si son absence dans l'Atlantique sud-ibérique est due à un mauvais échantillonnage ou si elle est réelle; dans ce dernier cas, les populations de Méditerranée et du golfe de Gascogne seraient séparées et il faudrait alors en faire une étude taxonomique comparée pour mettre en évidence d'éventuelles différences.

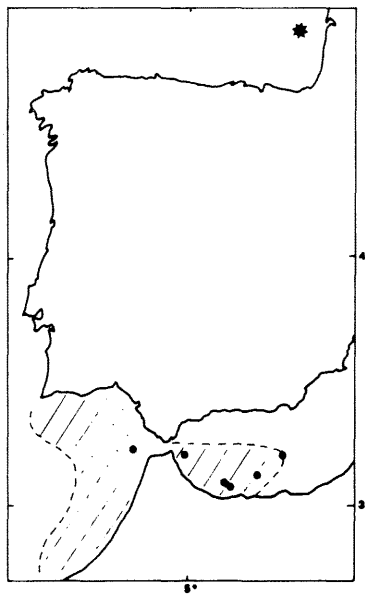

Fig.1.- Répartition de *Spadella birostrata* dans la Province atlanto-méditerranéenne. Les cercles indiquent les dragages positifs de la campagne "Balgim 84" (dont l'aire de prélèvements est hâchurée) et l'étoile la station de récoltes au traîneau en face d'Arcachon.

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* Je le remercie vivement pour m'avoir confié l'étude de ce matériel intéressant.

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Données concernant les appendiculaires des eaux Libyennes

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La faune zooplanctonique, donc aussi celle des Appendiculaires du secteur nord-africain de la Méditerranée, est assez peu connue (6).

Un riche matériel (356 échantillons quantitatifs de zooplancton pris des horizons standard de la surface à 400 m de profondeur, de 84 stations accomplies saisonnièrement de mai 1975 en août 1976) provenant des eaux libyennes de la Méditerranée, comprises entre les méridiens 19°40' et 24°50', nous a permis l'étude des Appendiculaires.* Les 17 espèces identifiées représentent 4,1 % du nombre total des zooplanctontes qu'on y a déterminées - proportion semblable à celle signalée dans les eaux libanaises pour la même période (5) - et environ 46 % du nombre des espèces d'Appendiculaires de l'entière Méditerranée (3).

La fréquence relative des espèces déterminées dans les eaux libyennes a été la suivante:

	PRINTEMPS	ETE	AUTOMNE	HIVER
Famille des Oikopleuridae				
1. Stegosoma magnum (Langerhans), 1880	34	18	16	56
2. Oikopleura albicans (Leuckart), 1854	3	5	20	24
3. Oikopleura cophocerca (Gegenbaur), 1855	-	21	4	48
4. Oikopleura dioica Fol, 1872	3	56	16	73
5. Oikopleura fusiformis Fol, 1872	6	17	13	21
6. Oikopleura intermedia Lohmann, 1896	-	-	-	5
7. Oikopleura longicauda (Vogt), 1854	44	44	48	43
8. Oikopleura parva Lohmann, 1896	-	3	5	19
9. Oikopleura rufescens Fol, 1872	-	3	3	16
Famille des Fritillaridae				
10. Appendicularia sicula Fol, 1874	-	2	-	-
11. Tectillaria fertilis (Lohmann), 1896	-	-	-	1
12. Fritillaria borealis Lohmann, 1896	16	1	20	5
13. Fritillaria formica Fol, 1872	-	3	-	-
14. Fritillaria megachila Fol, 1872	26	2	7	11
15. Fritillaria pellucida (Busch), 1851	-	34	-	50
16. Kowalevskia tenuis (Fol),1872	-	-	1	-

Selon leur distribution verticale, les plus nombreuses (53 %) sont les espèces rencontrées dans tous les horizons, 29 % sont des formes épipélagiques (Tectillaria fertilis, Kowalevskia tenuis, Oikopleura rufescens), et seulement quelques-unes (18 %) bathypélagiques (Stegosoma magnum, Oikopleura cophocerca).

Toutes les espèces sont cosmopolites, communes pour l'entière Méditerranée (3, 4), ainsi que pour l'Atlantique (3), la mer Rouge (2, 3) et l'océan Indien.

Le plus grand nombre d'espèces (14) fut identifié en hiver, bien que les espèces connues comme thermophiles (Appendicularia sicula, Fritillaria formica, Kowalevskia tenuis), manquent. Le printemps, la faune des Appendiculaires est appauvrie, les 7 espèces, dont la présence fut constatée, sont celles qu'on trouve dans l'entière colonne d'eau. On n'a pas observé de différences significatives entre l'été et l'automne. C'est Oikopleura longicauda qui se trouve toujours en forte majorité, pareillement à la Baie d'Alger (1).

En ce qui concerne la distribution quantitative des Appendiculaire, on a constaté qu'ils sont concentrés surtout dans les couches superficielles (0-150 m), où les densités moyennes dépassent 30 ex.m^{-3} et on a signalé même la valeur maximale (155 ex.m^{-3})(tableau 1). Au long de l'année les plus basses densités sont celles printanières et, comme suite des changements qui ont lieu dans la communauté zooplanctonique durant l'été et surtout en automne (5), en hiver on a enregistré de hautes valeurs de la densité, dans toutes les couches d'eau. Au long du littoral libyen, les valeurs de la densité des Appendiculaires sont toujours plus grandes dans les secteurs moins profonds.

Tableau 1

Les densités moyennes (ex.m^{-3}) des Appendiculaires dans les eaux libyennes de la Méditerranée du sud

HORIZON (m) / ZONE	10- 0	25- 10	50- 25	75- 50	100- 75	150- 100	200- 150	300- 200	400- 300
PRINTEMPS									
zone est	17	1	11	0	2	2	1		
zone centrale	6	6	3	5	11	6	4	3	4
zone ouest	9	9	155	22	20	5			
ETE									
zone est	28	14	8	21	31	15	14		
zone centrale	6	3	2	14	12	8	2	1	<1
zone ouest	16	8	4	10	5				
AUTOMNE									
zone est	13	7	4	21	4	3			
zone centrale	4	2	1	5	1	2	19	<1	<1
zone ouest	18	16	10	20	39	2			
HIVER									
zone est	31	36	31	36	39	19			
zone centrale	12	26	40	12	14	11	10	5	1
zone ouest	18	16	17	16	17				

L'analyse comparative des associations d'Ap - pendiculaires au long du littoral libyen (à l'aide du coefficient de similitude de SORENSEN) montre une certaine zonation.

On peut constater durant la saison froide l'existence de 3 zones distinctes (coefficient de similitude moins de 60%),comme suit: la zone ouest (Cyrénaïque),celle du secteur central et celle à l'est du méridien de 24°. C'est seulement dans la seconde que l'on a trouvé Oikopleura intermedia et O. rufescens, et uniquement dans la dernière - Tectillaria fertilis.Mais,dans chaque zone il y a une grande ressemblance(coefficient de similitude compris entre 90 et 100 %) entre les différentes couches d'eau.

Pendant le printemps,au long du littoral il y a une grande similitude entre les stations côtières, d'un côté, ainsi qu'entre celles du large, d'autre côté, donc une zonation selon la profondeur. On la constate aussi en été, mais limitée seulement au long de la Cyrénaïque. En automne, la dissimilitude est plus accentuée. Il y a une ressemblance seulement entre les stations côtières de la Cyrénaïque et entre les stations de large à l'est du méridien de 22°.

La zonation qui existe est due aux conditions hydrologiques : les courants (de surface, de l'ouest vers l'est et un contrecourant de profondeur) et surtout l'homogénéisation progressive qui se produit à la fin de l'automne entre les couches de surface et celles sousjacentes, entre les eaux néritiques et les eaux du large.

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"Neritic" and "oceanic" variability of zooplankton biomass in the Western Mediterranean Sea (Balearian Sea, Palma Bay and San Jorge Gulf)

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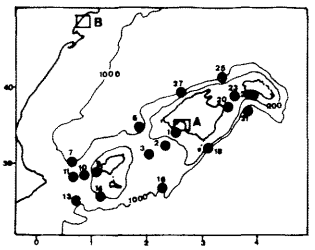
Qualitative study of zooplankton has been carried out in the western sector of the Mediterranean Sea, nevertheless the amount of the biomass of plankton remains poorly known, specially in these areas of the western Mediterranean.

The zooplankton biomass measurement is a good way to evaluate the potencial richness of the marine ecosystem.

In the present paper the cycle of the mesozooplankton "standing crop", the Balearian Sea is Analyzed and compared with other western Mediterranean areas.

The biomass values in the present study (mg Dry Weight/m3) are based on two different zones of the Balearic Sea (fig.1): Inshore (50-100 m. deep) and Offshore stations (200-1000 m. deep).



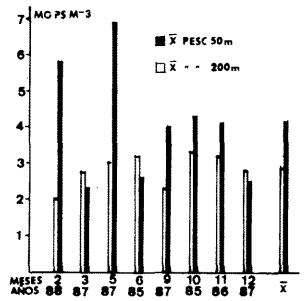
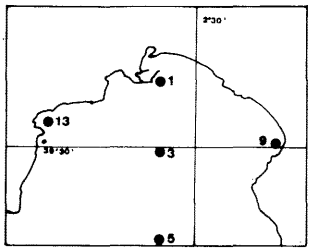


FIG 1



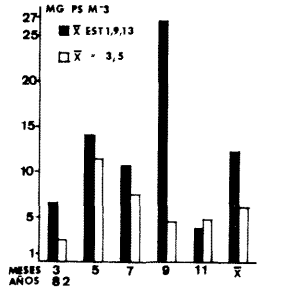
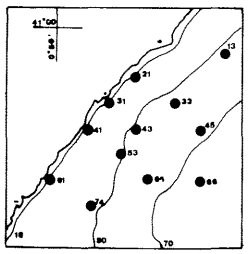


FIG 1A



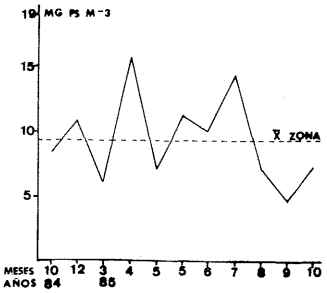


FIG 1B

Furthermore two different neritic areas were compared: Palma Bay (fig. 1 A) and San Jorge Gulf (fig. 1 B). Both opf them have a very long continental slope, the first is very near a city and the second is close to the Delta of the Ebro river.

Zooplanktonic samples were taken from oblique tows with 20 and 40 cm. Bongo plankton nets, equipped with a 250 um mesh and a General Oceanics 2030 flowmeter. Depths reached in coastal tows vary from 100-50 m. up and from 200 m. up in stations off Balearic Isles.

Results

The average of zooplankton data obtained monthly in each sector sampled are expressed in the right size of fig. 1, 1 A and 1 B. According to that, in offshore stations of the Balearian sea the mesozooplankton biomasses are quite homogeneous all along fluctuations can be observed (mean value = 2.8 mg/m3) while in inshore stations higher fluctuations can be observed (mean = 4.06 mg/m3). There zooplankton peaks appeared during the period studied, in february, midmay and in october in accordance with Margalef (1969) and Rodriguez (1983) for the western Mediterranean.

Similar fluctuations were obtained in central stations of the Palma (Est. 3 and Est. 5) but higher values (mean = 6 mg/m3) were found as fig. 1 A shows. The shallowest stations (St. 1, 9 and 13) have different variations (mean = 12.5 mg/m3) as a consequence of the urban influence on coastal water (26.5 mg/m3 in september 1982).

Stocks of zooplankton in the San Jorge Gulf (fig. 1 B) are quite irregular however it seems richer than those recorded in the former area analyzed (mean= 9 mg/m3) considering the special hydrological characteristics of the zone and the proximity of the Delta Ebro river.

Finally, correlation coefficients between number of individuals and biomasses (Dry Weights are calculated in the Bay of Palma (r=0.780) where Copepods are the most abundant and in the Gulf of San Jorge (r= 0.739) where the Cladocerans dominate.

Biomasse macroplanctonique et micronectonique au printemps 1987 à Villefranche-sur-Mer (mer Ligure)

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Introduction:

Dans le cadre du programme F.M.O. (Flux de matière dans l'océan) et de l'opération Dyfamed I, 11 traits de chalut Isaacs-Kidd 10 pieds ont été effectués, de jour, par le N.O."Koroneff" à la Station 5 (située à 8 milles du Cap-Ferrat, sur la radiale Nice-Calvi), au printemps 1987, les 14 avril, 15 et 22 mai et ler juin. A chacune de ces 4 dates, 2 pêches horizontales de 30 minutes (vitesse du bateau: 2 noeuds) ont été faites à 200m et 600m. Les 15 mai, 22 mai et ler juin, un trait oblique 800-0m a été également effectué. Plusieurs autres pêches, initialement prévues à d'autres dates, n'ont pu être faites en raison de l'état de la mer. Tous les animaux de ces prélèvements ont été comptés, mesurés et pesés (poids humide et poids sec) afin de connaître la biomasse à cette station.

RESULTATS:

52 espèces ont été identifiées, appartenant à 8 groupes zoologiques différents (7 méduses, 1 cténophore, 5 siphonophores, 6 mollusques, 2 chaetognathes, 18 crustacés, 4 tuniciers et 9 poissons). Afin d'évaluer l'importance réciproque des 2 groupes dans la chaîne trophique, on a séparé les individus en carnivores (et omnivores à tendance carnivore) et en herbivores (filtreurs et associés ainsi qu'omnivores à tendance herbivore). Toutes les valeurs concernent un volume d'eau de 10000 m3.

Nombre d'espèces: un nombre moyen a été calculé pour chaque profondeur.

- à 200m: 14 espèces ont été recensées (gélatineux 64,8%, crustacés 31,6% et poissons 3,5%).
- à 600m: 26 espèces sont présentes (gélatineux 46,7%, crustacés 40% et poissons 13,3%).
- dans les pêches obliques 800-0m on a trouvé 28 espèces. On constate une augmentation très nette du nombre d'espèces avec la profondeur, la journée, mais la proportion carnivores-herbivores ne varie pas (entre 75,4-77,1% de carnivores pour 22,9-24,6% d'herbivores).

Biomasse (en grammes pour 10000 m3):

- 200m: la biomasse totale diminue du 14 avril au ler juin (2,546g, 2,215g, 1,599g et 0,542g); cette décroissance est à mettre au compte des carnivores (fig.1).
- 600m: la biomasse totale est très nettement supérieure à ce qu'elle était à 200m (7,273g, 14,942g, 12,085g et 16,937g) ce qui représente, dans l'ordre chronologique, des valeurs 2,8- 6,7- 7,6 et 31 fois supérieures. La biomasse a également augmenté dans le temps (le ler juin elle est 2,3 fois plus forte que le 14 avril). Cette augmentation est essentiellement due aux carnivores (fig.2).
- 800-0m obliques (fig.3): ce sont les pêches les plus intéressantes car elles intègrent toutes les valeurs de la colonne et prennent également en compte une bonne partie des migrations verticales nycthémérales qui l'affectent, donc la réalité de ce qui s'y passe en 24 heures. La biomasse totale passe de 9,291g le 15 mai, à 13,806g le ler juin; entre ces 2 dates la biomasse des carnivores a plus que doublé, celle des herbivores a été divisé par 5,2. On peut raisonnablement penser qu'après une période riche en herbivores survenant à la suite d'une importante biomasse phytoplanctonique, le nombre des carnivores a augmenté au détriment de ceux-ci.

Fig. 1: 200m H

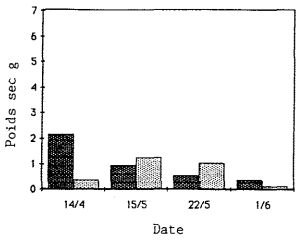


Fig. 2: 600m H

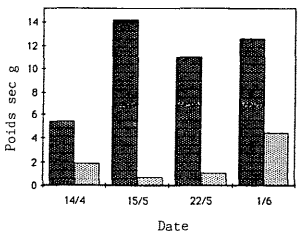
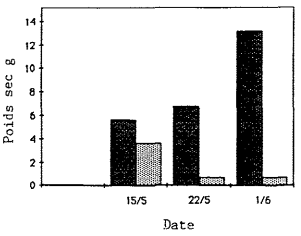
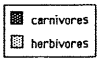


Fig. 3: Obliques 800-0m





Figures 1, 2 et 3:

Biomasse (g de poids sec pour 10000 m3) dans les pêches horizontales 200m, 600m et obliques 800-0m.

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Observations qualitatives et quantitatives sur le zooplancton de la mer de Monaco

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On rapporte ici quelques observations sur la composition relative du zooplancton pendant cinq années de pêches régulières (1979-1983) et la composition quantitative des copépodes pélagiques déterminée entre janvier 1982 et décembre 1983. Les pêches verticales bimensuelles (WP2) ont été faites sur quatre stations de prélèvement du fond, à -200m jusqu'à la surface. Le zooplancton observé en mer de Monaco est très diversifié. Il est composé en grande partie de copépodes pélagiques.

Le pourcentage mensuel moyen de copépodes, toutes stations confondues, est toujours supérieur à 60% des individus récoltés et peut atteindre 95%. Le pourcentage le plus élevé s'observe en février et en novembre, le minimum en été.

Pour le reste de l'holoplancton on note :

L'absence totale de *Creseis acicula* en 80 et 81 et son abondance en juillet 83 ; l'absence de *Cavolinia tridentata* et *C. inflexa* en 79 et 81, et sa faible présence en 80, 82 et 83 ; les salpides, présentes toutes les années de mars à mai. Le genre Podon, présent de juin à septembre de 79 à 81, en avril 82, absence en 83. Pour le méroplancton, on remarque l'absence des larves d'échinodermes en hiver 80-81, alors qu'elles représentent (40% du plancton en hiver 79-80).

Les familles des copépodes sont regroupées en quatre catégories selon leur fréquence d'apparition :

- Présents toute l'année :

♦ Famille des Calanidae, Paracalanidae et Pseudocalanidae abondance en février 82 et mars 83, mais présence faible en août, septembre 82 et mai 83.
♦ Famille des Acartiidae : abondance à la côte de mars à août et une baisse quantitative d'octobre à décembre.
♦ Les Oithonidae : abondants entre décembre et juin sur les 4 stations.
♦ Les Oncaeidae : maximum en mai 1983, mais le pourcentage reste.
♦ Les Eucalanidae : pourcentage non négligeable de la population en novembre 1982 et février 1983. Ils sont plus nombreux au témoin.
♦ Les Centropagidae : pourcentage très faible en début d'année et plus important entre avril et juillet.
♦ Les Coryceidae avec deux minimum en avril et juin 1983. Faible pourcentage de la population au témoin.
♦ Les Candacidae en faible quantité, plus fréquents sur les stations côtières.
♦ Les Tachydiidae très légers pics de janvier à avril et des quantités très faibles en mai, août et septembre.

- Famille présente à certaines périodes de l'année

* Les Temoridae de juin à octobre, apparitions sporadiques en début d'année mars 83. Très faible pourcentage au témoin.
* Les Metridiidae présents de septembre à mars en quantité régulière, mais faible en été uniquement au témoin.

- Famille présente irrégulièrement et en faible quantité

♦ Les Euchaetidae surtout entre juin-juillet-août, plus fréquents au large.
♦ Les Clytemnestridae lucicutiidae, les heterorhabdidae présents au Témoin sans période particulière.
♦ Les Augaptilidae : les deux premiers genres sont présence régulière en janvier et février sur les 4 stations.
♦ Les Phaennidae sont présents en faible quantité de juillet à septembre.
♦ Les Ectinosomidae et les Sapphirinidae s'observent de juillet à novembre. Microsetella uniquement près des côtes.

L'ensemble des observations faites sur le zooplancton de la mer de Monaco montre que les peuplements rencontrés ont une composition similaire à ceux trouvés dans d'autres zones de la Méditeranée Nord-Occidentale. Les Copépodes pélagiques constituent dans tous les cas, au moins, deux tiers de la population.

La composition des populations montre des différences entre le Témoin (Eucalanidae, Metridiidae) et les stations situées sur le plateau continental (Acartia, Centropages, Temoridae).

On peut noter la présence d'espèces considérés comme indicatrices d'eau d'origine atlantique : *Mecynocera clausi*, *Pleuromamma abdominalis*, *Lucicutia flavicornis*, ou de forme considérée comme mésopélagique : *Pleuromamma gracilis*.

En période estivale 82 et 83, on est amené à remarquer que la biomasse zooplanctonique comme le pourcentage de copépodes dans la population diminue alors que la situation est totalement opposée en 1972 dans la baie de Villefranche, (Seguin, 1981). Cette différence peut être due à une pratique de pêche différente mais aussi à des différences dans les conditions hydrologiques propres à chaque baies ou aux périodes d'observations : entre 1980 et 1983, la salinité de Monaco a été anormalement élevée et pourrait limiter l'abondance des espèces néritiques.

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Caractéristiques du développement quantitatif et de la structure du zooplancton des eaux côtières roumaines de la mer Noire, pendant la période 1981-1985

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Des études suivies concernant l'évolution du zooplancton dans le secteur de Constantza et aux embouchures du Danube entre 1970 et 1980 (1, 2, 3), ainsi que dans les eaux côtières du littoral sud, entre 1972 et 1979 (4), ont mis en évidence quelques transformations subies par les communautés zooplanctoniques en conditions d'eutrophisation.

Durant cette décenie, quand les agressions des diverses facteurs altéragènes se sont accentuées dans les communautés côtières, nous avons continué les observations, tout le long du littoral roumain jusqu'à 30 m de profondeur, dans un réseau de 28 stations (18 stations correspondant aux zones affectées par les eaux usées du littoral sud et 10 stations dans le nord du littoral influencés par les eaux du Danube). L'analyse de 864 échantillons zooplanctoniques prélevés mensuellement sur ces stations entre 1981 et 1985, ont permis les remarques suivantes:

- pendant la période considérée, le zooplancton des eaux côtières situées au sud du littoral (de Constantza jusqu'à Vama Veche) à une densité et une biomasse moyenne de 9987 ind./m^3 et 560,19 mg/m^3 (la biomasse moyenne du même secteur des années 1972 - 1980 a été 508,46 mg/m^3). Ainsi, le developpement actuel du zooplancton à un niveau quatre fois plus élevé que celui de la période 1961-1965 (152 mg/m^3). C'est en 1984 qu'on a enregistré les grandes valeurs, déterminés par les importantes biomasses de Noctiluca miliaris aux mois de juillet-août (jusqu'à 99% de la biomasse zooplanctonique globale).

Tableau 1. Valeurs moyennes annuelles des densités (ind./m^3) et des biomasses (mg/m^3) du zooplancton total des eaux côtières du littoral roumain de la mer Noire.

Années	1981	1982	1983	1984	1985
	zone sud (Constantza - Vama Veche)				
Densités (ind./m^3)	15241	4915	7403	17066	5308
Biomasse (mg/m^3)	746,46	131,45	550,19	1201,61	171,22
	zone nord (Constantza - Sulina)				
Densité (ind./m^3)	22545	1664	18971	5039	176968
Biomasse (mg/m^3)	836,33	199,27	976,76	253,74	10867,09

- pour le secteur situé au nord du littoral (de Constantza jusqu'aux embouchures du Danube), les valeurs moyennes sont quatre fois plus grandes qu'au sud: densité moyenne de 45.037 ind./m^3 et biomasse moyenne de 2627,17 mg/m^3. Les valeurs les plus élevés se situent en 1985: 176.968 ind./m^3 et 10.867,09 mg/m^3 (données toujours par Noctiluca miliaris (Tableau 1);

- au cours des quatre cycles annuels d'observations, pour les deux zones considérées, le développement maximal s'est produit en été (Tableau 2), maximum estival toujours constitué par un nombre réduit d'espèces plus tolérantes qui pullulent dans les communautés zooplanctoniques. En premier, on observe les poussées de Noctiluca miliaris; c'est alors qu'on constate une déstructuration du systeme zooplanctonique côtier;

- dans les zones côtières affectées directement par le déversement des eaux usées, les communautés zooplanctoniques sont appauvries et peuplées par un petit nombre d'especes: Acartia clausi Giesbr. la plus frequente (98-100%), Pleopis polyphaemoides Leuck. avec une fréquence de 75-83,3%, espèces caractéristiques des milieux fortement eutrophisés; plus rarement on rencontre deux autres copépodes: Oithona nana Giesbr. et Paracalanus parvus Claus., des rotiferes et des larves de Cirripedes.

Tableau 2. Valeurs moyennes mensuelles (1981-1985) des densités et biomasses zooplanctoniques des eaux côtières roumaines de la mer Noire

Mois	IV	V	VI	VII	VIII	IX	X	XI
Densités (ind./m^3)	1109	3717	7926	18807	24544	4991	6107	3512
Biomasse (mg/m^3)	33,00	95,72	486,03	880,63	1635,95	106,56	216,60	98,73

- les développements explosifs de Noctiluca miliaris durant les mois d'été de la période 1983-1985 (jusqu'a 99% de la biomasse du zooplancton total), représentent la caractéristique la plus importante dans l'évolution du zooplancton côtier;

- pour la totalité de la zone étudiée, marquée par une puissante eutrophisation, on a enregistré pendant ces années, un important développement quantitatif du zooplancton, mais les biomasses sont constituées par un très petit nombre d'espèces, organismes filtreurs ou capables d'utiliser la matière organique se trouvant en exces; la faible diversité spécifique est illustrée par les petites valeurs des indices de diversité de SHANNON (H = 0,07 à 1,9);

- l'organisation des populations varie énormément avec les saisons; on a constaté une periode de forte dominance d'une ou deux espèces au cours de l'été.

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Eléments concernant la structure trophique des communautés zooplanctoniques côtières du littoral roumain de la mer Noire en conditions de forte eutrophisation

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Le renforcement de l'eutrophisation des eaux du littoral roumain de la mer Noire qui a déterminé depuis la dernière décenie des quantités accrues de phytoplancton, d'amples et fréquents phénomènes de floraison (1) et une croissance remarquable du taux de détritus organiques en suspension (2), a influencé aussi, au niveau de l'écosystème pélagique, l'évolution des populations zooplanctoniques, principales consomatrices de la production primaire.

Entre 1983 et 1987, des recherches synécologique ont été effectuées sur les communautés planctoniques du littoral roumain en vue de connaître le déroulement des phénomènes de floraison et leurs conséquences sur l'écosystème côtier. Les caractéristiques fonctionelles des communautés planctoniques étant déterminées par les relations trophiques qui s'établissent entre ses différentes populations, nous avons étudié les relations spatiales et temporalles phyto-zooplanctoniques et les fluctuations de la biomasse des différents groupes trophiques du zooplancton. Nous avons analysé 562 échantillons zooplanctoniques provenant d'un réseau dense de stations situées de la côte à 30 milles au large et de l'extrémité nord du littoral jusqu'au sud de Constantza.

Les variations temporelles ont été déduites de prélévements mensuels effectués d'avril à octobre.

Durant la période analysée, caractérisée par l'ampleur et la succession très fréquente des phénomènes de floraison, parallèlement à l'augmentation des quantités de substances organiques dissoutes (nourriture en quantité excessivement grande) quelques espèces phytophages et détritophages ont dominé les communautés zooplanctoniques côtières. On remarque surtout l'importante prédominance numérique et pondérale de l'espèce détritophage Noctiluca miliaris; ses populations très abondantes, produisent de vraies floraisons de mai à août, immédiatement après les poussés phytoplanctoniques. Les quantités maximales de l'espèce (95-99% de la biomasse totale du zooplancton), ont été enregistrées en juin 1983, aout 1984 et juillet 1986 et 1987.

Du point de vue spatial, dans les secteurs fortement eutrophisés et où les floraisons sont persistantes, comme aux embouchures du Danube, à Portiţa et sur la côte de Constantza, les populations de Noctiluca miliaris ont constitué 99% de la biomasse totale du zooplancton(valeurs maximales de 31.914,00 mg/m^3 à Portiţa en 1984;126.396,5 mg/m^3 en 1986; 64.525 mg/m^3 en 1987, dans l'espace prédeltaique).

Du point de vue de l'évolution dans le temps,le phytoplancton s'est montré en permanence excédentaire, surtout apres les grandes poussées algales printanières et bien que le zooplancton soit dominé par les espèces herbivores qui assurent un grazing important. Les valeurs des coefficients de corrélations entre les biomasses du phytoplancton et du zooplancton ont été habituellement négatives ou bien positive mais très faibles (R = 0,16 en avril 1984; -0,39 en mai 1985; -0,6 en mai 1986 et -0,71 en juin 1987), signifiant une très faible dépendance en conditions de grandes quantités de phytoplancton.

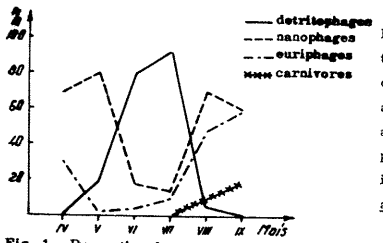

Fig. 1 - Proportion des groupes trophiques dans les communautés zooplanctoniques de la zone Constantza, pendant la période avril-septembre 1986.

Pour illustrer la succession et l'importance des différents groupes trophiques dans la structure des communautés zooplanctoniques on a choisi l'année 1986, car c'est au mois de juin que s'est produit, pour l'intervalle analysé, la plus importante des floraisons d'Exuviaella cordata (Fig. 1).

Au mois de mai, dans les conditions d'une premiere poussée algale, avec des espèces de petite taille, excellente nourriture pour le zooplancton herbivore, celui-ci a été dominé par les nanophages comme les tintinnides, les méroplanctontes et les formes juvéniles de copépodes. Malgré le broutage des zooplanctontes herbivores, l'échelon primaire toujours en excés, a engendré une grande quantité de détritus organiques. C'est ainsi qu'en juin et juillet, quand la floraison d'Exuviaella cordata et de Cyclotella caspia a produit un accroissement du taux de détritus organiques, pour tous les secteurs étudiés, le zooplancton était dominé par le detritophage Noctiluca miliaris. Dans le groupe des herbivores signalons maintenant les populations abondantes de Pleopis polyphaemoides et aussi l'euriphage Acartia clausi qui pullulent dans les communautés du mois d'août. A la meme epoque, les détritophages diminuent jusqu'à disparition; aux espèces herbivores s'ajoutent des zooplanctontes carnivores tels que le chaetognathe Sagitta setosa et le cténophore Pleurobrachia rhodopis.

La très grande production de détritus organiques a conduit à une sélection des espèces zooplanctoniques. Les plus tolérantes comme N.miliaris ont des développements explosifs qui contribuent eux aussi a l'accroissement du taux de détritus et a l'évolution vers des communautés zooplanctoniques peu structurées.

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R-I1

Temporal distribution of long-lived radionuclides in marine sediments at Southern Coast of Spain

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This communication describes the studies carried out at the southern coast of Spain, area of special interest as an accidental release of transuranides ocurred near the seaside in 1966.

Sediment samples were taken by a box-corer and a shipek-grab at this area in 1985. The vertical distribution of radionuclides were performed in these corers, further searchs on sediments chronology give a wide spectrum of the hystorical deposition of radionuclides.

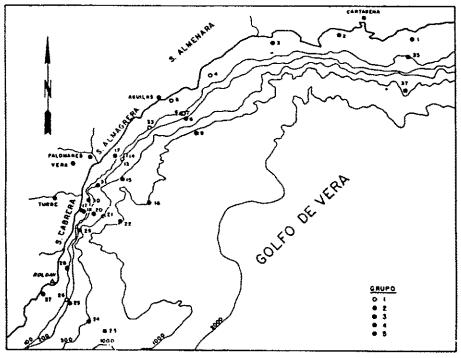


FIGURE 1 : SAMPLING SITES.

The profiles of transuranides distribution show an increase of concentration at the southern of the Almanzora river mouth, processes involved in this fact are investigated.

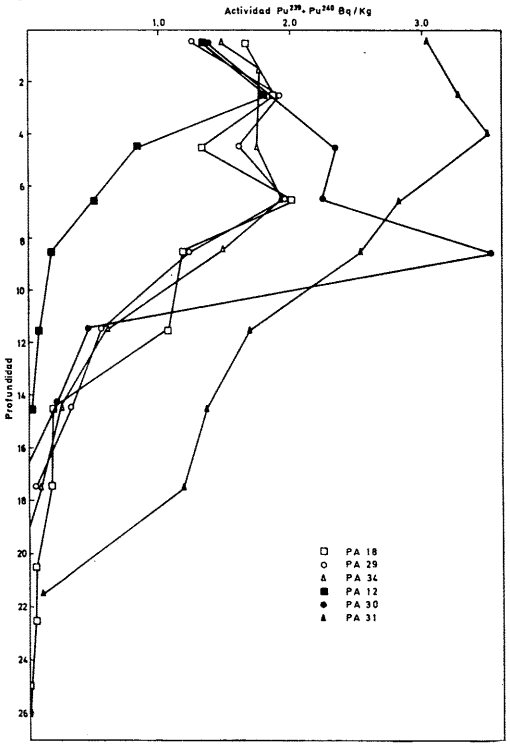
The accuracy of radiochemical transuranides analysis was checked by analyzing standard material and duplicated samples

METHODOLOGY

The area choosen for the study was the southern coast of Spain, including the coastal area of Palomares, between Cape of Palos and Cape of Gata. Samples were collected at 50,100,200,500 and 1000m-.depth. Sediments were sampled by a new desing box-corer and each core was extruded in slides of 1cm thick.

Pu^{239}+Pu^{240} and Am^{241} were analyzed by radiochemical separation techniques and measured by α-spectrometry, Pb^{210}, Pb^{210} and Cs^{137} were measured by γ spectrometry with Ge intrinsec detector.

The Pb^{210} method has been applied to study the chronology of sediments. The model of Robbins has been assumed as a first approach.



GRAPHIC 1 : CONCENTRACION DE PU EN FUNCTION DE LA PROFUNDIDAD EN EL NUCLEO.

RESULTS AND CONCLUSIONS

The results of the radionuclides analysis of some sediment corers are showed in the figures.

The studies about differences between inventories of the stations and the processes controling these, will contribute to the knowledge of transuranides behaviour in Mediterranean sea.

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R-I2

Biosystematic analysis in the study of environmental radiocontamination in marine ecosystems

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The distribution and circulation of radionuclides in marine ecosystems is regulated - as well as by physical-chemical factors - by the biological population, and often in a highly specific manner. Plankton and coastal benthos play a different role in these processes, given also the special hydrological conditions of the neritic zone, which is more affected by continental contributions.

This paper reports the methodological approach used in studying radiocontamination in a 20 Km-wide tract of sea extending from the Po River Delta to Cattolica. This research is part of a wider program sponsored by the Emilia Romagna Region for studying marine conditions in this area, especially as regards pollution.

The main purpose of our research is to evaluate the role that macrobenthic organisms play in the circulation of radionuclides in this stretch of sea, which is particularly influenced by the Po, whose waters are those chiefly responsible (in quantitative terms) for the conditions of environmental deterioration in the area (eutrophication, etc.).

Generally, in determining the levels of radiocontamination in an environment, one is limited to gathering certain biological samples, which are then identified taxonomically and prepared for the radiometric analyses, without going on to study the environmental context in which the species that have been collected live. This type of approach cannot be adopted in studying the circulation of radionuclides in a given environment, since it doesn't provide information on the space-time and trophic connections among the species, knowledge of which is fundamental to an effectively utilizable description of the radionuclide distribution.

The first essential point is to define, even in approximative terms, the demographic structure of the populations, particularly for the species that are quantitatively important in the area studied; this is necessary on one hand because of the different part that each group plays in the assumption of radionuclides, and on the other for evaluating the "state of health" of the population in question.

This type of information can be found thanks to the biometrics of the animals which are to be prepared for the radiometric procedures. We determined the population structure of all those species which were subsequently subjected to radiometry.

In the species in which it is possible, we go on to examine the "gut-content", so as to have as good an understanding as possible of the trophic role that the particular species sustains in the environment being considered. Remember that all the species in a given area were gathered homogeneously within a limited space and time precisely so as to respect any trophic relationships and thus be able to reconstruct them.

An efficient analysis of the contents of the alimentary canal is not possible for all species, and in some cases it is necessary to go by data in the literature regarding the species' potential diet. We were however able to examine successfully Astropecten irregularis and Philine aperta, obtaining among other things interesting information on the animal population of the specific area with respect to small species.

The study of the fauna, limited for technical reasons to the macroinvertebrates, is important in characterizing the environment; in addition, it furnishes accurate information regarding the probable role of the animal population in the circulation of radionuclides.

In the area studied there are various type of macrobenthic associations: from highly simplified zoocoenoses close to the coast to complex biocoenotic structures further off-shore, with a characteristic distribution of the different communities (Parisi et al., in preparation).

In addition to the distributive aspects of the species subjected to radiometric research, the data on the zoocoenoses is essential to an understanding of the different role that such communities may play in the circulation of radionuclides. This examination requires that they be interpreted in terms of the presence of filter-feeders, predators and scavengers, keeping in mind that there are no large herbivores in the area, given the absence of phytomacrobenthos. The former are fundamental in transferring radionuclides from the water to the sediment (as occurs in zoocoenoses where Bivalves predominate); the latter two instead are important in the fine redistribution of radionuclides in the sediment.

Preliminary data on ^{60}Co uptake by the Black Sea Molluscs Mytilus galloprovincialis Lam. and Mya arenaria L. under laboratory conditions

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ABSTRACT

Preliminary experimentally-derived concentration factors (CFs) for ^{60}Co in two common Black Sea bivalve molluscs collected along the Romanian shore are given.

RESUME

Ce travail présente des facteurs de concentration (FC) préliminaires du ^{60}Co déterminés en conditions expérimentales chez deux Mollusques Bivalves communs du littoral Roumain de la mer Noire.

Quantitatively, Mytilus galloprovincialis and Mya arenaria are among the most wide spread bivalve molluscs of the Romanian coast. Former radioecological approaches initiated on these biota (BOLOGA, 1984,1985) have confirmed their stature as bioindicators for certain radionuclides (e.g. POLIKARPOV,1966; DAHLGAARD,1981; GOMEZ et al., 1986). These researches have continued under laboratory conditions (IAEA,1975) by the determination of CFs for ^{60}Co, which is a vital microelement and also an important activation product, with a long half-life (5.25 y) and belonging to the upper medium radiotoxicity group.

MATERIALS AND METHOD

Adult specimens of mussel and soft clam were collected at Constantza and Mamaia between June and August 1987. The experimental procedure was previously described (BOLOGA,1984). For each species (shell, soft part, byssus and syphon) two uptake experiments were performed in 3o l aquaria, with 4o unfed animals per experiment, by adding 111 kBq l^{-1} aequous solution of $^{60}CoCl_2$. The experiments lasted between 1o-25 days. ^{60}Co activity was monitored during uptake and measured simultaneously in water and three animals per sampling point, every 2 to 3 d, with a mono-gamma counter IFIN-L8, coupled to a well-type NaI(Tl) scintillation crystal; counting efficiency was about 2%. The radioactive water was not changed during the experiments.

RESULTS, DISCUSSION, CONCLUSION

Table 1. Concentration factors (in relation to fresh weight) of ^{60}Co in mussel and soft clam

Species	shell	soft part	byssus	syphon
M. galloprovincialis	6-17 1o-18	15-32 1o-5o	251-723 253-754	- -
M. arenaria	3- 6 2- 6	5-17 3-12	- -	13-4o 1o-31

The highest CFs in mussel were found during the first experiment after 8 d in all samples and during the second one after 16, 25 and 1o d, respectively. In soft clam these CFs were reached during the first experiment after 6 d, and in the second after 1o d in all components.

It seems that due to the short duration of these preliminary experiments in 1987, equilibrium concentrations have not been achieved for the soft part of mussel and for all components of soft clam.

As to other reference data, the results obtained as yet on the mussel from the Black Sea agree with those on Mytilisepta virgatus from the Pacific Ocean with the following CFs: shell - 11, soft part - 13 and byssus - 658 (NISHIWAKI et al.,1981); with regard to the soft clam results are lower as compared to the rare data on the same species from the Pacific (HARRISON,1973).

The low CFs so far obtained in the mentioned bivalves point out the necessity of further work in order to establish if these species would make suitable bioindicators for ^{60}Co contamination in the Black Sea.

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Polonium-210 in marine Fish

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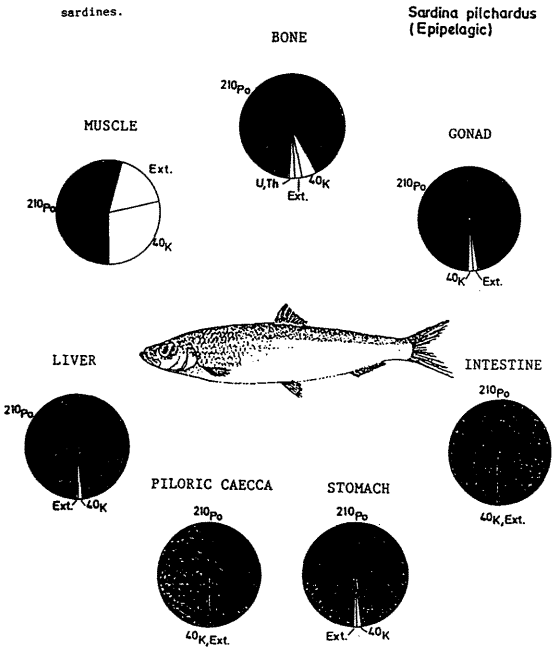
Po-210 is concentrated by marine organisms and concentration factors repported are typically about 10^4 for zooplankton, 10^2-10^3 for fish muscle and reach 10^5 for fish liver.

Po-210 activity concentration levels in marine fish were found to be independent of water depth in ocean, and high concentrations are displayed by epipelagic teleosts as well as by deep sea teleosts. Epipelagic teleosts, as sardine and maeckerel, which food heavily relies on zooplanktonic crustaceans, display the highest ^{210}Po concentration found in fish muscle (2-21 Bq.Kg^{-1} wet wt), while large predators as the blue-marlin and the oilfish display lower concentrations (0.4-0.7 Bq.Kg^{-1}). Varying ^{210}Po concentration were also measured in muscle of mesopelagic and bathypelagic fish. In all oceanic and neritic domains studied, ^{210}Po concentrations found in fish are explainable by food-chain transfer.

A similar pattern of ^{210}Po distribution in fish tissues was found in teleosts and elasmobranchs from all depths, but a clear cut exists between these two fish groups.

Fig 1. Relative contribution of internal (^{210}Po, ^{40}K, U, Th) and external radiation sources (Ext) to the absorbed dose rate in the tissues of the Atlantic sardines.



Absorbed radiation doses in fish come from internally accumulated nuclides and external radiation sources. External sources, as cosmic radiation, dissolved ^{40}K in sea water and natural nuclides in bottom sediments, give, however, lower contribution than internal ^{210}Po. Due to the variable ^{210}Po concentration in fish tissues also the contribution of this nuclide to the absorbed radiation dose varies accordingly. Considering for instance the common sardine, the ^{210}Po contribution for the absorbed dose rate is always the most important in every tissue (Fig.1). Dose equivalent rates due to ^{210}Po alone can be so high as $3x10^2$ mSv.y^{-1} in sardine liver and $5x10^3$ mSv.y^{-1} in intestinal walls.

In epipelagic teleosts the external radiation sources contribute with about 1/3 for the total absorbed dose rate in fish muscle. The remaining 2/3 contribution from the internal sources is mainly shared between ^{210}Po and ^{40}K, while man-made radionuclides, as ^{137}Cs and $^{239+240}$Pu, contribute with 0.5% or less to the absorbed dose.

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R-II3

Incorporation of Tc-95m in the brown Macroalgae Fucus serratus and Fucus spiralis under different experimental conditions

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ABSTRACT

Laboratory experiments with two macroalgae, collected along the Belgian and Dutch coasts, have shown that the concentration of technetium (Tc-95m) was increased in light and decreased in darkness. Moreover, it was lower at 4°C than at 21°C. In addition, inactivation of the algae at 50°C strongly inhibited technetium uptake.

INTRODUCTION

Radiochemical analyses of Tc-99 content of natural samples and laboratory experiments with Tc-95m have revealed that, among brown marine algae, some species belonging to the Fucales (Ascophyllum nodosum, Fucus serratus, Fucus spiralis and Fucus vesiculosus) show concentration factors (CFs) attaining 50,000 (see literature in Bonotto et al., 1988). The high CFs observed for Tc-99 under natural conditions might result from an integrated accumulation process, the algae being exposed to low levels of this radionuclide for quite a long time (up to a few years). Moreover, environmental and biological factors are thought to play an important role in the uptake, distribution and metabolism of technetium in marine algae. It was, thus, of interest to investigate the effect of light, darkness and temperature as well as the influence of the physiological conditions of the algae on the concentration of technetium. This paper reports results obtained with the species Fucus serratus and Fucus spiralis.

RESULTS AND DISCUSSION

The uptake of Tc-95m by both species of Fucus was found to be dependent on light and temperature. In Fucus serratus, the amount of Tc-95m taken up in darkness was only one fifth of that incorporated under light conditions. Moreover, in algae kept at 4°C, a strong reduction (about 70%) of technetium fixation was observed in short-term experiments (up to 6 hours). In addition, heat inactivated algae incorporated only 0.3% of the activity measured in the normal ones. Nevertheless, it has been possible to visualize by autoradiography the localization of Tc-95m in inactivated algae, by exposing them to an X-ray film for several days (fig.1). This result shows that in heat inactivated algae, like in the normal ones, Tc-95m is heterogeneously distributed, being more concentrated in some apical regions, probably because the inactivation was not complete. Scanning electron microscopy (SEM) of the surface of Fucus spiralis has shown that the cells were covered by an organic coating, which might bind some radionuclides. It was reported, in fact, that adsorption of americium (Am-243) occurs in the thin outer organic coating of the related species Fucus vesiculosus (Carvalho and Fowler, 1985). Although the experimental evidence accumulated till now suggests that Tc-95m uptake in Fucus serratus and Fucus spiralis is controlled by physiological processes, a limited surface adsorption of this radionuclide might occur.

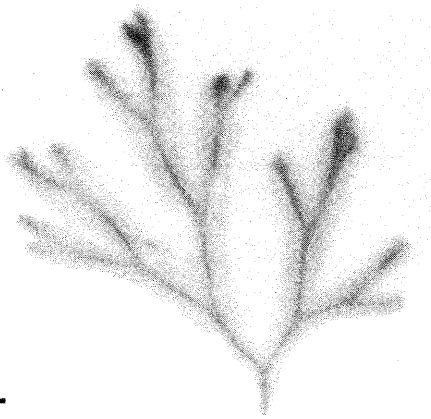

Fig.1.
Autoradiograph of Fucus serratus inactivated in sea water at 50°C (according to Topcuoğlu and Fowler, 1984) before to be supplied with Tc-95m and processed for autoradiography (according to Bonotto et al., 1986). Due to the very low incorporation, the alga was exposed to an X-ray film during 5 days. Note the more intense labeling of the midribs and of some apical regions. Scale = 1 cm.

ACKNOWLEDGEMENTS

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R-II4

The effect of temperature on Mercury toxicity in the Mussel Mytilus galloprovincialis

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ABSTRACT. The effect of temperature on the toxicity of mercury in Mytilus galloprovincialis collected from the shore of Bosporus, Turkey, was studied in experimental aquaria using Hg-203 as tracer. Results are referring to the experiments done in October and February in sea water temperature 22 and 15 Celsius respectively. An inverse ratio was found concerning the survival of mussels exposed to the mercury toxicity and the water temperature influence.

INTRODUCTION. Mercury is a heavy metal introduced in the environment as a waste product due to the developing industry and technology. Mercury toxic effects in organisms have reached dangerous levels in certain cases (1,2). It has been reported that season and temperature variations are functional parameters in the bioaccumulation of mercury by various organisms (3).

EXPERIMENTAL. Mytilus galloprovincialis specimens (about 60 mm length), collected from Yenikoy shore of Bosporus (Istanbul, Turkey), were used for the experiments performed in October and February, in sea water temperature 22 and 15 Celsius respectively. 0.2 mg/l of sublethal quantity HgCl2 (24 uCi/l Hg-203) were introduced into the experimental aquaria at both temperatures.

RESULTS AND DISCUSSION. The experimental data of this work referring to the radioactivity percentage and death ratio for M. galloprovincialis exposed to Hg-203 at 15 and 22 Celsius are presented in TABLE 1.

Biological accumulation is either directly or indirectly depended on the species of the organisms, the physicochemical characteristics of the contaminating substance and the physical condition of the medium (4). The effect of temperature and mercury concentration on the average survival of the mussel Mytilus edulis has been investigated (3). The average survival of mussels in a mercury dose 2.5 mg/l, when the animals were kept at 16 Celsius was found to be 5.0 days, while for mussels exposed to the same dose but kept at 20 Celsius, a lower value 3.1 days was observed. These results are in accordance with the ours given in TABLE 1, where an inverse ratio in the survival of the mussels exposed to mercury toxicity and the water temperature influence can be postulated.

TABLE 1. Radioactivity percentage in water (A/ml) and death ratio of mussels

	OCTOBER						FEBRUARY					
	22 C			15 C			22 C			15 C		
		S.M.			S.M.			S.M.			S.M.	
Days	A/ml (%)	E.	C.	A/ml (%)	E.	C.	A/ml (%)	E.	C.	A/ml (%)	E.	C.
1	100	28	10	100	7	7	100	10	10	100	7	7
2	76	27	10	28	7	7	33	10	10	36	7	7
3	58	14	10	17	7	7	18	10	10	20	7	7
4	44	4	10	13	7	7	16	10	10	15	7	7
7	2	1	10	9	7	7	13	2	10	10	7	7
8	2	-	10	8	7	7	7	1	10	9	7	7
9	-	-	10	6	7	7	6	-	10	7	7	7
11	-	-	10	5	7	7	-	-	10	5	7	7
15	-	-	10	5	7	7	-	-	10	4	7	7
18	-	-	10	3	7	7	-	-	10	3	7	7
24	-	-	10	3	7	7	-	-	10	3	7	7

(S.M.): Number of survived mussels
(E.): Experimental
(C.): Control

Mussels, in order to meet oxygen and nutrition requirements, use higher amount of water during their muscle movement. Thus mercury concentration in their organism is increased at higher temperatures. In relation to this phenomenon, the distribution rate of mercury taken up by the mussels increases due to the enhanced metabolic activity at high temperature and therefore the toxic effects are displayed faster.

From the data reported in litterature and the results of our experiments it can be concluded that the temperature is an important factor in the attainment of mercury toxic effect in the organism.

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Distribution, accumulation of Selenium-75 by time in different organs and tissues of Scardinus erythrophtalmus (Linné)

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Because of the importance of selenium in the metabolism of living organisms and its role in environmental pollution (1-5),a study on Scardinus erythrophthalmus (LINNE) which is important food was carried out by injecting 0.050 cc (0.34 µCi/g) of sodium salt of selenium-75 isotope into the abdomen muscle of the fishes. 11 fishes were dissected after 2 days and 3 fishes each after 4, 6,8,10,12 and 14 days. The radioactivity was measured on an Ecko N 530 G type scintillation detector with NaI (TI) crystal of 2x2 inch. The radioactivity was measured in one gram of the tissues and organs and reported as per mille of dose injected.

For all periods the tissues and organs of the fishes can be classified into three main groups according to the retention of selenium-75. The first group: liver, spleen, kidney, stomach, small and large intestine and gall bladder retained the highest amounts of selenium-75.The second group: fins,heart, gill, blood, air bladder, scale, skin, head, gonad, brain and fat tissue retained medium levels,The third group: chest muscle, tail muscle and dorsal muscle retained the lowest amounts of selenium-75.

Also the same organs and tissues did not give the same value by the time.

Some organs of the same structure and function,for example ventral and anal fins present relatively different behaviors with respect to the retention of selenium-75.

The selenium-75 concentrations determined during long periods after injection in tissues and organs of Carassius auratus gibelio (BLOCH) (6) and the results of the other investigations carried out on calves, lambs, pigs (7), rats (8) and human beings (9) support our findins relating the distributions of selenium - 75.

In our study, the digestive system, liver, spleen,kidney and gall bladder retained the highest amounts of selenium-75. These organs are not used as human food. Since the muscle tissues retained the lowest amount of selenium-75, the amount of selenium-75 taken by human body will be relatively lower by the use of this fish in feeding.

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Biokinetics of Selenium in the Benthic Shrimp Palaemon elegans *

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ABSTRACT

Organic compounds, probably low molecular weight peptides containing seleno-amino-acids, account for the most of the selenium dissolved in surface seawater. On the basis of this information, L-selenomethionine has been utilized for studying incorporation, body-distribution and elimination of selenium by the shrimp Palaemon elegans. Bioaccumulation of organic forms of selenium from seawater is much more pronounced than for inorganic forms such as selenite. More than 85% of the body burden of Se-75 was incorporated in high molecular weight proteins. Elimination of Se occurred following multiphasic kinetics, indicating the presence of at least three compartments, in which selenium shows different biological half-lives. The results obtained suggest the need of further studies on biomagnification and toxicity of organic selenium compounds to marine organisms.

INTRODUCTION

In consideration of their high toxicity of some selenium compounds experiments have been performed in order to elucidate the environmental behaviour of selenium and its transfer through terrestrial and aquatic food chains (1). Because of the relative low concentration factors (CF) (less than 50) encountered in experiments with marine organisms utilizing inorganic forms of Se-75 (2,3), in our experiments the kinetics of accumulation and loss of Se-75 have been studied in the benthic crustacean Palaemon elegans using seleno-methionine marked with Se-75. The seleno-aminoacid was chosen also because in marine surface waters selenium is predominantly present as organic compounds such as aminoacids and peptides of low molecular weight ((4). Therefore, it was appropriate to use seleno-L-methionine in our experiments in order to study accumulation, organ and tissue distribution as well as its release by the shrimp.

EXPERIMENTAL

The accumulation of 75-Se-L-methionine from water (370 kBq/10L) by the shrimp was followed for 25 days using two groups of 30 specimens each. During the experiment the concentration of 75-Se-methionine had to be corrected several times because of absorption to the container walls and excrements (5). After 25 days of accumulation no equilibrium was reached by the shrimp and accumulation continued linearily. At the end of the accumulation phase 10 individuals were dissected and the organ distribution determined.

RESULTS AND DISCUSSION

After 25 days, when the accumulation phase was interrupted, the concentration factor of the whole organism had reached a value of more than 400. Most of the radioactivity was found in the hepato-pancreas with a CF of about 4000 followed by gills (CF 1300) and stomach (CF 800).

The release of Se-75-methionine by the shrimp was observed for 59 days. At regular time intervals five specimens were dissected and the distribution of the radioactivity determined in the various organs and tissues. The release kinetic of selenium by the shrimp was characterized by three distinct phases: a fast phase, responsible for the elimination of about 30% of the body burden of Se-75 fixed in the hepato-pancreas and stomach, a medium phase which represents 52% of the total Se-75 and regards most of the remaining organs and a slow phase eliminating 18% of the total radioactivity localized in muscle tissues. The bilogical half-lives of 75-Se-methionine in the three compartments have been calculated to 2.3 days (digestive system), 15.4 days (remaining organs and tissues), and 138.6 days (muscle tissue).

About 90% of the 75-Se-methionine have been found in proteins (precipitation by Trichloroacetic acid) while the remainder was present as seleno-amino acids or peptides. Thus, one can assume that 75-Se-L-methionine is incorporated into proteins and substitutes the essential amino acid L-methionine.

During the experiments high mortalities could be observed in the shrimps which was attributed to the chemical toxicity of L-seleno-methionine, highly accumulated in some organs (digestive system) although the initial concentration in the water was extremely low (1nM).

These results require further studies for a better evaluation and understanding of the behaviour of organic compounds of selenium in the aquatic environment considering its bioavailability and transfer through the food chain as well as the determination of toxic levels for most sensitive species.

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R-II7

Remobilization of Technetium from sediments by Polychaetes at the sediment-water interface *

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ABSTRACT

Literature data indicate that bioturbation strongly affects the recycling of radionuclides through the benthic boundary layer. Technetium bound firmly in reducing sediments may be resolubilized by the biological activities of benthic organisms of the infauna. Results show that transfer of nuclides to fauna ingesting particles is very slow whereas transfer from interstitial water is probably the predominant source of technetium for sediment-dwelling fauna.

INTRODUCTION

In the geobiochemical cycling of many natural and man-made contaminants sediments may be considered as a final sink and/or ultimate pollutant reservoir in the marine environment. In addition to physical processes, bioturbation, generated by biological activities of the sediment-dwelling organisms, seems to be a principle mechanism in transfers and recycling of sediment-associated pollutants through benthic ecosystems (1,2).

Reworking of the upper sediment strata by bottom-dwelling organisms may reach down to 20-30 cm depth also in anoxic environments, thus oxidizing portions of anoxic sediments by pumping oxygen-rich surface water through their tubes. In this way contaminants such as radionuclides, reduced and immobilized in anoxic sediments, may be reoxidized and delivered to the water column.

On the basis of former results on leaching and remobilization of Tc from sediments (3,4) further studies were performed in order to evaluate the influence of biological activities of the infauna on the biogeochemical cycling of Tc with special reference to the sediment-water interface.

EXPERIMENTAL

Two polychaete species were used having different feeding habits which may be important to the distribution and fate of radionuclides in sediments. Nereis sp., a surface deposit feeder, may be especially important in vertical transport processes from the surface to deeper sediment layers, while Marphysa bellii, a subsurface feeder, may play an important role in the remobilization and recycling of radionuclides from sediment to the water column.

Aliquots (~1Kg) of humid sediment was mixed with seawater to gain a slurry to which 12 μCi (444 kBq) Tc-95m were added under strict anoxic conditions and stirred for more than 1 hour sustained by vigorous bubbling of nitrogen through the suspension, then filled equally into five tubes (ø 3.2cm, 35cm length, surface 8cm^2, medium depth of sediment 25cm) and let settle for three days. Only three tubes received Nereis sp. weighing 0.95, 1.17; 1.00, 2.73; and 1.78, 0.54g, respectively. The volume of the seawater overlaying the sediment was about 50ml at the beginning increasing daily because of compacting of the sediment by the activity of the worms. The oxygen content in the water was maintained constant by continous air-bubbling. The whole volume of overlaying water was sampled daily and measured for radioactivity.

RESULTS AND DISCUSSION

The results showed a steady release of radioactivity from the sediment to the water. On the average 0.26-0.36% of the total Tc-95m present were remobilized per day in relation to the polychaete biomass present. In tube 2 with 3.73g FW of worm 0.36% of Tc were released daily while tube 1 (2.12g FW) and tube 3 (2.33g FW) 0.28% and 0.26% of Tc were remobilized per day, respectively. After 49 days the overall percentages of Tc-95m removed were 13.89%, 18.13%, and 13.07% for tube 1,2,and 3, respectively, while in the same period the blank without worms lost only 4.36% of the total Tc which corrispond to 0.089% per day.

After centrifugation of the sediment of the blank the radioactivity content of Tc-95m in the interstitial water was found to be only 0.15-0.21% of the total Tc present in the sediment. Thus, it can be assumed that at the beginning of the experiment all Tc was bound to the sediment. The lost radioactivity from the blank may be explained by diffusion processes in the upper sediment layers and reoxidation in the water column.

At day 28 of the experiment tube 4 received one specimen of Marphysa bellii (2.57g) which removed only 2.21% of the Tc-95m in 20 days, i.e. 0.11% per day. This low value may be due to the lower physiological activity of this polychaete compared to Nereis.

However, concentration factors (CF) calculated at the end of the 49 days period showed a medium value in Nereis of CF 13.5±4.6 while Marphysa reached a CF of 80.6. This higher CF may result from direct uptake of Tc-95m from the sediment since Marphysa ingests very often sediment and produces fecal pellets consisting totally of sediment grains. Transfer factors (TF) of Tc-95m from sediments to worms were low and confirmed data from the literature (5,6,7). Nereis showed medium values of TF 0.25 while in Marphysa the TF was about four times higher, i.e. TF 1.112 confirming a higher sediment bound nutrition than in Nereis sp..

So far, the results of the laboratory experiments let presume that in areas of high polychaete population densities where Tc results bound in the upper 20cm of the sediment, a considerable amount of the radionuclide may be remobilized by the biological activities of the infauna.

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R-II8

Trivalent Cr-51 bioaccumulation study in two Mollusc species

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ABSTRACT. The uptake and elimination of Cr-51 in the trivalent form by the molluscs Venerupis sp. and Mytilus sp. were studied. The uptake experiments lasted 20 days and the concentration factors (K) found were 55 for Mytilus sp. and 47 for Venerupis sp, while the biological half life values were 36.3 and 42.5 days respectively. The distribution pattern of Cr-51 in the body of both mollusc was also determined.

INTRODUCTION. Large amounts of chromium are used in industry and sources to the environement include metal plating, fossil combustion ore refining, leather industry and others. The presence of Cr-51 in the marine environment has been reported by several investigators (1). Radioactive chromium is derived from nuclear tests and from the disposal of radioactive waste of atomic plants. Moreover Cr-51 is one of the corrosion products of nuclear power ships. The ability of certain marine species to concentrate Cr-51 in the trivalent or hexavalent state has been reported (2,3,4). In order to extend our knowledge on the acummulation of Cr-51 by various mollusc species we studied the Cr-51 biokinetics in Venerupis sp. and Mytilus galloprovincialis. The species chosen have a commercial value and are used for human consumption.

EXPERIMENTAL. Venerupis sp. and Mytilus sp. were collected from Salamis Island in Saronicos Gulf (Greece). Sea water was also taken from the same area. Two uptake experiments were performed (n=10) for each species at a temperature (about 20 Centigrade) and salinity (38‰) using the gamma emitting radioisotope Cr-51, H.L. 27.8 d. as chromium chloride (40 uCi Cr-51/18 l sea water). The experiments lasted 20 days. In order to determine the distribution of Cr-51 accumulated in the body of the molluscs certain individuals from each species were dissected at the end of the uptake experiments and the Cr-51 activity in the different parts of their body was counted. The elimination of Cr-51 in the two mollusc species was studied in order to determine the biological half life. Moreover leaching experiments were performed by placing the shells in 0.5 N HCL.

RESULTS AND DISCUSSION. The concentration of Cr-51 in Mytilus sp. reached a stable level within 10 days from the begining of the uptake experiment and in Venerupis sp. within 8 days; the concentration factors were found to be K=55 and K=47 respectively. The distribution of Cr-51 in the whole body of Mytilus sp. and Venerupis sp. is given in Table 1.

TABLE 1. Distribution pattern of Cr-51 radioactivity (%), in the whole body of the two molluscs after 20 d. exposure

Organism	Shell	Soft parts	Byssus	Body fluid
Mytilus sp.	35.2	33.8	23.5	7.5
Venerupis sp.	58.9	29.4	-	11.7

In the soft tissues of the species studied the distribution pattern of Cr-51 was found to be as follows: Mytilus sp. (Visceral mass 82.6%, muscle 1.7%, foot 0.6%, gills 10.1% and mantle 5.0%). Venerupis sp. (Visceral mass 85.5%, muscle 2.7%, foot 0.7%, gills 3.1%, mantle 3.8%, ventral siphon 1.8% and dorsal siphon 2.4%). The biological half life in Mytilus sp. was found to be 36.3 d. and in Venerupis sp. 42.5 d.

Medium concentration factors for both mollusc species were found. In Venerupis sp. the larger part of the accumulated whole body radioactivity was found in the shell. This is in agreement with previous data concerning another mollusc species (3). However in Mytilus sp. only 35.2% of the Cr-51 activity was found in the shell, while a considerable part of the radioactivity was found in the byssus. Viscera found to be an important deposition site of Cr-51. This is in accordance with our previous data refering to the accumulation of trivalent chromium in viscera of the mollusc Venus verrucosa (3).

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Bioaccumulation of ^{106}Ru by marine Phytoplankton

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ABSTRACT

The chlorophyte Dunaliella tertiolecta and the diatom Thalassiosira pseudonana readily accumulate ^{106}Ru reaching volume concentration factors of roughly 10^3 and 10^4, respectively. The uptake process is passive and is most likely related to surface sorption. High uptake by live and dead cells (phytodetritus) indicate that phytoplankton were likely initial vectors in the rapid vertical transport of ^{106}Ru noted after the arrival of Chernobyl fallout.

INTRODUCTION

The radioisotopes of ruthenium, particularly ^{103}Ru and ^{106}Ru, are considered among the more important radioactive contaminants because of their relatively high yield from fission and their moderately long half-lives. Ruthenium-106 ($T_{\frac{1}{2}} \simeq 373$ days) has entered the marine environment primarily as fallout from previous nuclear tests and in waste effluents from several nuclear reprocessing plants. Furthermore, the recent accident at Chernobyl resulted in a major input of ^{106}Ru to marine waters (Fowler et al., 1987).

The behaviour of ruthenium in sea water is complex (IAEA, 1975) and a large fraction of the radionuclide concentration is associated with particulate matter (Coughtrey and Thorne, 1983). The relatively high reactivity of ^{106}Ru results in its being readily accumulated by a variety of marine organisms including phytoplankton. Data from recent Chernobyl fallout studies (Fowler et al., 1987; Kempe and Nies, 1987) have suggested that phytoplankton is probably the vector by which ^{106}Ru enters the pelagic food chain and is subsequently transported vertically through the water column. Since information on the mechanisms controlling ^{106}Ru uptake by phytoplankton species is limited, a series of experiments were undertaken to examine ^{106}Ru biokinetics in two common species of phytoplankton.

METHODS AND MATERIALS

The chlorophyte Dunaliella tertiolecta (clone DUN) and the diatom Thalassiosira pseudonana (clone 3H) were used in all experiments. Different concentrations of cells in mid to late log phase were exposed to ^{106}Ru (as $RuCl_2$) in the light and dark under rigorously controlled conditions similar to those described previously for other radionuclides (Fisher et al., 1983). In addition, heat-killed cells of both species were exposed in parallel with live cultures to examine the effect of metabolism on uptake. All culture conditions filtration techniques, counting procedures and computation of volume concentation factors were identical to those employed by Fisher et al. (1983) for these species.

RESULTS AND DISCUSSION

The results of two sets of experiments each carried out in triplicate are presented in Table 1. It is clear that uptake by these two species is primarily a passive adsorptive process since there was virtually no difference in the accumulation pattern between live cells in the dark and dead cells. Furthermore, during the first 24 hours, uptake by live cells in the light was also identical to the other two treatments; however, between days 1 and 3 concentration factors decreased as cell density increased. This is most likely an effect of reduced uptake by biological dilution. Uptake was also noticeably higher in the green alga Dunaliella (VCF $\simeq 10^5$)

Table 1. Bioaccumulation of ^{106}Ru (Volume concentration factor x 10^4)+ over time in uptake experiments with D. tertiolecta (DUN) and T. pseudonana (3H).
A = alive; De = dead; L = light; D = dark

Species	Treatment	1 hr.	1 d.	2 d.	3 d.
		(VCF x 10^4)			
3H	A L	0.174	2.55	1.72	1.10
3H	A D	0.112	5.65	9.85	14.0
3H	De	0.23	4.17	15.3	37.6
DUN	A L	0.95	36.8	25.1	16.8
DUN	A D	0.72	46.7	81.8	122
DUN	De	1.34	47.1	92.7	118

+VCF values are averages of two experiments with three replicates each.

than in the diatom Thalassiosira (VCF $\simeq 10^4$). This differs from the transuranic elements plutonium and americium with which the reverse is found (Fisher et al., 1983). In any event, the relatively high VCFs for ^{106}Ru in these two species, which approach those reported for transuranics, indicate that ^{106}Ru entering the sea would rapidly become associated with phytoplankton which could then be passed on to zooplankton grazing the cells. Thus, contaminated phytodetritus and zooplankton excreta would become prime vectors for rapidly moving ruthenium downward in the water column as was seen to occur immediately following the Chernobyl accident in both the Mediterranean (Fowler et al., 1987) and the North Sea (Kempe and Nies, 1987).

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Transfer of ^{137}Cs across the Gills epithelial cells of the Crab Carcinus mediterraneus

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Apart from their function in osmoregulation and respiration the gills of marine organisms play an absorptive role in distributing a wide range of pollutants into the various tissues and organs. The role of the gills in radioactive caesium transport and distribution in Crustacea has been pointed out by Bryan (1961a,b), but the problem has not yet been solved in detail. Therefore, for a better understanding the transport of radioactive pollutant in epithelial gill cells we studied the transfer of Cs-137 across perfused isolated Carcinus gill preparations. Green crabs Carcinus mediterraneus Czrn., were obtained from the central Adriatic near the island of Dugi Otok. Crabs were acclimated in diluted sea water (15×10^{-3} salinity), fed and kept at a constant room temperature (16°C). In the experiments described 3 posterior gill pairs were collected for the perfusion technique. Experimental details were described by Lucu and Siebers,1986; 1987. Radioactive caesium (3.7 kBq Cs-137/ml diluted sea water) was used for experimental purposes. Afferent and efferent blood vessels we conected by polyethylene capillary tubes and preparation was fixed by neoprene block immersed in the bathing solution (20 - 40 ml). Identical diluted sea water (260 mM Na^+) to the bathing solution was perfused through the gills by a peristaltic pump. The transbranchial potential (TBP) between the haemolymph oriented gill side and the bathing medium was measured by an Ivell 1111 multimeter device. Cs-137 transport factor (% x 0.1 g^{-1} fresh weight of gills) was calculated according to:

$$\text{Transport factor} = \frac{^{137}Cs \text{ transported across epithelia}}{^{137}Cs \text{ in bathing solution} \times W} \quad (1)$$

where W is the fresh gill weight in grams.

Effects of diuretic amiloride (Merch Sharp Dohme, Munich) on caesium fluxes from the apical (bathing side) to the basolateral haemolymph side (influxes) and in the opposite direction (effluxes) were studied (Table 1.). Cs-137 and stable Cs effluxes are greater than influxes, showing that the basolaterally oriented gill side is more permeable to Cs-137 than the apically oriented one. Therefore, the Cs-137 transport factors are larger from the haemolymph side to the bathing side (effluxes) than the fluxes in the opposite direction (Table 1.). In addition, influxes and effluxes of Cs-137 (and stable caesium) was inhibited by amiloride (0.1 mM), added to the bathing solution.
This relatively high concentration of amiloride showed a similar effect on Na^+ inhibition from the apical site as reported by Lucu and Siebers, 1986. Since Cs have similar physico-chemical behaviour to K (Bryan,1961) we suggest that Cs competes with K^+ for the K^+/H^+ exchanger located on the apical membrane side. Since amiloride failed to affect this mechanism at the lower concentrations the presence of an ion channel interaction was precluded.

	Transport factor (% of ^{137}Cs x 0.1 $g^{-1}h^{-1}$)		TBP (mV)	Caesium fluxe (μmol x g^{-1} h^{-1})	
Control	1.65±0.20	6.49±1.04	-3.1	0.99±0.09	2.28±0.70
Amiloride	0.93±0.11	4.70±0.46	-7.5	0.56±0.01	1.51±0.01

Table 1. Caesium fluxes through the isolated perfused Carcinus gill epithelia. Mean values of 6 observations ± S.E. TBP= transbranchial potential (in mV).

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V-I1

Allocation, assessment and management of the Cephalopod fishery resourses in Greek waters, 1964-1985

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ABSTRACT

Mean annual cephalopod catch in Greek waters amounted to 2154 t in 1964-1985 of which 64.7% are fished with trawlers, 34.3% with boats involved in the coastal fishery and 1% with purse-seiners. Fishing effort in recent years is significantly higher than optimum effort, Fopt, for both coastal and trawl fisheries. This clearly indicates that cephalopod resources are overfished and authorities must take immediate measures. Possible measures for the protection of cephalopods are discussed.

INTRODUCTION

The total cephalopod catch in the Mediterranean Sea amounted to 50,971 t in 1983 (1) representing 2.7% of the total Mediterranean catch. Here the cephalopod fishery resources in Greek waters are reviewed for 1964-1985. In addition, the state of the cephalopod resources is assessed using FOX's surplus-yield model (2).

MATERIAL AND METHODS

Greek catches of cephalopods as well as fishing effort in HP of the fishing fleet have been recorded on a monthly basis since 1964 (3). The catches of boats involved in the coastal fishery with horsepower less than 19HP are not recorded since 1969 (their total landings are estimated to be about 28,000 t). Catches and fishing effort are used in the exponential surplus-yield model assuming exponential growth (2). The following relationship is used: $U=U_{\infty}e^{-bF}$ where U=catch per unit effort (here in kgr/HP), U_{∞}= catch/effort proportional to maximum population size, F=fishing effort (here in HP) and b=functional regression coefficient.

RESULTS

The mean annual catch of cephalopods in 1964-1981 amounted to 5237.1 t of which 1997 t (36.1%) were fished in Greek waters, whilst the rest was fished in the Atlantic and North coast of Africa (4). Mean annual cephalopod catch in Greek waters amounted to 2154 t in 1964-1985 (Table 1) of which 1393.8 t (64.7%) are fished with trawlers, 738.8 t (34.3%) with boats involved in the coastal fishery and 21.2 t (1%) with purse-seiners (Table 1). Total cephalopod catch in 1983 represented 5.2% of the total Mediterranean catch in that year (50,971 t). Mean trawl cephalopod catch in 1964-1981 was alloted as follows: 11.9% to loliginid squids, 52.9% to octopods, 20.8% to cuttlefishes and 14.4% to ommastrephid squids (5). Mean coastal catch in 1964-1981 was mainly composed of cuttlefish, 50.8%, whilst squids, octopods and flying squids represented 25.9%, 22% and 1.4% respectively (6). The catches of cephalopods attributed to purse-seiners are very low (Table 1) and are mainly composed of squids (more than 60%) (STERGIOU unpubl. data).

Cephalopod resources are very well described by the exponential surplus-yield model (Table 1). Fishing effort in recent years is significantly higher than optimum fishing effort, Fopt, for both coastal and trawl fisheries. This clearly indicates that cephalopod resources are overfished and authorities must take immediate measures. The multispecies nature of the fishery in the Mediterranean poses certain difficulties in drawing uniform measures for the protection of the resources. Measures that are favorable for some species may not be so for other. Experimental closing and opening of different areas and/or seasons and licence restriction may be used beneficially for the protection and management of the overexploited trawl and coastal fishery resources in Greek waters. A codend mesh size of 40mm, stretched, in trawlers as opposed to 28mm used in Greece, is also essential for the protection of demersal resources (7).

It has been shown that cephalopod catches in 1928-1939, a period of minimal exploitation, were significantly, positively correlated with the air temperatures during the migration, prespawning and spawning period (8). This implies that abiotic factors, which have been repeatedly shown to greatly affect the abundance of marine organisms (9,10), may hold a key in the abundance of cephalopods. However, anthropogenic pressure in recent years seems to greatly affect the abundance of marine populations and may mask, or be superimposed on, natural changes. Hence, rational management calls for the study of both natural and anthropogenic feed-back on marine ecosystems.

TABLE 1. Catches of cephalopods (T=trawl, P= purse -seine, C=coastal) and effort in HP (2= trawlers including effort of mixed boats, 1= coastal fishery)

YEAR	1	T	P	C	2
1964	48470	954.5	14.5	928.8	50047
1965	51362	1171.2	4.7	1000.6	50643
1966	56034	1022.1	14.1	962.6	51313
1967	61650	987.3	11.7	999	53814
1968	79675	1064	12.2	976.1	56227
1969	86552	1229.3	6.2	844.8	58730
1970	60226	1349.5	9.9	328	63497
1971	68779	1427.4	12.6	296.1	65786
1972	70029	1259.5	13.4	337.7	64115
1973	90663	1305.7	16.8	345	86263
1974	101513	1483.9	58.3	379.2	94424
1975	117814	1693.3	11.9	530.3	107337
1976	127819	1671.9	15.2	569.7	111759
1977	153750	1360.8	61	731.5	107352
1978	180337	1610.1	20.4	921.5	114648
1979	201596	1598.3	14.3	791	118088
1980	226517	1534.6	23.3	865.6	123360
1981	251463	1541.8	43.4	756.3	128659
1982	279890	1744.9	24.9	657.9	132168
1983	308288	1666.9	32.2	938.8	135703
1984	330005	1479.4	27.2	902	139156
1985	346516	1507.3	17.8	1191.3	135819
MEAN		1393.8	21.2	738.8	
%		64.7	1.0	34.3	

TABLE 2. Results of the exponential surplus-yield model (Fopt in HP, Uopt and U.. in kgr/HP and Ymax in t)

FISHERY	r	b	Uopt	Fopt	Ymax	U..
COASTAL	0.51	-0.0000048124	4.2	207798	882	11.54
TRAWL	0.89	-0.0000067937	10.9	147194	1606	29.68
TOTAL	0.90	-0.0000031737	8.0	315087	2530	21.82

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V-I2

La pêche artisanale aux Céphalopodes

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Le présente étude s'inscrit dans le programme "La pesca en Cataluña" subventionné par la Direction Générale XIV de la Communauté économique Européene.

CHALUT- En Catalogne on n'utilise que des engins de chalutage de fond. Le problème principal de la pêche au chalut est de tenir ouverte la bouche du filet pendant la navigation de la barque. C'est pourquoi on a introduit différentes modifications pour cet engin. Les pièces constituant l'engin sont formées par différentes mailles, de sorte qu'elles sont plus serrées au fur et à mesure qu'on arrive au sommet. Pour ouvrir l'engin horizontalement on utilise, de façon exclusive, les panneaux. Au cours du temps on a modifié leur forme. De cette façon nous trouvons des panneaux rectangulaires, ovales et mixtes. A l'aide de ce type d'engin on peut pêcher toutes les espèces de céphalopodes qui existent dans ces endroits. Cependant la capture de quelques espèces, comme Octopus vulgaris, est sporadique. Actuellement il existe, réglementée de façon provisoire, la pêche du petit poulpe (Eledone cirrhosa) qui se pratique dans les mêmes fonds que le reste de la pêche au chalut, mais à l'aide d'une maille plus serrée. On établit un maximum de cinq mois par an consacrés dans chaque port à cette pêcherie, et les barques pêchant le petit poulpe sont obligées de porter sur le pont un cercle rouge d'identification.

NASSES- La nasse est un attirail de fond fixe constituée par une bourse d'entrée facile et sortie difficile. On attire les proies moyennant un appât placé à l'intérieur des bourses. Leur forme est variable. Elles peuvent être calées ou bien indiviellement, ou bien en groupes. Au cas d'être calées en groupe, elles sont attachées à une corde principale, "mère", en les intercalant chaque 5-13 m. En principe la nasse est calée à une profondeur faible (5-7 m). On laisse les nasses calées sur le fond pendant des mois, mais elles sont contrôlées chaque jour ou touts les 3 à 4 jours. La saison de pêche est très variable, et elle dépend de l'espèce-cible; ainsi nous savons que la nasse destinée à la seiche (Sepia officinalis) est calée de mars à août. L'espèce à capturer dépend de l'appât, de la forme ou de la place où l'on cale les nasses. Dans quelques ports du nord de la Catalogne on les utilise à la pêche du poulpe (Octopus vulgaris). Par contre, aux ports du sud, principalement au delta de l'Ebro, on les utilise habituellement pour pêcher la seiche (Sepia officinalis). En ce cas-là on place à l'intérieur une branche de houx (Ruscus aculeatus); c'est alors que la seiche y entre pour déposer sa ponte.

CADUPS- Les "cadups" constituent un engin spécifique pour la pêche du poulpe (Octopus vulgaris); on profite de la conduite singulière des organismes qui cherchent ou fabriquent des "nids". On connaît ce système depuis longtemps . En Calatogne cette méthode de pêche n'avait pas réussi grandement jusqu'aux temps les plus recents où la hausse spectaculaire des prix du poulpe a converti les "cadups" en un attirail utilisé professionellement. Le "cadup" est un récipient calé au fond à faible profondeur sans aucun type d'appât. Le poulpe entre dans ce vase et on le capture en ramassant l'attirail. On a utilisé nombre de récipients. Celui qui est traditionnel est un vase en poterie et on l'utilise comme attirail à pêche après avoir pratiqué un trou dans son fond. On cale ces engins de façon presque pareille à celles des nasses. On laisse calés les "cadups" sur place pendant toute la saison en les révisant chaque jour par mauvais temps et chaque deux jours s'il fait beau. Pour l'enlèvement du poulpe de l'intérieur du "cadup" on verse une petite quantité de lessive, vinaigre ou sel à travers le trou. En général les barques vouées à cette pêcherie sont petites et elles alternent cette tâche avec d'autres, selon la saison.

PêCHE DE LA SEICHE "A LA FEMELLE"- La pêche de seiches á la femelle (Sepia officinalis) consiste a capturer des mâles de cette espèce en utilisant une femelle comme leurre. D'une façon on d'une autre on capture d'abord une seiche femelle . On cloue un hameçon sur le manteau en cherchant á traverser l'os de façon qu'elle ne soit pas déchirée et perdue. On traîne cette femelle avec un fil de longueur 2 á 4 m lesté d'un plomb, la barque á vitesse faible, par jours de mer calme. De temps á autre on segague un peu de fil et si on voit que le mâle suit la femelle on le capture avec un haveneau. On peut utiliser la même femelle plusieurs fois.' C'est une pêcherie particulière du printemps. Nous ne pouvons pas la considérer comme une pêche commerciale, bien qu'elle soit pratiquée par des professionnels des petits métiers comme une façon supplémentaire de capture. A cause de la simplicité de l'opération et du matériel nécessaire, on peut considérer que l'on pratique le long de toute la côte catalane.

"POTERA"- La "potera" est un type d'hameçon en forme d'un plomb fusiforme paré de couleurs brillantes jouant le rôle d'appât, et pourvu d'une couronne d'hameçons sans languette (des aiguilles fléchies). L'espèce-cible de la pêche à "potera" est le calamar (Loligo vulgaris). Généralement on pêche à la "potera" de nuit, à l'aide d'une lampe (á gaz ou générateur), la barque arrêtée et ancrée. Le fond approprié est de 11 à 25 m. La lumière attire les poissons et le calmar accourt pour manger. Le pêcheur largue et segague du fil de sorte que la "potera" voyage à partir de mi-eau jusqu'au fond; on la remonte de nouveau et on recommence l'operation. Les canots faisant cette pêche sont équipés d'une lampe par des pêcheurs braconneurs ou demi-professionnels, parfois des professionnels la pratiquent comme une activité complementaire des autres modèles de pêche comme le trémail et les méthodes semblables. La saison où se fait ce type de pêche commence en Juillet et finit en Novembre. C'est en Septembre et Octobre que les calmars sont les plus grands.

TRéMAIL- Le trémail est un engin de filet fixe (de fond) formé de trois pièces dont deux sont pareilles à maille grande, et la troisieme, au milieu des deux autres, a la maille plus serrée mais mince et ses mesures sont beaucoup plus grandes, presque doublées, afin de former des bourses, placées entre les autres deux mailles. Il s'agit d'un engin ou la proie reste dans les bourses de la maille centrale. C'est une des méthodes de petit métier plus traditionnel, important à Catalogne. Un trémail complet est formé d'un nombre variable de pièces, généralement entre 20 et 50 chacune, de 50 à 100 de longueur (on considère les pièces doubles étant celles qui sont utilisées à l'actualité; c'est pourquoi un trémail armé mesure entre 25 et 50 m). La longueur du trémail dépend, finalement, de l'espèce-cible, de la réglementation de chaque port, et de l'habitude de chaque pêcheur. La hauteur des pièces se trouve entre 1 et 1.5 m. L'espèce-cible détermine le type de trémail et la dimension de la maille centrale. On emploie des mailles de 6 p/p pour la seiche.

	CHALUT	NASSE	CADUP	POTERA	"FEMELLE"	TRéMAIL
Octopus vulgaris	x	xx	xxx			x
Eledone cirrhosa	xx					
E. cirrhosa (jovenes)	xxx					
Loligo vulgaris	xx			xxx		
Sepia officinalis	x	xxx			xxx	xxx
Sepia orbignyana	x	x				
Alloteuthis spp	x					
Ommastrephidae	x			x		

x= Capturé occasionnellement. xx= Capturé copieusement, mais il ne s'agit pas d'un engin spécifique de cette espéce. xxx= C'est un engin (ou une variante de l'engin) spécifique pour cette espèce.

Predictive use of length-weight regression in Eledone cirrhosa

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ABSTRACT : Statistical error both in weight and length measurement of octopods, normally distributed data frequency and low correlation coefficients suggest the use of predictive (ordinary or inverted) regression to be often preferable to the functional one.

Body length measurements have been a classical problem in many species of octopods. Because of the physical mouldy structure, dorsal mantle length recordings still cause various and dissimilar results, especially with respect to estimation of length-weight correlations.

Pereiro & Bravo de Laguna (1980) report good examples of such a problem by analysing different length-weight relationships described in literature. Correlation coefficients are usually lower than in most vertebrate species: this is mainly due to high variability, both in weight estimate and in length measurements (Caddy, 1983). The present paper deals with estimation and use of length-weight functions for the species Eledone cirrhosa.

A three years trawl survey (5 campaigns) has been carried out in northern Tyrrhenian Sea by means of 148 tows. Global catches of E. cirrhosa (1500 individuals) have been subsampled , frozen at -20 °C and weeks later used for morphometric analyses. Dorsal mantle length and total body weight measurements were collected upon 823 specimens (340 males and 483 females) and log-transformed with the common technique (Ricker 1975).

Three kinds of L-W regression have been considered:
- The ordinary predictive regression. - The inverse predictive regression. - The functional regression.

	MALES		FEMALES	
	r	n	r	n
April 1985	0.87	66	0.93	128
August 1985	0.95	55	0.95	81
May 1986	0.98	59	0.97	86
September 1986	0.95	46	0.95	42
April 1987	0.96	114	0.91	146
grouped springs	0.94	239	0.94	360
grouped summers	0.95	101	0.96	123
all grouped	0.94	340	0.97	483

Tab. 1 Correlation coefficient (r) and specimen number (n) of the 16 sets data of E. cirrhosa.

The correlation coefficients have been computed for each survey and sex separately (see table 1). Grouping together these sets of data gives no advantage resulting in similar r values. The regression results of the 16 groups of data have been compared and analysed. Main common features can be summarized into four points.

1) The result precision (i.e. correlation coefficient) is quite unlinked to the number of specimens used, but it is likely determined by the sex and the gonadic development stage.
2) The correlation coefficient is almost never close to 1, then the application of the GM regression for predictive use is not correct (Jensen, 1986). This can be done only if the basic assumptions of the parametric regression, such as random sampling and variance homoscedasticity, are not met (Ricker 1973).
3) The lower r , the higher results the difference between the ordinary and the inverse predictive regression lines (e.g. fig.1). In our samples, the weight estimated from a length datum with the two ways gives up to 10-20 % differences in the extreme sizes (see tab.2).

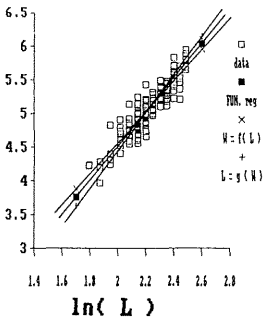

Fig.1 Predictive and functional regressions: sample of 146 females (April 87).

4) E. cirrhosa is a short-lived species (about 18 months), and by means of fishing sampling, it normally shows a single age class. Consequently all our frequency distributions satisfy the Normal distribution at 99% level if tested with the Kolmogorov-Smirnov procedure.

In E. cirrhosa, and likely in other octopods, variability is due to both length and weight measurement, and regression assumptions are usually met.

So, r being never close to 1 and regression lines different, any predictive use, namely to estimate weight from length or length from weight, must be done with the respective minimization.

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Length-weight relationship in males and females of Sepia orbignyana and Sepia elegans (Cephalopoda : Sepiidae)

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Cephalopods are dioecious and, except a few species, the two sexes do not show marked differences. Sexual dimorphism is mostly limited to hectocotylization in males and to different body proportions, which can be displayed as different length-weight relationships.

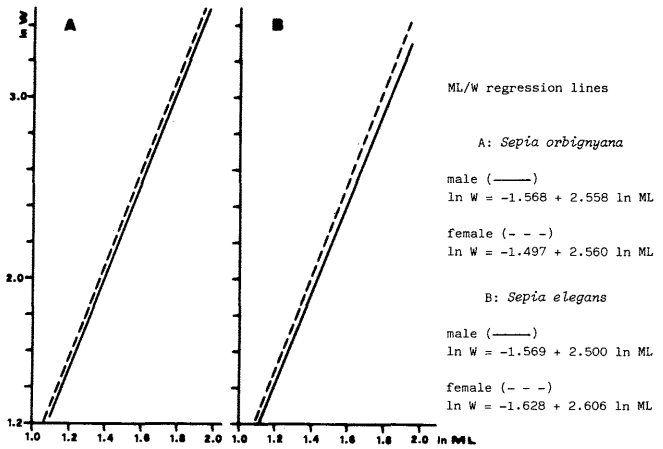
The genus *Sepia* is characterized by the presence of the rigid cuttlebone which allows precise measurement of mantle length. The genus is represented by three species in the Mediterranean: *Sepia officinalis* L., 1758, *Sepia orbignyana* Férussac , 1826, and *Sepia elegans* Blainville, 1827, all of which exhibit some degree of sexual dimorphism, mostly evident in the posterior part of the cuttlebone, which is broader in females to hold the large egg mass. Sexual dimorphism is less distinct in the latter two species (NAEF, 1923), in both of which females attain a larger size than males (MANGOLD-WIRZ, 1963). According to ADAM (1952) as well, in both *S. orbignyana* and *S. elegans* females are slightly larger than males, also the cuttlebone is larger; males have longer arms than females. ADAM & REES (1966), who quote the data of ADAM (*op. cit.*), state that in *S. elegans* "there is no noteworthy difference in the relative measurements of the two sexes".

To detect possible sexual differences in body proportions in *S. orbignyana* and *S. elegans*, the mantle length-weight relationships of the two sexes of each species were compared.

Specimens of the two species were collected in the South Adriatic Sea by a trawler from Mola di Bari (Italy) at a depth of 130 m, in May 1986. Mantle length (ML) was measured to the nearest 0.1 cm, and weight (W) to the nearest 0.1 gr. The parameters of the ML/W regression curves of each sex for the two species were calculated using the power curve equation: $W = a\,ML^b$. For statistical analysis these curves were then transformed into straight line equations using natural logarithms: $\ln W = \ln a + b \ln ML$. The pairs of straight lines of each species were compared by the Student's *t*-test, with the method of the "*axe majeur réduit*" (MAYRAT, 1959), being ln ML the independent variable (table 1).

	sex	n	Range of ML (cm)	a	b	r	P(%)	df	slope t	slope cl(%)	position t	position cl(%)
S. orbignyana	♂	38	3.6-7.1	0.208	2.558	0.982	<0.1	85	0.266	20.4	4.453	>99.9
	♀	51	2.3-9.0	0.224	2.560	0.992	<0.1					
S. elegans	♂	51	3.2-6.3	0.208	2.500	0.956	<0.1	99	0.317	24.8	5.358	>99.9
	♀	52	3.2-6.2	0.196	2.606	0.980	<0.1					

n = number of specimens; *a*, *b* = parameters of power curve ($W = a\,ML^b$); *r* = correlation coefficient; *P* = significance level of *r*; *df* = degree of freedom; *t* = Student's *t*; *cl* = confidence level of difference.



In both species the differences between the male and the female ML/W regression curves are very highly significant (*cl* > 99.9%), limited to their position; on the contrary, as regards their slope, the pairs of curves do not differ significantly (*cl* <90%)(table 1). Therefore it can be assumed that in both sexes the individual growth in weight basically follows the same physiological rules; whereas the significant differences in position show that females of both species are statistically heavier than males. Bearing in mind that males have longer arms than females (ADAM, 1952), and that there is no noticeable difference in mantle thickness, it follows that the body is proportionally broader in females than in males. The comparatively small size of the samples should not affect negatively the present test. Actually an increase in size of samples should increase the *t* value and, thus, further increase the level of confidence (MAYRAT, 1959).

Finally all four regression curves have the value of the exponent *b* less than 3, which shows that in both sexes of both species growth in weight is negatively allometric, i.e. cuttlefishes become more slender as size increases, as already pointed out by NAEF (1923) and, limited to *S. elegans*, by ADAM (1952).

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V-I5

Further considerations on growth of Cephalopods

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In the recent volumes "Cephalopod life cycles" (part I and II) edited by BOYLE, contributors reviewed what is known about cephalopod growth from both laboratory and field studies. The authors again stressed that cephalopods are short-lived and fast-growing animals. As in the previous work by MANGOLD (1983) they reported a number of quite different growth curves for various species. Most of the reviewed articles are based on laboratory research: the authors in fact agreed on the unreliability of the field studies because of the bias in the samples and the lack of population structure analysis techniques (BOYLE, 1983; WORMS, 1983; FORSYTHE and VAN HEUKELEM, 1987; see also BOYLE and KNOBLOCH, 1982). These reviews incite to a critical discussion on this aspect of the cephalopod biology not yet completely defined and described. Problems arise from the proposed life spans. In some cases ideal curves and observations based on a poor sample or on a single specimen reared under aquarium conditions have been used to support that the life of the considered species spans one year or less. For instance, the observed laboratory growth of Eledone cirrhosa (FORSYTHE and VAN HEUKELEM, 1987) is considered only on the basis of the exponential "ideal curve of maximum growth" computed by BOYLE and KNOBLOCH (1982) on the basis of a 315 days life, ignoring the typical sigmoid shape of the growth observed by the same authors on individual animals under artificial conditions. On the other hand, BOYLE himself (1983) proposed a composite model of the life cycle of E. cirrhosa based on a life span of two years. The general opinion that the field data are not sufficient to investigate growth in cephalopods is supported by the subjective weight given by the authors to some negative factors. Besides an equal number of negative factors affects the laboratory results, mainly the reduced number of specimens involved in the experiment and the general aquarium conditions (shape, colour, size, chemistry of the tanks; feeding, activity etc.). Nevertheless these factors seem to be accepted, while the statistical and mathematical techniques which can improve the field results seem to be neglected. Sampling optimization and frequency distribution decomposition methods have been described and successfully used (SCHWEIGERT and SIBERT, 1983; AKAMINE, 1985; MATRICARDI et al., 1987) also for species with a long recruitment and with a consequent overlap of age classes. Although many authors in Boyle's reviews devote a large part of their work to discuss quite different mathematical models in the cephalopod growth, the problem is not yet defined. Asymptotic equation is recognized to be inadequate (SAVILLE, 1987), but the significance of the parameters of this model is often misunderstood (PRUITT et al., 1979) and the equation sometimes is inappropriately forced on an incomplete data set (WORMS, 1983). This model was found inadequate to describe the growth during early stages and the cyclic trends in the cephalopod life. About this latter aspect PAULY (1985) introduced a modification in the model to improve its fitting which must yet be applied and thus confirmed or rejected. Some aspects of the other mathematical models proposed for various cephalopod species need further discussion: i.e. the confidence limits of the linear and exponential growth obtained by a regression on few data (TURK et al., 1986) or the attempt to employ two equations (exponential and logarithmic) to describe a growth curve which is clearly sigmoid. The arguments are inciting enough to continue along this line.

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V-I6

Feeding of Sepietta oweniana (d'Orbigny 1839) along the slope of the Ligurian Sea : a preliminary note

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In a random stratified sampling effected in spring and summer in the range 0-700 m (Research programme on trawl fisheries "Evaluation of demersal resources", Ministero della Marina Mercantile, Italy, 1985-87) *S. oweniana* was sporadically captured on the shelf, while the most important concentrations were observed in summer between 400 and 500 m depth. This Sepiolid apparently alternates reproductive migrations in circalittoral waters where the eggs are laid (Mangold Wirz 1963) with trophic migrations along the slope. These brief notes describe the diet in this latter environment.

As the sampling design was based on day-time hauls, each lasting one hour, it was possible to analyse the stomach content of specimens caught at different times. Additional sampling was carried out in autumn and winter, so that all seasons would be represented. A very large number of animals had to be examined before a total of one hundred stomachs with food remains (table 1) could be assembled; similar ratios probably due to quick digestion were observed in many species of Cephalopods (Nixon 1987). Feeding however did occur at different times (tab. 1). An average of about 1.5 food items per animal was obtained, which shows a definite preference for a few specific prey types (Mangold 1983). As the categories "vegetable remains" and "Cephalopods" - as explained later - seem to be "false" food, the percentage composition of total stomach content was: Crustacea 65.4%, Osteichthyes 28.3%, other organisms 6.3%.

Crustacea Decapoda and mainly the pelagic eurybathic *Pasiphaea sivado* are the most important prey, both in terms of size and energy value. The importance of *P. sivado* may be even greater considering that a fraction of unidentified Decapods probably belongs to it. Crustacea Peracarida were also frequently recorded, with a marked preference for the benthic isopod *Cirolana borealis*; however, in terms of size, they have a lesser role. Osteichthyes formed the most frequent food item, but their occurrence was in most cases limited to skin and scales or fragments of fins. Lenses, vertebrae or other very small bones were found only in a few cases. Are these simply discarded after the soft tissue has been eaten, as has been seen in squids (Nixon 1987)? In view of the feeding habits observed in captivity (Bergström 1983a, b) this seems not to be the case. Remains of Cephalopods belong invariably to Sepiolidae. There have been cases of an entire club and an arm tip of *S. oweniana*, freshly ingested (in the net or perhaps on the deck when the animal was dying), a fragmented, partially digested segment of an arm and isolated suckers (6 records of 1 or 2). Probably *S. oweniana* fights for food or is somewhat clumsy in pulling the prey to its mouth. Vegetables are mainly fragments of wood or leaves of terrestrial plants (only one instance of weed).

Considering table 1 in more detail, blocks A and B compare morning and afternoon records in a deep environment: among similar numbers of prey, a tendency to rest on the bottom in the afternoon (cf. Boletzky et al. 1971) is indicated by the reduction of the ratio pelagic to benthic crustaceans. Blocks C,D,E,F compare different seasons: the scarcity of Decapods in winter and spring, only in small part balanced by

Table 1. Feeding of *S. oweniana* on bathyal bottoms.

	Predators examined	*Pasiphaea sivado*	other Decapods	*Meganyctiphanes norvegica*	Crustacea Peracarida	unidentified Crustacea	Osteichthyes	*Leptometra* sp.	unidentified organisms	vegetable remains	Cephalopoda	Total food items
A -450 m summer 7-8.30	30	13	7	1	5	2	9		1	2	3	43
B -450 m summer 15.30-17	30	9	2		10	6	10		1		3	41
C -250 m summer 11.30-13	10	2	3		1		6		1		1	14
D -250 m autumn 11.30-13	10	5	1		2	1	6		2	1	1	19
E -250 m winter 11.30-13	10	1	1	1	1	4	1	2	1	6	1	19
F -250 m spring 11.30-13	10	1		1	2	1	4			1		10
Numbers of *S. oweniana*	100	31	14	3	21	14	36	2	6	10	9	146

Meganyctiphanes norvegica, seems to force *S. oweniana* to eat benthic prey such as *Leptometra* sp. or directly vegetable remains settled on the bottom; the latter however appear undigested.

An important feature of this preliminary diet analysis is, in our opinion, the central role of *Pasiphaea sivado* in the feeding of bathyal benthic organisms. Analogous records were obtained in the analysis of stomach contents of Selachians, Anacanthini, red shrimps and in *Geryon longipes* of the Ligurian Sea. On the other hand, the natural foraging of *S. oweniana* was studied in animals trawled in Gullmar Fjord, mostly at 90-100 m (Bergström 1983). In this case Euphasiids were 56.7% of the prey. Mediterranean *S. oweniana*, although it utilizes to some extent *M. norvegica*, seems to be a specialized hunter of *Pasiphaea sivado*; also the summer concentrations of *S. oweniana* on the edge of mesobathyal levels could be explained in relation to the vertical movements of this prey (Franqueville 1971).

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Preliminary observations on laboratory-reared Sepia orbignyana (Mollusca, Cephalopoda)

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Sepia orbignyana, a rather small species of cuttlefish, is found at depths ranging from 50 to 370 m in the area of Banyuls-sur-Mer (Mangold-Wirz, 1963). Over the past few years, the eggs of this species, which spawns all the year round, were collected regularly from various sponges sampled at a depth of about 100 m on the west side of the "rech Lacaze-Duthiers" (42° 30'-35' N, 3° 22'-23' E).

Rearing experiments made under natural daylight conditions, using standard techniques (Boletzky & Hanlon, 1983), were successful only up to 2 months after hatching. Why the animals ceased feeding and died after this time is not clear. From a series of experiments set up at constant artificial dim light, in an underground laboratory with running sea water, only two individuals kept in a 50 l tank from hatching (15 Oct. 1986) survived to reach the adult stage. In contrast to other experimental batches that were kept either on pure mud substrate, smooth hard substrate or on plastic netting, these two animals lived on a "mixed" substrate composed of clean, decaying crab exoskeletons, sand and mud.

The newly hatched animals, which measured about 6 mm in dorsal mantle length (ML), settled on the substrate and generally appeared only to move over short distances, either by active swimming or by slowly "walking" (using their ventral arms) along the bottom. They fed on small prawns and mysids of a size similar to their own. No direct observations on feeding were possible for the early months of rearing, but after about 5 months the animals were repeatedly seen to ingest palaemonid shrimps.

Apparently S. orbignyana does not bury itself in soft substrate. The covering behaviour, which is so characteristic of S. officinalis and other species (cf. Boletzky, 1983), was never observed at any growth stage, either under strong or under feeble light. On the other hand, colour patterns, skin papillation and arm displays were very similar to what is known of S. officinalis. In very young S. orbignyana, the lateral waving of raised dorsal arms is much quicker and more pronounced than in S. officinalis. The attachment to a hard substrate by means of ventral skin ("sucker") adhesion is also very pronounced in young S. orbignyana.

A very slight difference became apparent after a few weeks in the growth of these two individuals (Fig. 1), but it remained rather insignificant up to an age of about 4 months. Over the following two months it became very distinct, after which similar growth rates resulted in virtually parallel growth trajectories. After 9 months the smaller individual had some skin damage on the fins and was found swimming at the water surface. After a few days it was found dead (16 July 1987). It should be noted that temperature of the circulating sea water was rising, finally to a level about 10°C above water temperatures in winter (In its natural environment S. orbignyna lives at 12-13°C all the year round). Dissection of the animal, which measured 36.5 mm ML, showed that it was an immature female with nidamental glands only 2 mm in length. The cuttlebone had 63 lamellae (last loculus 13.5 mm in length); the lamellar index was 0.52. The larger individual soon after this showed some tissue degeneration at the mantle tip (around the spine); it was sacrificed on 25 July and turned out to be a mature male with spermatophores (3 mm in length) stored in the Needham sac. The cuttlebone had 68 lamellae (last loculus 13.5 mm in length); the lamellar index was 0.54. This is low compared to the lamellar index of wild-caught S. orbignyana which generally ranges from about 0.65 to 0.75; it suggests a reduced growth rate under aquarium conditions (cf. Boletzky, 1983).

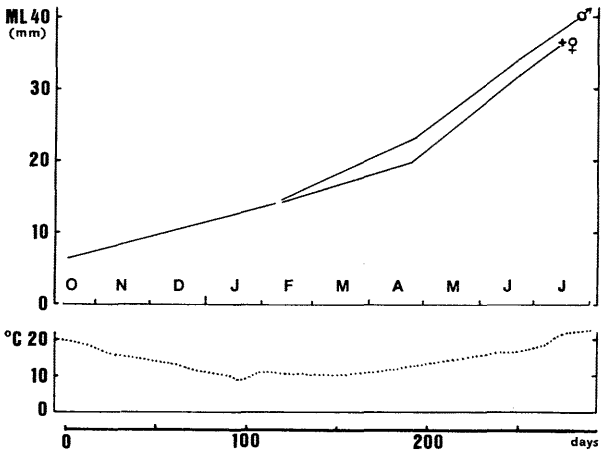

Fig. 1. - The growth of two individuals of S. orbignyana reared under artificial light conditions and at varying temperatures.

Acknowledgments. The animals used in this study were collected during the sampling program CEPHALOGOLION. The excellent collaboration of the captains and crew of N/O Pr. GEORGES PETIT is gratefully acknowledged.

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On an anomaly of the tentacular club in Loligo vulgaris Lamarck, 1798

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The most reliable macroscopic character to distinguish L. vulgaris from L. forbesi is the relative size of the suckers on the tentacle club (for literature see MANGOLD & BOLETZKY, 1987). A peculiar specimen of L. vulgaris was trawled at about 15 miles SE of Marsala (Western Sicily), at a depth of about 214 m., in November 1986 (Fig.1). The most noticeable feature of this specimen is the dimorphism in the two tentacular clubs (Fig.2): the left tentacular club corresponded to L. vulgaris the right to L. forbesi, according to the average ratio between the relative suckers diameters (JEREB & RAGONESE, in press) and the dentition of the suckers rings. The specimen can nevertheless be identified as a female of Loligo vulgaris (*), following other characters such as the chromatophoric pattern, the fins - mantle length ratio and the morphology of the beak. This female has a well developed ovary but no eggs in the oviducts. Biometric parameters, taken on the thawed specimen, are given in the TABLE. Both tentacles were intact and perfectly formed, with no sign of regeneration although such cases have been observed on Loligo specimens from the English Channel (FERAL, 1978). As far as the authors know, this is the first report of such an anomaly recorded in the Mediterranean Sea; an analogous case has been reported for Alloteuthis subulata from the belgian coast (ADAM, 1932). If the true specific identity can be ascertained in this and similar cases of unilateral "malformation" or "aberrancy", the question remains as to whether bilateral/symmetrical modification of the same (essentially functional) type would be recognized by a taxonomist. The ultimate question thus is whether a subspecies or even a species described on the basis of a single specimen differing from a known species by only one character can be considered valid.

TAB.- All the parameters following ROPER & VOSS, 1983

T.W. (gr.)		187,8
T.L. (mm.)		446
M.L.	"	189
M.W.	"	49
F.L.	"	126
F.W.	"	114
H.W.	"	33
H.L.	"	37
E.D.	"	22
Tentacles:	Left	Right
Tt.L. (mm)	228	200
* Cl.L. "	67	62
* Dc.L. "	21	18
* Mn.L. " }	46	44
* Cr.L. " }		

* Cl.L. = Club length
* Dc.L. = Dactylus length
* Mn.L. = Manus length
* Cr.L. = Carpus length

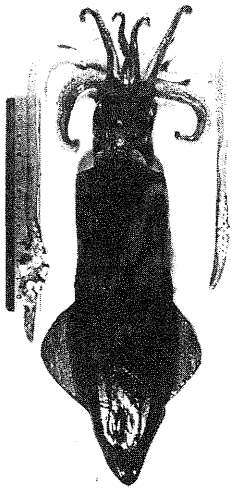

FIG.1 - Aspect of the whole animal, thawed

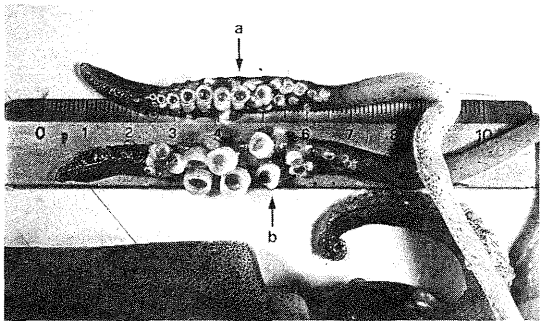

FIG.2 - a) right tentacle
b) left tentacle

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(*) Available in our collection, labelled I.T.P.P. - CS03

V-I9

A new record of long-continued spawning in Sepia officinalis (Mollusca, Cephalopoda)

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Females of the common cuttlefish Sepia officinalis are known to spawn over a period of several weeks before becoming exhausted (see Boletzky, 1983). Precise data on the total length of individual spawning, and the total number of eggs laid by an individual are now available from aquarium studies (Boletzky, 1987). Up till now, a period of about four months appeared to represent the maximum length of intermittent or chronic spawning for an individual female of Sepia. The present note reports a new maximum of seven months obtained under aquarium conditions.

The individual under consideration was one of a batch of animals reared from hatching in late July, 1984. It lived under continuous artificial dim light in an underground facility with running sea water at temperatures ranging from 22°C at the time of hatching to a minimum of 10°C in winter. During the first month the animal lived on amphipods present in large numbers in the rearing tank; later it was fed small prawns, and finally crabs and large prawns. It attained its final size of 15 cm ML (dorsal mantle length) after about 17 months from hatching. It was mated for the first time after 15 months. The first eggs were laid at age 16½ months, in mid December 1985, at temperatures around 12.5°C. Within a few days, the animal produced about 200 eggs (Fig. 1). This and subsequent batches were removed to a different tank for development, except a few eggs that were left on the spawning site as a visual stimulus. The second batch of ca 300 eggs was laid about 40 days later, within only two days. As no more egg laying was observed for nearly two months, a male was introduced again, and two days later the female laid about 275 eggs within three days. After another interval of 24 days, the animal laid about 300 eggs, 86 of which failed to develop (? unfertilized). Thus within 4 months, a total of over 1000 eggs was produced (with about 980 eggs developing normally into viable hatchlings measuring 7 to 8 mm ML). After another interval of about three weeks, during which another mating was achieved, the female continued spawning and produced a batch of more than 750 eggs within two weeks. With short intervals lasting 4 to 7 days each, it thereafter laid five batches of 328, 262, 276, 240 and 277 eggs, respectively. The last batch, laid exactly 7 months after the first eggs, was accompanied by a series of aberrant eggs. The total volume of the more than 3000 ova produced during the whole time of spawning must have been close to 10 times the instantaneous holding capacity of the ovarian sac.

The animal was still active after the last egg laying when it was aged nearly 2 years, but it had degenerating skin and soon became moribund. Its body size had not increased during spawning. The final fresh weight of the animal was 425 g. The cuttlebone had 147 lamellae of decreasing length towards the anterior end (last loculus 35 mm in length), resulting in a lamellar index of 0.93 (cf. Boletzky, 1983).

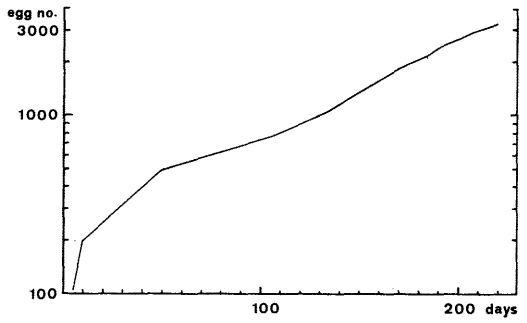

Fig. 1. - Cumulative curve giving total number of eggs laid over the whole period of spawning in a laboratory-reared Sepia officinalis.

These results emphasize once more that terminal reproduction in cephalopods can be drawn out over a relatively long time during which the spawning female feeds regularly (cf. Mangold, 1983); thus reproduction can hardly be called "suicidal" under these circumstances (cf. Geraerts, 1986). However, the fact that the physiology of the animal allows long-continued spawning does not prove that this capacity is always fully exploited under natural conditions; it only proves that the p o s s i b i l i t y of such protracted spawning really exists, and it suggests that this possibility becomes important under certain environmental conditions to counterbalance high mortality rates.

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V-II1

Essai de spéciation biochimique de six espèces de Gobiidés du littoral Languedocien

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INTRODUCTION - Les Gobiidés atlantoméditerranéens présentent une grande richesse, tant générique que spécifique (MILLER,1986) : de grandes ressemblances morphoanatomiques entre de nombreuses espèces, même à l'âge adulte, rendent leur distinction malaisée. De plus l'acquisition des caractères spécifiques essentiels, les organes ciatiformes (SANZO,1911), sur lesquels se fonde la systématique de cette famille, est progressive, ce qui pose le problème ardu de la détermination des larves et des juvéniles, stades particulièrement importants pour la compréhension des mécanismes de peuplement. C'est donc tant pour apporter d'éventuelles précisions au niveau taxonomique de certaines espèces que pour connaître les possibilités d'identification des stades jeunes de ces poissons que nous avons entrepris l'étude des protéines musculaires de 6 espèces sympatriques des côtes languedociennes. L'analyse de protéines musculaires sarcoplasmiques (parvalbumines, PA) et de structure (chaînes légères de la myosines, LC) au moyen des techniques de séparation électrophorétiques sur gel de polyacrylamide de plusieurs espèces très proches de poissons marins (FOCANT et PEQUEUX,1985; FOCANT et al.,1986) et d'eau douce (HURIAUX et FOCANT,1985; FOCANT et VANDEWALLE,1987) a démontré la valeur de ce critère biochimique de spéciation.

RESULTATS - Nous avons appliqué ces techniques à une série d'espèces de la famille des Gobiidés : Pomatoschistus marmoratus(RISSO,1810),Pomatoschistus minutus(PALLAS, 1770),Pomatoschistus microps(KRØYER,1838),Gobius niger LINNE,1758 ,Gobius paganellus LINNE,1758 et Zosterisessor ophiocephalus(PALLAS,1811) provenant du littoral languedocien. Les muscles du tronc sont prélevés immédiatement après la mort et conservés dans une solution glycérinée de pH neutre à -18°C de 1 à 12 mois. Après centrifugation, la mise en évidence des PA est réalisée à partir de la solution surnageante tandis que la myosine est extraite par une solution saline à partir des myofibrilles. L'électrophorétogramme de la FIG.1 (gel à 10% en acrylamide en présence de glycérine à pH 8.6) illustre la séparation des différentes isoformes des PA de ces 6 espèces. Suivant ce critère, les Gobiidés étudiés se répartissent en 4 groupes distincts comprenant : (a) P.marmoratus et (d) P.microps avec chacun une PA dominante typique, (b) G.paganellus et Z.ophiocephalus et (c) G.niger et P.minutus possédant chacun 2 PA de mobilités légèrement différentes et de proportions propres. La FIG.2 (gel à 20% en acrylamide en présence de dodécylsulphate de sodium à pH 8.8) met en évidence, en fonction de leurs poids moléculaires, les différentes chaînes légères de la myosine des espèces étudiées. Il apparait nettement qu'elles sont toutes caractéristiques de l'espèce.

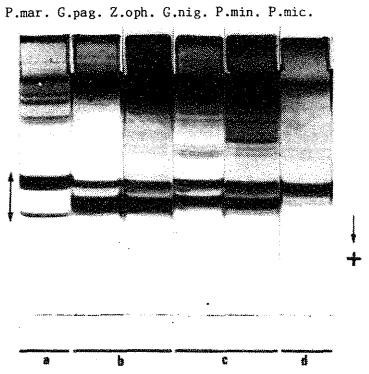

FIG.1

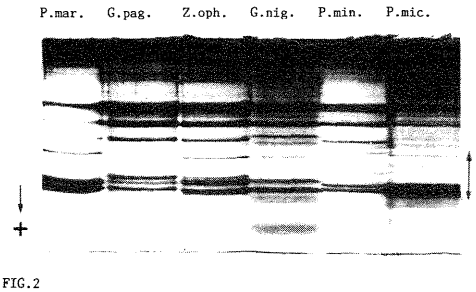

FIG.2

FIG.1 : Electrophorétogramme des parvalbumines sur gel de polyacrylamide en présence d'urée à pH 8.6. La flèche indique la zone de migration des parvalbumines.

FIG.2 : Electrophorétogramme des chaînes légères des myosines sur gel de polyacrylamide en présence de SDS à pH 8.8. La flèche indique la zone de migration des chaînes légères.

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DISCUSSION - L'électrophorèse de ces protéines musculaires fournit une "signature" typique de l'espèce et apporte une aide biochimique appréciable à la systématique réputée difficile des Gobiidés. Applicable à de faibles quantités de muscle (0.1 gr.), cette méthode, indépendante des caractères anatomiques, permet d'envisager la reconnaissance précoce des jeunes stades (larves et juvéniles).

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Biochemical analysis of parvalbumins and myosin light chains from Mediterranean Serranids : first application to the systematic

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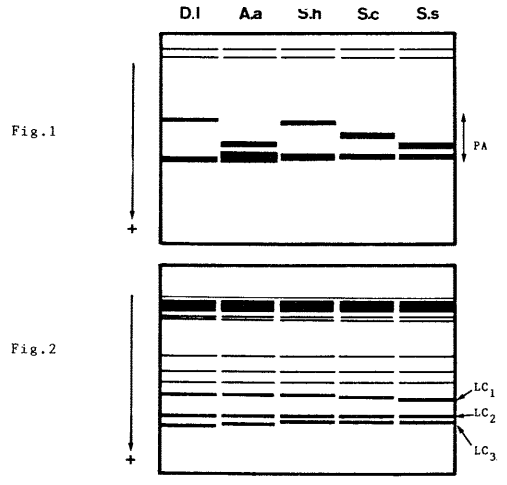
INTRODUCTION - Researchs in adaptative strategies of mediterranean Serranid fishes (sensu lato) involve multidirectional investigations. Their behaviour was the subject of different studies (for ex.: LEJEUNE et al.,1980) and the morphology of their muscles is now under analysis in our laboratories (for ex.: BENMOUNA et al., 1984). On the other hand, the classification of the Serranid species is always based on classical systematic methods (external morphological characteristics) (for ex.: STARCK,1961).
A first biochemical systematic investigation was attempted from two mediterranean Serranids : Serranus scriba L. and Serranus cabrilla L. obviously showing reproductible differences at the level of sarcoplasmic parvalbumins and myosin light chains between the muscles of the two species (FOCANT et al.,1986).
Parvalbumins (PA) are specific low molecular weight calcium-binding proteins present in relatively large amount in fish muscle sarcoplasm. Myosin is the major muscle contractile protein containing light subunits, the myosin light chains (LC); they can also be specific. Biochemical differences between these proteins from various species are put forward by electrophoretic technics discriminating between them by their specific electric charge and molecular weight.

RESULTS - These hopeful results have to be verified from a greater number of species originating from different places of the north-west mediterranean sea. We obtained from Barcelona (Spain) 3 Dicentrarchus labrax L., 2 Anthias anthias L., 5 Serranus scriba L. and 3 Serranus cabrilla L.;from Montpellier (France) 3 Serranus hepatus L.; from Solenzara, Corsica (France) 1 Dicentrarchus labrax L. and from Calvi, Corsica (France) 6 Serranus scriba L. and 6 Serranus cabrilla L..
We present in this paper the preliminary results :
Essentially two types of gel electrophoresis (PAGE) were successfully used : 8 M urea or 10% glycerol-PAGE for the separation of specific PA isoforms according to their electric charge and SDS-PAGE on which myosin LC solely migrate on the basis of their molecular weight (FOCANT et al.,1981).
The two schematic electrophoretograms (Fig. 1 and 2) together allow a clearcut separation of the 5 Serranid species, based on PA for the 3 Serranus , D.labrax and A.anthias, on myosin LC_1 for S.scriba and S.cabrilla and on myosin LC_3 for D.labrax, A.anthias and S.hepatus.

DISCUSSION - The electrophoretic method possesses an excellent discriminating ability for Serranid species. The specificity of muscle proteins examined appears invariable and unconnected with the geographical localisation of the species. The biochemical differences observed are similar to that encountered between the members of other fish families. Divergences between two species of the same genus, Serranus scriba and Serranus cabrilla are more considerable than between two fishes from distinct genus, Serranus scriba and Dicentrarchus labrax. These differences do not allow us to establish phyletic relations between species, unless the systematic could be standing in error.

ACKNOWLEDGMENTS - This work is supported by a NATO grant (N°0447/87) and a contract of the "Fonds National de la Recherche Scientifique" of Belgium (N°3.4513.85). B.F. and P.V are "Research associate of that found.
The authors wish to thank the Laboratoire d'Ichthyologie et de Parasitologie générale (Prof.QUIGNARD), Univ. des Sciences et des Techniques du Languedoc, Montpellier, France and the belgian oceanographic research station (STARESO), Calvi, Corsica, France.

FIGURES 1 AND 2 - Schematic electrophoretograms showing the separation of the PA isoforms (Fig.1, 10% glycerol-PAGE) and of myosin LC subunits (Fig.2, SDS-PAGE) from the muscle of 5 Serranids species : D.labrax (D.l), A.anthias (A.a), S.hepatus (S.h), S.cabrilla (S.c) and S.scriba (S.s).



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Données sur quelques caractères numériques des espèces du genre Belone (Poissons, Téléostéens) des côtes Tunisiennes

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Afin de caractériser biométriquement les populations des deux espèces d'orphie présentes sur les côtes tunisiennes *Belone belone gracilis* Lowe, 1839 et *Belone svetovidovi* Collette et Parin, 1970, nous avons effectué des observations sur des lots de poissons pêchés en mer dans le secteur de Bizerte et de Monastir et en lagune dans le lac de Bizerte et de l'Ichkeul. La taille des individus étudiés varie entre 12 et 45 cm de longueur du corps (distance comprise entre le bord postérieur de l'opercule et la base de la nageoire caudale). Cinq caractères numériques sont considérés : le nombre de rayons aux nageoires dorsale et anale, le nombre total de vertèbres, le nombre total de branchiospines sur le premier arc branchial et le nombre de dents situées à mi-longueur de la mâchoire supérieure sur une longueur égale au diamètre orbitaire. Les résultats obtenus sont consignés dans le tableau ci-après. Il en ressort les points suivants :
- Au sein d'un même milieu, marin ou lagunaire, les caractères numériques des populations de *B.b.gracilis* ne diffèrent pas significativement d'un secteur marin à un autre ou d'une lagune à une autre. Il en est de même des populations marines de *B. svetovidovi*. Ceci dénote une remarquable homogénéité des populations d'orphies peuplant les eaux tunisiennes.
- En revanche, les populations lagunaires de *B.b.gracilis* se distinguent très nettement des populations marines notamment par la moyenne vertébrale particulièrement basse (75,79 contre 79,68) et par le nombre de rayons aux nageoires dorsale et anale plus élevé. Ces orphies à faible moyenne vertébrale se reproduisent dans les lagunes. Elles constituent des stocks indépendants des populations franchement marines.
Ce phénomène n'est pas propre aux orphies ; chez d'autres poissons comme l'anchois par exemple, il a été mis en évidence des populations à faible moyenne vertébrale dont les individus pondent en milieu lagunaire.
- Les valeurs que donnent COLLETTE et PARIN (1970) pour caractériser *Belone belone* de Méditerranée sont à l'exception du nombre de rayons à la nageoire dorsale, très différentes de celles trouvées pour les populations marines des côtes tunisiennes. Elles sont en effet plus faibles pour les branchiospines (32,02 contre 34,77), pour les vertèbres (78,44 contre 79,68) et pour le nombre de rayons à la nageoire dorsale (17,39 contre 17,53) mais plus fortes pour les dents(8,95 contre 7,37).
-Pour ce qui est de *Belone svetovidovi*, les valeurs relevées par COLLETTE et PARIN sont semblables à celles des populations tunisiennes pour le nombre de vertèbres et celui des rayons à la nageoire dorsale ; elles sont au contraire plus faibles pour le nombre de branchiospines (43,00 contre 45,40) et le nombre de rayons à la nageoire anale (21,34 contre 21,76) et plus fortes pour les dents (15,03 contre 14,10).

	N. dorsale N	N. dorsale $\bar{x}$	N. dorsale s	N. anale N	N. anale $\bar{x}$	N. anale s	Branchiospines N	Branchiospines $\bar{x}$	Branchiospines s	Dents N	Dents $\bar{x}$	Dents s	Vertèbres N	Vertèbres $\bar{x}$	Vertèbres s
B. b. gracilis															
Ichkeul (lac)	60	18,167	0,642	60	21,333	0,837	59	34,440	2,011	59	7,797	1,387	60	75,733	1,505
Bizerte (lac)	58	18,190	0,847	57	21,386	0,750	54	35,222	2,304	58	6,517	0,843	56	75,857	1,354
Total	118	18,178	0,747	117	21,359	0,793	113	34,814	2,182	117	7,162	1,313	116	75,793	1,430
Bizerte (Mer)	145	17,565	0,806	145	21,228	0,685	143	34,692	2,689	145	7,400	0,869	145	79,745	1,284
Monastir (Mer)	80	17,462	0,674	80	21,137	0,670	81	34,914	2,341	80	7,312	0,756	81	79,568	1,244
Total	225	17,529	0,762	225	21,196	0,679	224	34,772	2,565	225	7,369	0,830	226	79,681	1,270
B. svetovidovi															
Bizerte (Mer)	135	17,259	0,712	134	21,769	0,703	135	45,274	3,004	117	14,145	1,381	134	77,754	1,029
Monastir (Mer)	30	17,167	0,747	30	21,700	0,702	30	45,967	2,906	27	13,926	0,730	30	77,567	1,251
Total	165	17,242	0,717	164	21,756	0,702	165	45,400	2,989	144	14,104	1,294	164	77,720	1,071

Variations de quelques caractères numériques chez *Belone belone gracilis* et *Belone svetovidovi*.
N : effectif ; $\bar{x}$: moyenne ; s : écart type.

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V-II4

Quelques caractéristiques numériques d'Hyporhamphus picarti (Valenciennes, 1846) (Téléostéen, Hemiramphidae) des côtes de Tunisie. Comparaison avec les populations atlanto-méditerranéennes

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La famille des Hémiramphidés est représentée en Méditerranée, principalement sur sa rive sud par deux espèces *Hemiramphus far* (Forskal, 1775) et *Hyporhamphus picarti* (Valenciennes, 1846). Il semble que seule cette dernière fréquente les eaux tunisiennes. Nous en avons capturé durant l'été 1985, une première fois, cinq cents individus à l'entrée du lac Ichkeul et, une deuxième fois quelques exemplaires au large de Monastir.

Afin de contribuer à préciser les caractéristiques des populations tunisiennes, nous avons procédé, pour un nombre de 131 individus mesurant entre 6 et 12 cm de longueur totale et provenant du lac Ichkeul à l'analyse de cinq caractères méristiques : le nombre de rayons aux nageoires dorsale , anale et pectorales, le nombre de vertèbres et le nombre de branchiospines sur le premier arc branchial. De plus, nous avons confronté nos résultats avec ceux obtenus par COLLETTE (1965) d'après l'examen de cinq échantillons dont l'un provient, pour l'essentiel des côtes d'Egypte et d'Israël et les quatre autres des côtes atlantiques ouest-africaines. Vu l'homogénéité des populations atlantiques nous avons repris les données les concernant en les regroupant et en établissant de nouveaux calculs. Les résultats consignés dans le tableau ci-dessous, permettent de tirer les conclusions suivantes :

- L'existence, au niveau des populations étudiées, de divergences plus ou moins importantes selon le caractère pris en compte met clairement en évidence l'aspect polymorphe de *H.picarti*.
- Quel que soit le caractère considéré, la population de l'Ichkeul se distingue nettement des autres par des valeurs moyennes élevées. Celles-ci seraient induites par les températures relativement basses des eaux baignant les côtes nord de la Tunisie.
- Contrairement à ce que relève COLLETTE pour les populations atlantiques, celles de la Méditerranée sont très hétérogènes. Cette hétérogénéité qui affecte également d'autres poissons méditerranéens reste encore difficile à expliquer.
- Les populations du sud-est méditerranéen, bien qu'elles occupent une position intermédiaire entre les populations tunisiennes et celles atlantiques, présentent plus d'affinités avec ces dernières et ce, très vraisemblablement en raison de la similitude des carctéristiques hydrologiques du bassin levantin et du secteur sud-est atlantique.
- Enfin l'étude de l'échantillon du lac Ichkeul fait apparaître une relation linéaire entre le nombre de branchiospines et la longueur totale du poisson se traduisant par l'équation : Br = 0,043 LT + 29,392.

	N. dorsale			N. pectorales			N. anale			Vertèbres			Branchiospines		
	N	$\bar{x}$	s	N	$\bar{x}$	s	N	$\bar{x}$	s	N	$\bar{x}$	s	N	$\bar{x}$	s
Ichkeul	130	15,369	0,672	131	11,046	0,273	131	16,153	0,650	129	49,783	0,718	130	33,138	1,374
Méditerranée ★	42	14,500	0,707	34	10,941	0,239	39	15,359	0,873	34	48,323	0,767	46	32,826	1,338
Atlantique ★	249	14,590	0,596	141	10,957	0,394	252	15,278	0,607	230	47,548	0,721	245	31,804	1,458

Variations de quelques caractères numériques chez *Hyporhamphus picarti* . N: effectif ; $\bar{x}$: moyenne ; s : écart type. (★ : données de Collette, 1965).

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V-II5

Movements of the pharyngeal bones of Serranus scriba (Pisces, Serranidae) : preliminary analysis

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SUMMARY. In Serranus scriba, the pharyngeal jaws move in quite diverse,synchronous or opposite, ways. Left bones may move independently from the right ones. Such movements are maybe related to an unspecialized diet.

RESUME. Les os pharyngiens de Serranus scriba présentent des mouvements très variés synchronisés ou opposés. Les pièces gauches peuvent être mues indépendamment des pièces droites. Ces mouvements sont sans doute en rapport avec un régime alimentaire peu spécialisé.

INTRODUCTION. Many teleosts perform succion feeding by a rapid expansion of the bucco-pharyngeal cavity (ELSHOUD-OLDENHAVE and OSSE, 1976; LAUDER, 1980; VANDEWALLE, 1980; CYRUS and BLADER, 1982; VAN LEEUWEN and MULLER, 1984;...).We observed the same behaviour in mediterranean serranid fishes. That way of feeding thus makes it necessary to handle the food items in the bucco-pharyngeal cavity without any work of the jaws. That is why we have investigated the movements of the pharyngeal jaws during food catching in Serranus scriba. The aim of this paper is restricted to the presentation of movement possibilities of the pharyngeal jaws as seem in lateral view. In Serranus scriba, each of lower pharyngeal jaw consists of a 5th ceratobranchial. The upper jaws are composed of distinct 2nd, 3rd and 4th pharyngobranchials (BENMOUNA et al., 1984).

MATERIAL and METHODS. Pharyngeal jaws were labeled with lead points (Fig.1) and food injected with baritine. Food catching and handling were recorded by means of cineradiography using an Arriflex 16 mm camera at 50 frames/sec.

OBSERVATIONS. In the rest position, the pharyngeal jaws are placed one in front of the other at a slight distance. When food items come at their level, they move in very different ways :

- upper and lower jaws may be elevated or lowered;
- they may be protracted or retracted;
- they may be rotated around a transverse axis;
- the right jaws may be moved independently from the left ones;
- any combination of the above mentioned movements is possible (fig.2).

DISCUSSION. LIEM (1978) gives the first description of movements of the pharyngeal jaws of Perciforms based on cineradiography. Movements are very simple : the jaws move forward or rearward or rotate together. LIEM and SANDERSON (1986) and LIEM (1986) describe very regular and well-synchronized cycles of movements of the pharyngeal boens during mastication and swallowing in Labridae and Embiotocidae. In the same year, AERTS et al.(1986)observe opposite movements of the upper and lower pharyngeal jaws during mastication in the cichlid Oreochromis niloticus. CLAES and DE VREE (1988) report in the same species asymmetrical mastication increased upper jaw movements and muscles activity at the active side.
In Serranus scriba, movements are even more diversified. Relationships between food type and kinematic pattern are not yet established. So large diversity of movements is possibly related to an unspecialized diet for which simple and not too rigid pharyngeal jaws would be convenient. On the other hand increasing alimentary specialization could result in increasing stiffness and decreasing mobility of the pharyngeal jaw apparatus. In Serranids, the four pharyngeal jaws are able to move independently and the upper ones seem to be flexible. Cichlids possess only one functional lower jaw and two rigid upper ones whereas in Labrids, the single lower pharyngeal jaw moreover articulates on the pectoral girdle (LIEM and GREENWOOD, 1981) .

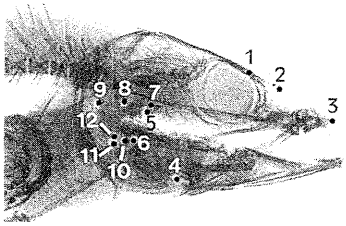

fig.1. Radiograph in lateral view of the head of Serranus scriba showing implanted lead dots marking the location of bones. 1,2, neurocranium; 3, premaxillary; 4, hyoid arch; 5, left upper pharyngeal jaw; 6, left lower pharyngeal jaw; 7, 8, 9, right upper pharyngeal jaw; 10, 11, 12, right lower pharyngeal jaw.

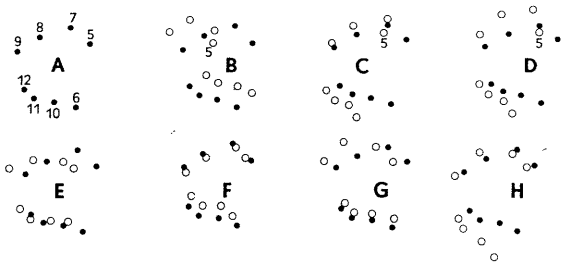

fig.2. Some different positions of the pellets marking the location of pharyngeal bones during the feeding in Serranus scriba. The first drawing is considered as the rest position and is repeated on the other ones. For the numbers, see fig.1.

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Pathologie du Loup en élevage au Centre National Aquacole de Monastir

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ABSTRACT : A study of diseases in the sea-bass, *Dicentrarchus labrax*, Fish-farmed at the National Center of Monastir (Tunisia) is carried out. The more frequent observed diseases are: -the copepodosis in genitors = this disease is due to a parasitic Copepod, *Caligus minimus*, fixed both into the buccal cavity and on the body of fishes.
- the incomplete inflation or the non inflation of swim bladder in fingerlings and juveniles
- the abdominal distension, spinal curvature and incomplete operculum in the same figerlings and juveniles.

Un suivi régulier pendant un an (Octobre 1985-Octobre 1986) a permis de mettre en évidence différentes affections qui surviennent chez le loup, *Dicentrarchus labrax*, au cours de la croissance (alevins juvéniles) et chez les géniteurs.

A.- Chez les géniteurs

1) Copépodose : Il s'agit d'une affection grave, due à la pullulation d'un Copépode parasite, *Caligus minimus*. Les poissons parasités sont porteurs de plusieurs dizaines de Caligides, non seulement dans la cavité buccale, mais aussi sur tout le corps, particulièrement au niveau de la tête et des nageoires. Chez ces poissons, nous avons remarqué : un arrêt de la prise de nourriture, un amaigrissement important une coloration sombre, des plages déchiquetées et hémorragiques, surtout au niveau des nageoires.

2) Nécrose du pédoncule caudal et ulcère de la peau: Des géniteurs maigres présentent des lésions cutanées caractérisées par la présence, au niveau du pédoncule caudal, de plages érodées et blanchâtres. Les poissons atteints montrent une nage difficile, un arrêt de la prise de nourriture et ils finissent par succomber. L'examen des lésions externes a révélé la présence d'ulcérations tégumentaires congestionnées, pénétrant dans les muscles superficiels. Au voisinage des zones nécrosées, la peau a tendance à la desquamation. Les myxobactéries provoquent souvent ce genre d'affection (De Kinkelin et coll., 1985)

B.- Chez les alevins et les juvéniles

1) Distension abdominale : Nous avons remarqué, parmi les populations de juvéniles, de nombreux individus présentant un "gros ventre". Chez certains poissons, la distension abdominale est la seule affection rencontrée. Chez d'autres, au contraire, celle-ci est associée à la déviation, aux anomalies de la colonne vertébrale et de la vessie gazeuse. Dans tous les cas, l'autopsie a révélé la présence d'un dépôt anormal de graisse,péridigestif. Ces poissons ont été nourris avec un aliment composé dont plus de la moitié est formée de chair de sardines. Or, un régime de ce genre, riche en lipides et en protéines, produit des loups dont la croissance pondérale est correcte mais dont le coefficient de condition et la teneur en graisses sont beaucoup trop élevés (Roche et coll., 1984). Il est probable que ces "loups métabolisent préférentiellement les protéines, alors qu'ils stockent les lipides dont l'excès conduit à des dépôts graisseux" (Roche et coll., 1984). A ceci, il faut ajouter que les poissons présentant des déformations du squelette ainsi qu'une calcification anormale des os, montrent souvent un dépôt graisseux péridigestif (Tacon, 1986).

2) Anomalies de la vessie gazeuse : Deux anomalies principales sont mises en évidence sur des images radiographiques :
- réduction du volume et modification de la position de la vessie : cette anomalie semble en relation avec le tassement des vertèbres et de myomères. Ainsi, les individus présentant un nombre important de vertèbres tassées ont une vessie très écartée de sa position normale, horizontale. Chez ces poissons, une autre anomalie peut affecter le volume de la vessie qui se trouve alors réduit.
- absence totale de vessie :les images radiographiques d'autres jeunes poissons ont révélé l'absence totale de vessie gazeuse. Le non gonflement de la vessie est une affection connue chez le loup. On pense qu'elle est le résultat d'anomalies affectant le conduit pneumatique au moment du gonflement initial (Giavenni et Doimi, 1983). En outre, ces poissons peuvent montrer des tassements de vertèbres, mais aussi, et dans tous les cas, des déviations de la colonne vertébrale de type lordose. Les alevins et les juvéniles présentant ces deux types d'anomalies ont une nage continue,oblique, parfois même verticale et coulent dès qu'ils s'arrêtent de nager. Parmi ceux-ci, certains sont fortement amaigris. D'autres poissons sont incapables de nager et se posent en permanence sur le fond où ils finissent par mourir.

3) Déformations du corps : Diverses déformations du corps ont été observées. Elles sont, pour la plupart, liées aux déformations de la colonne vertébrale et donc aux anomalies de la vessie gazeuse. Les gibbosités, en particulier au niveau du dos, les torsions du corps et les déformations de la tête et de la bouche sont les anomalies les plus fréquemment rencontrées.

4) Anomalies des nageoires : Chez les jeunes loups présentant diverses déformations du corps, des anomalies affectant la forme, la position des nageoires ainsi que le nombre de rayons durs ont été observés. Nous avons noté chez quelques individus l'atrophie ou l'absence totale de certaines nageoires.

5) Entassement et modification des écailles : Chez les poissons montrant un tassement important des vertèbres et des myomères, nous avons remarqué un empilement des écailles à ce niveau. Dans ces régions les écailles se chevauchent, formant des plages épaisses et rugueuses. Elles gardent cependant une forme et une taille normale. Ce chevauchement intéresse également les écailles de la ligne latérale qui ne sont plus percées dans leur champ antérieur de l'orifice laissant passer le canal appartenant au système latéral.

6) Les malformations des os operculaires : Chez certains alevins et juvéniles la chambre branchiale incomplètement couverte, laissait entrevoir les branchies dont une partie, plus ou moins importante selon le degré de l'affection, était seule visible. Dans les cas extrêmes l'ensemble des branchies était découvert. Ces atteintes peuvent être symétriques ou n'intéresser que le côté droit ou gauche. Elles peuvent être associées ou non à des déformations du corps résultant elles-mêmes de déformations et anomalies de la colonne vertébrale. L'examen des os couvrant la chambre branchiale nous a permis de constater que les anomalies observées résultent d'une atrophie et d'une torsion de l'opercule ou du sous-opercule, ou encore des deux.

CONCLUSION : Cette étude nous a permis de connaître les différentes affections du loup élevé à la station de Monastir. Parmi celles-ci, les plus fréquentes sont : la copépodose chez les géniteurs, l'inflation incomplète ou le non gonflement de la vessie gazeuse chez les alevins et les juvéniles, la distension abdominale, les malformations du rachis et des os operculaires chez les mêmes alevins et juvéniles.

Dans le premier cas, l'affection est due à la fixation d'un Copépode parasite,*Caligus minimus*. Dans les autres cas la cause des affections reste indéterminée. Celles-ci ont déjà été signalées dans de nombreuses installations méditerranéennes d'élevage intensif du loup où on a souvent incriminé les conditions générales de l'installation aquacole dans l'apparition de ces affections, sans pouvoir établir un lien avec un facteur précis, réellement responsable.

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L'absorption de la glucosamine par l'intestin de l'Anguille (Anguilla anguilla, Linné 1758) : effets de la température et de la concentration

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Poursuivant nos travaux sur l'absorption intestinale chez l'Anguille (TRITAR et coll. 1986) nous avons étudié l'influence de la température et de la concentration sur l'absorption digestive de la glucosamine.

Les expériences sont effectuées in vivo selon un protocole qui a été précédemment décrit (PERES et coll.1973) et qui consiste en une perfusion continue de l'intestin du poisson. Le perfusat est préparé à partir de Ringer à 9‰ de Nacl et de glucosamine M/4 de façon à amener la concentration en sucre aminé à 0,5mM. La présence d'un marqueur radio-isotopique (glucosamine ^{14}C) permet la détermination des quantités de glusocamine absorbées par l'intestin.

Des perfusions à six températures différentes ont été réalisées : 5°C,10°C, 15°C, 20°, 25°C et 30°C. La durée de chaque perfusion est de 30 minutes et la concentration en sucre aminé est de 0,5mM .

Les résultats obtenus montrent qu'une élévation de la température provoque "in vivo" une augmentation de l'absorption intestinale de la glucosamine. C'est ce que montre la diagramme réalisé à partir des moyennes des quantités de glucosamine absorbées par les douzes animaux aux six températures (Fig.1).

Les valeurs du coefficient thermique ou Q_{10} : 1,78 dans l'intervalle 5°C, 10°C; 2,02 dans les intervalles 10°C - 20°C, et 15°C, 25°C;1,74 dans l'intervalle 20°C -30°C, montrent que l'action de la température s'exerce non seulement sur la diffusion passive mais aussi sur un transport à caractère métabolique (BRYAN et coll.1971, PERES et coll. 1974).

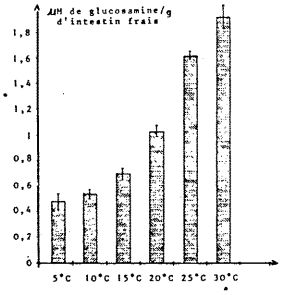

FIGURE 1 .- EFFET DE LA VARIATION DE LA TEMPERATURE SUR L'ABSORPTION DE LA GLUCOSAMINE A 0,5 mM. CHEZ *Anguilla anguilla*

Des perfusions à cinq concentrations différentes en sucre aminé ont été envisagées 0,5mM, 1mM, 2mM, 5mM, et 10 mM. La durée de perfusion est de 30 minutes et la température est maintenue constante à 20°C.

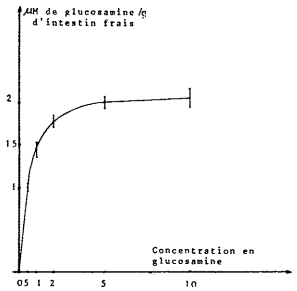

FIGURE 2.- INFLUENCE DE LA CONCENTRATION EN GLUCOSAMINE (&0,5 mM- 1 mM- 2 mM- 5 mM- 10 mM) chez l'anguille.

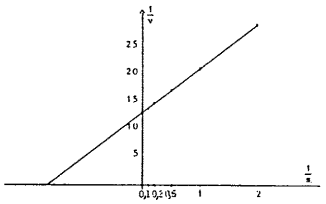

FIGURE 3. Etude de l'absorption de différentes concentrations de la glucosamine par l'intestin de l'anguille. Représentation selon LINEWEAVER et BURK (1934).

Les résultats obtenus montrent que l'absorption de la glucosamine croit avec l'augmentation de la concentration en substrat et fait apparaitre un phénomène de saturation au delà de 5mM. (Fig.2).

Le pourcentage d'absorption de la glucosamine évolue en sens inverse de celui de la concentration de ce sucre aminé soit 21,42% pour 0,5mM, 14,5% pour 1mM, 8,95% pour 2mM, 4,17% pour 5mM et 2,22% pour 10mM.

Les résultats analysés selon la méthode préconisée par LINEWEAVER et BURK (1934) donnent une représentation graphique sous la forme d'une droite (fig.3) d'équation $y = 7,61 x + 12,89$. L'application de la théorie de MICHAELIS et MENTEN (1973) donne une constante de MICHAELIS km égale à 0,59 mM et une vitesse maximale $V_m = 0,08$ µM par gramme d'intestin frais et par minute. La valeur faible de la constante de MICHAELIS et MENTEN (km = 0,59 uM) révèle une forte affinité du système de transport pour la glucosamine (BRYAN et coll.1971).

Ces études sur la concentration montrent que l'absorption de la glucosamine se présente comme un phénomène à caractère métabolique .

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V-II8

A new method for classifying the prey of fish

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Analysis of stomach contents is commonly used in studies of fish diet. Once prey are identified, food preferences can be assessed by calculating the relative proportions of each major prey category in terms of percent number, percent weight, or frequency of occurrence. These methods and others, with their advantages and disadvantages, are the subject of many papers like that of Berg (1979). In addition to this direct approach various indices of dietary preference have been developed which combine two or three of these measures. Some authors have proposed to classify the major prey categories of fish, in terms of preference, with regard to their dietary index value. In the present study three dietary indices and prey classification methods are applied to two sparid fish (*Diplodus sargus* and *Pagellus erythrinus*) stomach data.

$$MFI = \frac{(N + F) \times W}{2} \quad \text{(Zander, 1982)} \qquad Q = N \times P \quad \text{(Hureau, 1970)} \qquad IA = \frac{F \times P}{100} \quad \text{(Lauzanne, 1975)}$$

where $N = 100 \times \frac{\text{Number of Individuals of Prey i}}{\text{Total Number of Prey}}$ $\qquad W = 100 \times \frac{\text{Weight of Prey i}}{\text{Total Weight of Prey}}$

$$F = 100 \ \frac{\text{Number of Stomachs containing Prey i}}{\text{Total Number of Stomachs Containing Food}}$$

With the MFI and IA indices all prey appear to have almost the same importance and major prey cannot be distinguished (Table 1). These indices do not discriminate enough prey categories, especially when these are numerous. Hureau's (1970) classification of categories can be applied successfully to sparid fish since all prey are distributed in the three proposed categories. These methods of classifying dietary items were adapted to the species studied by their proposing authors, but the categories and their limits are empirical and cannot be applied to all predators. A more reliable distinction between prey categories may be required, for example when comparing two fish species or several classes within one fish species.

The following method is proposed : Stomach content data are first analyzed by any dietary index (N,F,Q,MFI, etc) and the total index value of all prey categories is calculated. Each individual value is then expressed as a percentage of the total value. As a result all indices are transformed to the same scale and comparisons (between fish species or classes within a species) become simpler. Prey categories are ranked by decreasing order, with regard to their index value. From prey of rank 1 to prey of rank n, the transformed index values of each prey are summed until 50% is reached. It is suggested that these prey are termed PREFERENTIAL. The values of the following prey are added up to 75% of the total index and it is proposed to call these prey SECONDARY. The remaining prey in the list are considered as ACCESSORY.

There are situations, however, where one has to be cautious when applying this method. When the index values of prey are very close it can be impossible to separate them between preferential and secondary. 1st ex. : 50%, 49%, 1%. 2nd ex. : 40%, 10%, 9%, 3%. When the combined percent values of the first and second prey represent almost 50% but the third prey has a very low value, it is unacceptable to include it in the group of Preferential prey. Ex. : 30%, 19%, 4%.

As a example the proposed method has been applied to *Diplodus sargus* stomach data (Table 2). Whatever index is considered (IA, MFI, or Q) a distinction is made between preferential prey and others, which was not always the case with the other methods. The present method always provides a prey ranking, for every kind of predator. It can be used to compare several fish diets even if the original data were not analyzed using the same index. In traditional classifications key values are fixed *a priori*, or based on data obtained with a given species. Prey are distributed individually in each category according to their index value. With our proposed classification it is not only the individual index value which is taken into account, but also the cumulative index values of all prey.

INDICES		PREY	*Diplodus sargus*	*Pagellus erythrinus*
IA	50-100	Main	-	-
	25- 50	Essential	-	Annelids
	10- 25	Not negligeable	-	-
	0- 10	Secondary	All Prey	Other Prey
MFI	> 75	Main	-	-
	51- 75	Principal	-	-
	25- 50	Secondary	-	Annelids
	< 26	Accessory	All Prey	Other Prey
Q	> 200	Preferential	Molluscs	Annelids Decapods
	20-200	Secondary	Fish Decapods Annelids Echinoderms	Molluscs Echinoderms Amphipods -
	< 20	Accidental	Other Prey	Other Prey

Table 1 : Classifications proposed by 3 authors with regard to the dietary indices. Application to two sparid species.

	%IA	%MFI	%Q
PREFERENTIAL PREY	Fish..... 33 Molluscs..... 22	Molluscs..... 19 Fish..... 19 Decapods..... 13 Annelids..... 13	Molluscs..... 45 Fish..... 18
SECONDARY PREY	Decapods..... 15 Annelids..... 13	Echinoderms.. 9 Plant remains 8	Decapods..... 10 Annelids..... 11
ACCESSORY PREY	Echinoderms.. 6 Plant remains 6	Amphipods.... 5	Echinoderms.. 5 Amphipods.... 4

Table 2 : New prey classification, example of *Diplodus sargus*.

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V-II9

Food items of *Saurida undosquamis* in the Northern Cilician Basin (Eastern Mediterranean)

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Lizard fish is known as a carnivorous fish (RAO, 1981). This species emigrated into the eastern Mediterranean Sea and beame commercially important along the coastline of the Levantine Basin in the mid fifties (BEN-YAMI and GLASER, 1973). In 1952 this species was not found in the Gulf of Mersin and its neighbouring waters (GOTTLIEB and BEN-TUVIA, 1953, in BEN-YAMI and GLASER, 1973). In the same years AKYUZ (1957) had not included Lizard fish in the species list of Indo-Pacific emigrants. This fish is now commercial species in the inshore region of the eastern Mediterranean coast of Turkey (BINGEL, 1981, 1987).

Nevertheless, very little is known about the feeding habit of Lizard fish in the Levantine Basin.

Material collected in two stations are approximately 17 nautical miles apart from each other. Samples were taken before noon, iced on board and kept frozen in the laboratory.

Food specimens in the stomachs of Lizard fish were tried to be identified at species level. Totally 5223 individuals from both stations were collected monthly between July 1980-September 1981 and examined.

It is found that Lizard fish fed mainly on fish (97.3 %). The significant food items consisted of MULLIDAE 40.1 %, SPARIDAE 13.5 %, LEIOGNATHIDAE 12.4 % and SYNODONTIDAE 7.4 %

Table 1: Food composition of S. undosquamis in the northern Cilician Basin.

Food organisms	Number of identified specimens July 1980 - September 1981 Numbers	%
M. barbatus	134	36.8
L. klunzingeri	45	12.4
S. undosquamis	27	7.4
Diplodus sp.	36	9.9
M. chryselis	23	6.3
Sardine sp.	17	4.7
U. moluccensis	12	3.3
Gobius sp.	10	2.7
Pagellus sp.	10	2.7
B. boops	8	2.2
T. trachurus	7	1.9
E. encrasiccolus	5	1.4
S. aurata	5	1.4
Trigla sp.	3	0.8
P. saltator	3	0.8
Trachinus sp.	3	0.8
A. laterna	2	0.5
C. linguatula	1	0.3
Sphyraena sp.	1	0.3
Siganus sp.	1	0.3
M. merluccius	1	0.3
Loligo & Sepia sp.	6	1.6
Penaeidae	3	0.8
Others	1	0.3
Total	364	100.0

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Time series of the stomach fillings of Saurida undosquamis in the Northern Cilician Basin (Eastern Mediterranean)

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The Lizard fish emigrated into the eastern Mediterranean Sea via the Suez Canal and became commercially important along the coastline of the Levantine Basin in the mid fifties (BEN-YAMI and GLASER, 1973). This fish is today one of the most important commercial species in the inshore region of the eastern Mediterranean coast of Turkey (BINGEL, 1981, 1987).

As far as known there is no special work dealing with the cahanges of stomach content of this fish in the northern Cilician Basin.

For the analysis of temporal differences of the stomach filling of this fish two stations were chosen and sampled from July 1980 to September 1981.

Lizard fish feeds little during day time but most intensively during the early morning, i.e., two hours after sun rise (TORIYAMA, (1958). Therefore samples were taken before noon, iced on board and kept frozen in the laboratory.

Food specimens in the stomachs of Lizard fish were tried to be identified at species level. The stomachs were simply categorized as full if they contained food or otherwise as empty, and totally 5223 individuals from both stations (2801 in Goksu-River-Delta and 2422 in Tirtar region) were collected monthly between July 1980-September 1981 and examined.

In the Tirtar region relatively intensive feeding starts in July-August and reaches its maximum in September-October and slows down towards November-December. In this period (July-December) 73.07 % of the total food consumed annually is already taken. In contrast to the Tirtar station, feeding intensity was found rather low in July-August in Goksu station, where higher rates were observed in September-December, with a maximum in November-December. During this time (July-December) Lizard fish consumed 70.59 % of its total annual food requirement (Figure 1).

As shown in Figure 1 this fish feeds intensively between April-July and most intensively between September and November . BINGEL (1988) stressed that Lizard fish spawns twice a year. The times of the spawning period and the times of inytensive feeding overlaps in both stations. This is in contrast to the known behaviour of fish in colder climates such as in northern Europe.

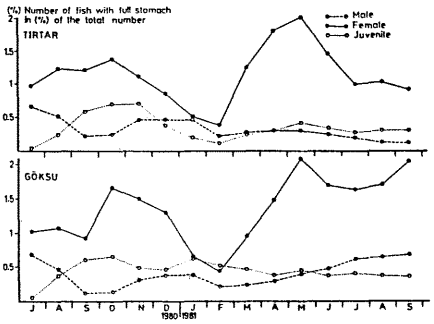

Figure 1: Three times running averages of stomach filling.

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Prey size of Saurida undosquamis in the Northern Cilician Basin (Eastern Mediterranean)

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Food is the most important component which determines growth. Nevertheless, very little is known about the feeding habit and especially about the prey size of Lizard fish in the Levantine Basin, where it mostly feed on *Mullus barbatus*, *Leiognathus klunzingeri* and *Saurida undosquamis* in the northern Cilician Basin (BINGEL & AVSAR, 1988 a).

In November 1982 for a determination of the prey sizes 35 individuals in the Goksu river delta and 73 individuals in the Tirtar region were examined with full stomachs and the food specimens in the stomachs of Lizard fish were tried to be identified at species level.

The distribution of prey sizes of Lizard fish is given in Table 1. As theoretically expected the prey size increases with increasing fish length. But the weights of prey did not always follow this trend.

In the Tirtar station, the largest prey ever taken by a Lizard fish of 31.8 cm in length, was the same species with a length of 15.7 cm and weighing 22.03 g. In the Goksu station, the largest prey was a common sole (20.39 g and 14.7 cm) swallowed by a Lizard fish of 33.8 cm in length.

Minimum prey size is usually observed by females and juvenile individuals at both stations. The mean weight of the prey ranged between 0.6 - 5.4 g. The standard deviations and the variances of the means were found high (Table 1).

Utilizing the mean prey weights (male, female & juveniles) (3.75 g) and assuming that this value reflects the mean daily ration of this fish at times of relatively intense feeding (July-December=6 months BINGEL & AVSAR, 1988 b), than, one may end up with 674 g fish flesh consumption per specimen/6 months. Considering the total duration of sampling an annual consumption of 750 g prey/year/specimen was calculated. This will result in a production of fish flesh of 75 g/year on the basis of 1/10 food transfer. Based on the data presented in the report of BINGEL (1987) the length and weights for different age groups and the obtainable flesh production in view of above suggestions will be as follows:

As seen from the table below the expected weights calculated from food consumption for different age groups aggree well with the mean weights. At least these have the same order of magnitude.

Age Group	Mean Length	Mean Weight	Weight expected from food consumption
0	5.9	3.1	-
I	18.3	49.3	75
II	26.4	120.9	150
III	31.8	190.7	225
IV	35.3	246.3	300

Table 1: Minimum, maximum and mean prey sizes of *Saurida undosquamis* in the northern Cilician Basin.

	n	Min	Max	Mean	s	s'
TIRTAR MALES						
Length (mm)	22	49	123	92.6	19.6	367.8
Weight (g)	22	1.6	10.2	5.4	2.5	5.7
TIRTAR FEMALES						
Length (mm)	42	33	208	81.5	32.6	1035.1
Weight (g)	42	0.2	22.0	4.2	3.8	13.7
TIRTAR JUVENILES						
Length (mm)	9	24	98	49.3	22.3	440.2
Weight (g)	9	0.2	1.3	0.6	0.4	0.1
GOKSU MALES						
Length (mm)	6	37	144	84.2	40.0	1333.1
Weight (g)	6	0.6	14.3	5.2	5	20.7
GOKSU FEMALES						
Length (mm)	21	35	147	85.7	33.3	1058.0
Weight (g)	21	0.2	20.4	5.4	5.8	31.4
GOKSU JUVENILES						
Length (mm)	8	42	76	60	12.7	140.3
Weight (g)	8	0.5	4.6	1.7	1.4	1.7

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V-II12

Food preferences of juvenile Red Mullet Mullus barbatus in Western Adriatic nursery ground (Osteichthyes : Mullidae)

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Red mullet (*Mullus barbatus*) is a very important species for the Mediterranean fishery, and food preferences of adults (Total Length >9 cm) were investigated by several Authors (Wirzubsky, 1953; Planas and Vives, 1956; Haidar, 1970; Jukic, 1972; Focardi *et al.*, 1980; Caragitsou and Tsimenidis, 1982a-b).

Food preferences of juveniles, that in summer months concentrate in coastal nursery grounds, are briefly discussed only by Garbi and Ktari (1979).

To investigate this topic, samples of Red mullet were collected with a bottom trawl at 3 selected depths (7-10-13 m) in a coastal area about 10 miles NW of Ancona (central Adriatic Sea) between August and November 1975, in daylight hours, when feeding activity and vulnerability of Red mullet are the highest (Caragitsou and Tsimenidis, 1982b; Froglia and Gramitto, 1986).

A total of 474 stomachs from fish in the size range 5 - 9 cm (T.L.) were examined; only 13 were found empty (Vc = 0.03).

Standard techniques (for a review see: Berg, 1979) were followed in the analysis of stomach contents, but frequently I found impossible to number individuals in the bulk of Polychaete and Bivalve remains.

Peracarid Crustaceans were found to be by far the most important food item, followed by small Decapods (size range 1-20 mm T.L.), Polychaete worms and Bivalves ("pullus" and juveniles measuring 0.8 - 4 mm shell length).

For the 8 most important food items observed, the "Frequency of occurrence" and the "Percentage of (wet) weight" are summarized in Fig. 1 separately for the three depths considered.

Importance of different food items remarkably changes among the depths considered also if the sampled areas are only one mile apart from each other and the depth range is only 5 meters.

Grab samples of benthic communities collected contemporaneously to trawl samples, suggest a density-dependent prey selection by the young Red mullets, at least for some Crustacean food items (Tanaids and Apeliscidae).

Moreover, as predator grows, it shifts its diet to larger preys.

In samples collected at 10 m depth small Peracarids, like Cumacea, were recorded with a mean number of 6.1 individuals per stomach in 96% of the Red mullets of 6 cm length, whereas their mean number decreased to 2.7 individuals and the frequency dropped to 22% in the Red mullets of 9 cm TL.

In samples obtained at 13 m depth, predation on large shrimps (*Processa* sp.) was found higher among larger fishes: mean number 1.7, frequency 13% for Red mullets of 6 cm, and mean number 2.5, frequency 36% for Red mullets of 9 cm.

Wthin a single food item, the largest sizes recorded in the stomachs increased with the predator size, whereas the smallest sizes were roughly constant, but their abundance markedly decreased, as if larger Red mullets would search for larger preys but not disregard the small one encountered by chance.

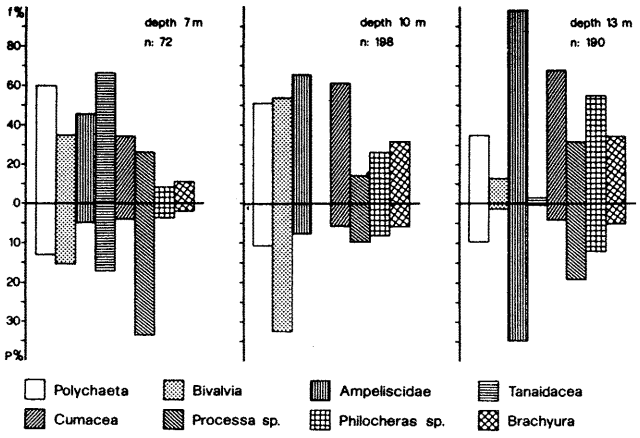

Fig. 1 - Food preferences of juvenile Red mullet.

For example the largest prawns recorded in stomachs of Red mullets of 5 and 9 cm (TL) measured respectively 5 and 20 mm in total length, whereas the size of the smallest Cumacean was about 2 mm throughout the whole size range of predators. Such a feeding behavior seems to me the most efficient in terms of energy gain from available food resources.

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V-II13

Food habits and dietary overlap of Lepidotriglia cavillone in Greek Seas

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INTRODUCTION

Lepidotrigla cavillone (Large scale gurnard) is among the most abundant triglid fish species in demersal communities in the Greek seas (PAPACONSTANTINOU, 1982, 1983). In order to know more about the role of this fish in its ecological communities, including competitive- predatory relationships, more data are required on their food habits. The objectives of this study were 1) to describe the food habits of the L. cavillone that is very common in trawl catches in the Greek seas, 2) to evaluate the possible effects of size of fish, season of capture and geographic area on its food habits.

MATERIAL AND METHODS

A total of 1437 stomach samples from L.cavillone was collected during a bottom trawl survey in Greek waters from summer 1977 to spring 1978. Samples of stomachs were taken in four areas: Saronikos Gulf (437) Pagassitikos Gulf (270); Thermaikos Gulf (303); Thracian Sea (427). In the laboratory the preserved stomachs were individually opened and their contents emptied onto a 0,25 mm mesh openinmg screen sieve to permit washing without loss of any food items. The stomach contents were shorted, identified and counted. Major prey items and commonly occurring but relatively minor prey, in terms of weight and number, were identified to species whenever possible. The weight of all stomach content groups was determined to the nearest 0,01g and all information recorded. A stomach was considered empty when no food items could be identified and the mate- rial found in the stomach weighted <0.01 g. Niche overlap was calculated using the formula proposed by PIANKA(1973)

$$Aij = \frac{[\Sigma pihpjh]}{[\Sigma p^2ih\ \Sigma p^2jh]}$$

where Aij is the overlap of species j on species i, Pih is the porpotion (percentage weight) of a particular food h (h=1...,s) in the diet of species i; and Pjh is the proportion of the same food h in the diet of species j. Values for the overlap index may vary between 0, if no overlap occurs, and 100 for complete overlap.

TABLE I. Percent by weight, number and frequency of occurrence that mysidacea food taxa composed the diet of L.cavillone in Greek Seas

	THERMAIKOS			PAGASSITIKOS			SARONIKOS			THRAKIKON		
	f	W	N	E	f	W	N	E	f	W	N	E
winter	91	80	92	27	95	85	84	26				
spring	77	57	64	15	77	68	88	9	77	76	88	11	74	67	50	10
summer	91	79	97	6	61	36	46	6	77	72	67	10	100	100	100	3
fall	94	87	98	10	45	36	59	8	91	88	95	14	94	86	93	40

f= frequency of occurrence, W= percentage weight, N=number percentage. E= % empty stomachs.

RESULTS AND DISCUSSION

Of the 1434 stomachs that were examined, 211 were empty. The proportion of empty stomachs was remarkably varied among the four geographical areas throught the year. The summer shows a lower proportion in empty stomachs, while the winter a larger one (Table I). The proportion (by weight) of the major taxa in the diet of L.cavillone were sometimes markedly different among areas. Prey composition and availability may be functions of sediment, depth and season. The first two parameters characterize each geographical area. Mysids constituted over 75% of the diet on a weight basis in Thermaikos, Saronikos Gulf and Thracian sea almost all round the year, while in Pagassitikos gulf only during winter arrived 85% (Table I). In the last area decapods were the major food items in the diet for the three other seasons. A complete list of mysids prey items in term of numbers, weight and frequency is presented by season and geographical area in Table I. Lophotes typicus and Paramysis helleri were the dominant mysids consumed, while the Siriella clausi occurred among the proportion of prey taxa of secondary importance.

Within these geographical areas, differences occurred among the proportions of prey taxa of secondary importance. Cumacea were more abundant during spring and summer in the Pagassitikos Gulf and Thracian Sea, during winter and spring in the Thermaikos Gulf and summer in the Saronikos Gulf. Gammaridea were rarely found in the diet. The capture of a fish prey suggests that they may also prey on small fish. From the feeding spectrum analysis of L.cavillone it is suggested that it feeds as an active predator on the just above the bottom utilizing mainly nectonic or pelagic invertabrates.

TABLE II. Similarity indices for the diets of L.cavillone within different seasons in the study area.

classes		fish No:	code	2	3	4	5	6	7	8	9	10	11	12	13	14
Sar/kos,	spring	140	(1)	49	49	50	49	31	35	49	46	50	50	49	48	50
"	summer	162	(2)		49	55	49	37	39	50	48	48	49	50	47	49
"	fall	135	(3)			50	48	44	33	50	44	49	50	48	49	50
Pags/kos	winter	53	(4)			49	31	33	50	45	48	50	48	49	50	
"	spring	54	(5)			36	39	49	66	48	48	50	46	48		
"	summer	78	(6)			49	35	54	29	31	36	26	31			
"	fall	85	(7)			37	46	33	33	39	28	33				
Ther/kos	winter	79	(8)			47	48	50	49	48	50					
"	spring	118	(9)			44	44	48	41	45						
"	summer	49	(10)			50	47	48	48							
"	fall	57	(11)			48	49	50								
Thracian	spring	269	(12)			45	49									
"	summer	30	(13)			49										
"	fall	128	(14)													

To illustrate the similarities of the food habits of L.cavillone among season and geographical areas we constructed a matrix using the PIANKA (1973) index. A value >30 is significant and ones >70 are considered high (KRAST, 1978). The L.cavillone communities in Greek seas showed a considerable degree of food overlap (Table II). This is a reflection of the dominance of mysids and decapods in its diet. The greatest dietary overlap occurred between Pagassitikos and Thracian Sea during spring and summer. In addition, only three code-pairs had overlap value <30. This is attributed to feeding priority from mysids in the Thracian Sea during summer.

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Relations masse-longueur, sex-ratio et reproduction (saison de ponte, fécondités) de Sardinella aurita (Val. 1847) des côtes Oranaises (Algérie)

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Résumé: La période de reproduction de l'allache de la région oranaise se déroule de juillet à septembre. Durant cette période le pourcentage des femelles est supérieur à celui des mâles. La fécondité absolue, trés variable , augmente avec la masse et la taille du poisson. La fécondité relative, également variable, a des valeurs voisines de celles fournies pour d'autres secteurs méditerranéens.

D'octobre 1985 à octobre 1986 nous avons étudié la biométrie, le cycle sexuel et la fécondité de Sardinella aurita exploitée sur les côtes oranaises. 797 femelles et 555 mâles ont été échantillonnés.

Aprés ouverture de la cavité abdominale, le sexe des poissons est déterminé et pour chacun d'eux les paramètres suivants sont évalués : longueur totale (LT) et longueur à la fourche (LF) au millimètre prés, masse des poissons (M) à 0,1 g. prés, masse des gonades (Mg) au milligramme prés.

Pour l'étude de la reproduction, nous n'avons considéré que les femelles. Les ovaires sont pesés et leur stade de maturité déterminé selon l'échelle de FONTANA (1969). Les gonades sélectionnées sont mises soit entièrement dans du liquide de Gilson pour étude de la fécondité (ovaires de stade IV), soit dans du Bouin alcoolique pour étude histologique.

RESULTATS

Les relations masse-taille des femelles (141mm≤LT≤310mm, 125mm≤LF≤292mm, 17,0g.≤M≤254,0g.) sont les suivantes :

$M = 2,477.10^{-5}\ LF^{3,277}$ r= 0,990

$M = 2,974.10^{-5}\ LT^{3,188}$ r= 0,988

Le sex-ratio annuel est voisin de l'unité pour les individus ≤ 180mm et, pour ceux de plus grande taille, on constate une légère dominance des femelles (55,9%) qui augmente avec la taille, du moins jusqu'à LF = 230mm(au delà, l'effectif traîté est trop faible pour confirmer cette tendance). Durant la saison de reproduction qui s'étend de juillet à septembre, au moment des maxima thermiques,avec une ponte maximale en août et septembre, cette supériorité numérique des femelles est plus marquée (59,5%).

La fécondité absolue (F) est trés variable : 26000 à 216000 oeufs, et augmente avec la taille et la masse des poissons :

F = 585,8 M - 7115,7 r = 0,951

F = 1149,7 LF - 180171,1 r = 0,913

La fécondité relative oscille entre 246 et 933 oeufs/g. de poisson non éviscéré.

Les femelles ayant des gonades de stade IV sont rares dans les échantillons.Ceci pourrait être dû soit à la fugacité de ce stade, soit au fait qu'elles restent hors de portée des engins de pêche au moment de la ponte.

DISCUSSION

Les résultats concernant le sex-ratio sont conformes à ceux de DIEUZEIDE et ROLAND (1957) en Algérie et de KARTAS (1981) en Tunisie. Il est voisin de l'unité et le pourcentage de femelles augmente avec la taille.

La période de reproduction est tout à fait ou à un mois prés semblable à celle enregistrée dans de nombreuses régions méditerranéennes, elle correspond au moment où les eaux sont à leur maximum thermique (Algérie : BOUNHIOL, 1921; DIEUZEIDE et ROLAND, 1957; Tunisie : KARTAS, 1981; Baléares : NAVARRO, 1927; ANDREU et RODRIGUEZ-RODA, 1951; Golfe du Lion: LEE, 1961; mer Egée : ANANIADE, 1952). Dans les ovaires mûrs de l'allache d'Oran, on ne trouve, en plus du stock général, qu'un seul lot d'ovocytes. Donc, comme dans d'autres secteurs méditerranéens et contrairement à l'Atlantique, la ponte s'effectuerait en une seule émission d'ovocytes. Le diamètre des oeufs de ce lot varie entre 250 et 650 µm avec un mode à 470 µm. En Tunisie (KARTAS, 1981), il est compris entre 100 et 850 µm avec un mode à 500µm.

Les valeurs des fécondités absolues trouvées à Oran sont voisines de celles de Tunisie (KARTAS, 1981) où elles sont comprises entre 37000 et 220000 ovocytes. Par contre les fécondités relatives de l'ouest algérien semblent plus faibles qu'en Tunisie où elles oscillent entre 1260 et 1670 ovocytes/g. de poisson plein pour des femelles de 25 à 120g.

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Etude comparative de la relation taille-poids de la Bogue : Boops boops (Linné, 1758), Poisson Téléostéen Sparidae des côtes Tunisiennes (Méditerranée occidentale) et Béninoises (Atlantique oriental)

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INTRODUCTION

La bogue est généralement capturée sur les côtes tunisiennes et béninoises presqu'aux mêmes profondeurs (50 à 100 m et parfois plus); mais, la température (T°C) et la salinité (S‰) au niveau des lieux de capture diffèrent notablement, soit : eaux relativement froides et plus salées dans le golfe de Tunis ($14°4 \leq T° \leq 16°C$ et $36,7 \leq S‰ \leq 37,6‰$; AZOUZ 1974); eaux chaudes et moins salées dans le golfe du Bénin ($16° \leq T° \leq 18°C$ et $35,7 \leq S‰ \leq 36‰$, communication personnelle), ce qui peut influencer la physiologie de ce poisson.

METHODES D'ETUDE

Les équations de la relation taille-poids des bogues échantillonnées (262 poissons dans le golfe de Tunis et 176 dans celui du Bénin) ont été établies par la méthode des moindres rectangles conformément à la formule log.We=n.logLst+log.a (We; poids éviscéré en g, Lst; longueur standard en cm, n; coefficient d'allométrie ou taux de croissance et "a"; une constante).

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Equations *Tests / Zone		log.We=n.log Lst+log a				r	Sdy	Sdx	effec-tif	tailles limites (Lst en cm)	poids limites (We en g)	tpe	tpo
golfe/Tunis		log We=2,8674 log Lst-1,6156				0,9982	0,0252	0,0087	262	8-22	11-176	1,70 (-)	2,06 (+)
golfe/Bénin		log We=3,0213 log Lst-1,7943				0,9491	0,0339	0,0112	176	11-17	22-84		
Poids calculé (We en g)	Lst	8	10	12	14	16	18	20	21,61	22			
	We Tunis	9,81	18,70	31,65	49,40	72,64	102,05	138,35	173,01	182,18			
	We Bénin	8,59	16,86	29,26	46,61	69,78	99,60	136,93	173,01	182,62			
	≠We	1,22	1,84	2,39	2,79	2,86	2,46	1,42	0,00	-	≠ We = 2,14		

Tableau 1 : Equations de la relation taille-poids avec comparaison des pentes (tpe), des positions (tpo) des AMR et valeurs estimées du poids eviscéré (We en g) des bogues des golfes de TUNIS et du BENIN; ≠ We et ≠ We: Différences en poids et la moyenne.

Les pentes et les positions des axes majeurs réduits (A.M.R) ont été comparées selon la méthode de MAYRAT (1959) et la signification des tests, estimée par rapport à la valeur t=1,96 d'après les tables de STUDENT; soit un coefficient de sécurité égal à 95%.

RESULTATS ET INTERPRETATIONS

L'analyse des équations de la relation taille-poids des bogues étudiées révèle ce qui suit (Tabl.1; Fig.1) :

- les valeurs du coefficient de corrélation "r" dans les deux cas (golfes de Tunis et du Bénin) sont proches de l'unité, soit respectivement 0,9982 et 0,9491 donc supérieures à 0,70; ce qui atteste la validité des ajustements réalisés;
- les droites représentatives des équations ne présentent pas une différence de pente significative (tpe=1,70; sécurité comprise entre 90 et 95%); mais leur différence de position est assez significative (tpo=2,06; sécurité comprise entre 95 et 98%).

Cette différence de position des A.M.R.se traduit, en effet, par une différence de poids de 02,14 g en moyenne en faveur des bogues des côtes tunisiennes à tailles égales avec celles des côtes béninoises et c'est seulement à 21,61 cm (Lst) que les échantillons provenant des deux golfes ont le même poids soit We=173,01 g.

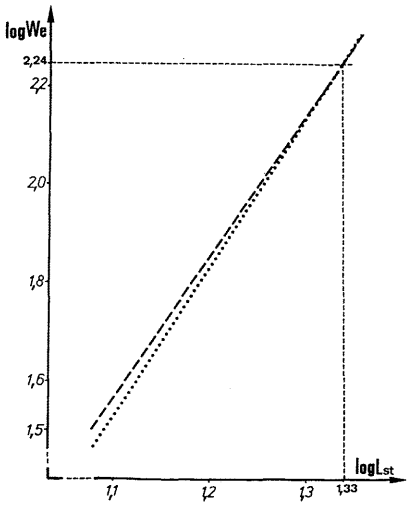

Fig.1: Droites représentatives des équations de la relation taille-poids (A.M.R.) des bogues des Golfes de TUNIS (———) et du BENIN (·····).

- CONCLUSION -

Il ressort de cette étude comparative de la relation taille-poids des bogues échantillonnées que les différences de conditions écologiques peuvent avoir un impact sur la physiologie de cette espèce. Dans les limites de tailles et de poids des spécimens étudiés, nous pouvons dire que l'évolution pondérale de ce poisson est meilleure sur les côtes tunisiennes que sur les côtes béninoises.

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Croissance linéaire absolue des Rascasses (Scorpaena porcus et S. scrofa) du golfe de Gabès (Tunisie)

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ABSTRACT : The age and growth of the scorpion-fish (*Scorpena porcus* and *S.scrofa*) living in the gulf of Gabès have been studied by the scalimetric method and the theorical growth equations calculated.

RESUME : Nous avons étudié la croissance linéaire en fonction de l'âge par scalimétrie, chez *Scorpena porcus* et *S. scrofa* du golfe de Gabès.

ESTIMATION DE L'AGE : D'après l'observation des écailles, les stries d'arrêt de croissance apparaissent principalement en Novembre pour les deux espèces. La ponte a lieu entre Juin et Août pour *S. porcus* et entre Juillet et Septembre pour *S. scrofa*, ce qui nous a permis d'établir l'âge approximatif des rascasses à l'apparition de chaque anneau d'arrêt de croissance (tabl. 1).

Anneaux		1	2	3	4	5	6	7	8	n
Age (mois)		14-17	26-29	38-41	50 - 53	62-65	74-77	86-89	98-101	
S.scrofa mâles	A	70,03	100,08	131-32	152,38	170,83	195,23	213,35	231,67	23
	B	65,65	96,22	124,41	150,41	174,38	196,49	216,88	235,68	
S.scrofa femelles	A	62,90	91,34	127,18	148,13	161,22	179,47			31
	B	52,32	89,67	117,66	137,38	167,28	189,23			
Age (mois)		15-18	27-30	39-42	51-54	63-66	75-78			
S. porcus femelles	A	71,00	95,92	117,39	131,62	140,87	154,39			148
	B	69,86	93,60	113,57	130,37	144,50	156,38			
S. porcus mâles	A	64,40	85,42	104,22	117,40					48
	B	65,04	86,04	103,27	117,40					

Tableau n° 1 : Age et taille (Lst en mm) calculée par scalimétrie [log Lst = f (log R)] (A) et à partir du modèle de Von BERTALANFFY (B) n : Effectif.

CROISSANCE LINEAIRE : Les équations de régression reliant la longueur standard du poisson (Lst en mm) au rayon total de l'écaille (R en mm) figurent dans le tableau n° 2.

A partir de ces équations nous avons calculé la taille des poissons à l'apparition de chaque anneau d'arrêt de croissance (table. 1).

MODELE THEORIQUE DE LA CROISSANCE : Pour établir les paramètres de l'équation théorique de Von BERTALANFFY, nous avons pris en considération l'âge minimum estimé (tabl. 1) à l'apparition de chaque anneau de croissance. Ces paramètres figurent dans le tableau n° 3.

Espèces	Equations	n	r	Sdx	Sdy
S. porcus ♂	Log Lst = 0,642 log R + 4,335	58	0,865	0,109	0,081
S. porcus ♀	Log Lst = 0,663 log R + 4,386	211	0,793	0,101	0,085
S. scrofa ♂	Log Lst = 0,907 log R + 3,850	46	0,937	0,075	0,072
S. scrofa ♀	Log Lst = 0,967 log R + 3,754	41	0,936	0,064	0,066

Tableau n° 2 : Relation log Lst = f (log R), ; n : effectif ; r : coefficient de correlation ; Sdx et Sdy : erreurs standards d'estimation.

Espèces	Lst ∞ (mm)	K	to (ans)
S. porcus ♂	181,95	0,198	- 0,984
S. porcus ♀	219,31	0,173	- 0,967
S. scrofa ♂	458,53	0,081	- 0,741
S. scrofa ♀	449,41	0,081	- 0,671

Tableau n° 3 : Paramètres de l'équation théorique de Von BERTALANFFY des rascasses du golfe de Gabès.

Discussion : Les valeurs des longueurs standards théoriques en fonction de l'âge (modèle de Von BERTALANFFY) (tab. 1) sont très proches de celles obtenues par le calcul rétrospectif , donc ce modèle s'applique à la croissance des rascasses.

- Les femelles de *S. porcus* grandissent plus vite que les mâles, alors que chez *S. scrofa* on note le phénomène inverse. (Tabl. 1 ; Fig. 1).

- A partir de la troisième année de vie *S. scrofa* croit plus vite que *S. porcus* (tabl. 1 ; Fig. 1).

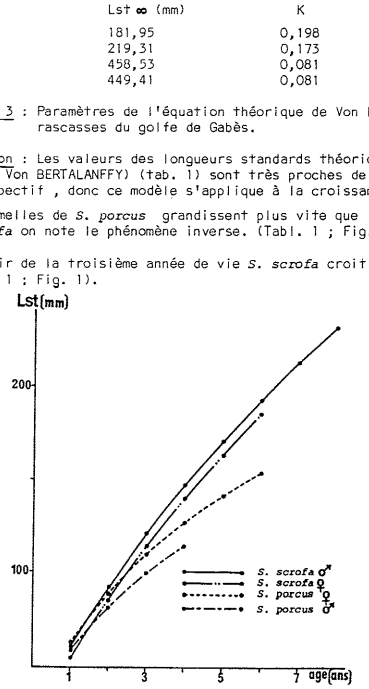

Figure N° 1 : Croissance linéaire absolue en fonction de l'âge (modèle de Von BERTANFFY) des rascasses du golfe de Gabès.

Growth rate of Gilthead Bream Sparus aurata L.

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ABSTRACT

Growth rates of the gilthead bream Sparus aurata L. in its natural habitat (Egyptian Mediterranean waters) have been determined.Absolute growth, annual increment and percentage annual gain (in length as well as in weight) were estimated from scale readings.The regression equation representing fish length / scale radius relationship is given.A length / weight formula is also derived.Maximum expected length (L∞) and weight (W∞) were computed adopting Bertalamffy's growth equation.

TABLES

Age (yr)	Av. total length(cm) at capture	calc.	theor.	Annual increm.	Av. total weight(g) calc.	theor.	Annual increm.
1	23.7	17.4	17.5	17.4	66.6	67.4	66.6
2	29.0	27.3	26.8	9.9	262.3	269.5	195.7
3	35.1	34.1	34.1	6.8	537.1	592.2	274.8
4	42.7	39.7	40.2	5.6	906.1	986.1	369.0
5	46.7	45.1	44.8	5.4	1360.3	1403.7	454.2

Table (1)- Comparison between calculated (sum of average increment) and theroretical (Bertalamffy's equation) lengths and weights at different years of life of gilthead bream Sparus aurata.

FIGURES

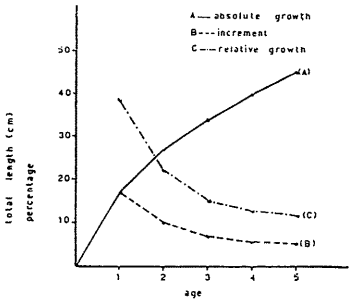

Fig (1)-Growth in length with age of Sparus aurata.

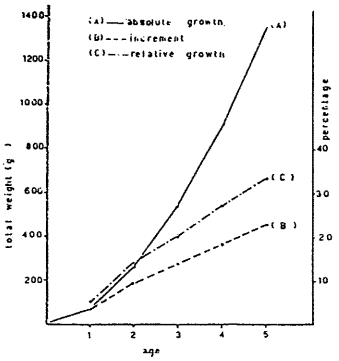

Fig (2)-Growth in weight with age of Sparus aurata.

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Growth of Poor Cod Trisopterus minutus capelanus (Lacepede) (Pisces, Gadidae) in the Central Adriatic Sea

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The poor cod (*Trisopterus minutus capelanus*) is a very common species in the Central Adriatic Sea, living on soft bottoms at depths ranging from 40 to 250 m, and it is actively exploited by bottom trawlers.
In spite of its commercial importance, data on biology of the species in this area were supported only by Froglia (1981).
To investigate on age and growth of *Trisopterus minutus capelanus* otoliths (Sagitta) from 747 specimens, ranging between 3 and 25 cm of total length, were collected during trawl fishery investigations in 1986 and 1987 in a coastal area 15 miles NNW of Ancona at 50-55 m depth.
Fish total length was recorded to the centimeter below, weight to the 0.1 gram.
Specimens were sexed by macroscopical observation of gonads, but especially in summer samples the youngest immature specimens born in the same year could not be sexed without gonad sectioning, and were recorded as "indeterminate".
To determinate age, we used thin otolith sections (0.25-0.40 mm thickness), obtained with the "thin cross section technique" (see GFCM, 1982), placed in ethanol 75% and examined under reflected light with a stereomicroscope by both authors. Unreadible otoliths and discordant readings were discarded. Finally 639 otolith readings were retained for length-age computations.
The rings pattern (alternance of opaque and hyaline zones) was find to be the classic one of cold-temperate species.
In the Mediterranean Sea sexual maturity is reached at the end of the first year of life; ripe females are found from January to early May and probably the species is a partial spawner (Vives and Suau, 1956; Froglia, 1981).
Owing to this, conventional birthday was allocated at the first of January.
Age was computed in months.
Parameters of the von Bertalanffy growth equation were computed separately for the two sexes, using the program VONBER by K.R. Allen (Sims, 1985).
The young specimens (n = 93) up to a size of 12 cm T.L. which could not be sexed were used in computing both the equations (Tab. 1).

Tab. 1 - Parameters (with 95% confidence limits) of the von Bertalanffy growth equations obtained for males and females of *T. m. capelanus*.

SEX	L_∞ (cm)	K	t_0 (months)	N
♂	23.59 (±1.73)	0.0387 (±0.0065)	-4.778 (±1.165)	210+93
♀	24.72 (±1.00)	0.0668 (±0.0074)	-0.348 (±0.594)	336+93

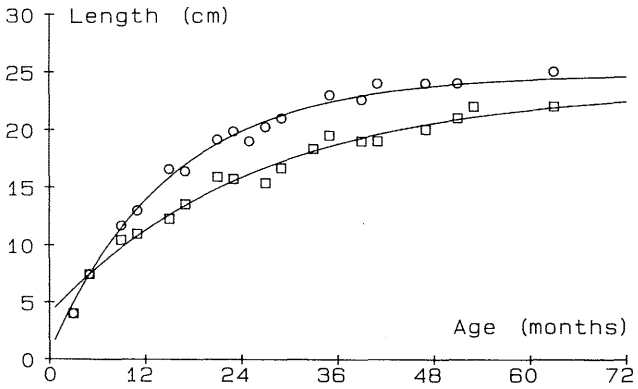

Fig. 1 - Von Bertalanffy growth curves and experimental average length/age values for males (□) and females (○) of *Trisopterus minutus capelanus* in the Adriatic Sea.

A significative difference in growth rate between males and females can be noted (Fig. 1); at the same age females attain a larger size than males.
Our data show a faster growth compared with that of the nominal species reported by Menon (1950) for the Plymouth area, while are in good agreement with those given for the Mediterranean Sea (Vives and Suau, 1956; Froglia and Zoppini, 1981).
Finally the length-weight relationship was computed as G.M. Functional Regression for the two sexes separately:

MALES $W = 0.005986\ L^{3.186}$ FEMALES $W = 0.005098\ L^{3.265}$

where W is weight in grams and L is total length in centimeters.

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Age and growth of Anchovy, Engraulis encrasicolus (L.) in the Middle Adriatic

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INTRODUCTION

Anchovy, Engraulis encrasicolus (L.) are rather widely distributed in the Adriatic and play an important role in Yugoslav commercial fisheries. The knowledge of growth parameters are of utmost importance in biology and fisheries studies. Nevertheless, growth parameters of the anchovy from the Adriatic has not been studied at all. Hence, the present paper deals with anchovy growth parameters.

MATERIAL AND METHODS

Anchovy data were collected between April and December 1979. from Kaštela Bay (inshore waters) and from the region of Vis and Biševo Islands (offshore waters). A total of 1510 individuals were examined. Data on anchovy length reffering to their total length are expressed in centimetres. Age of anchovy was studied by sagitta readings.

RESULTS

Anchovy specimens ranged from 7.0 to 19.0 cm. in total length. Four age classes were found.

Values of growth parameters were obtained from mean anchovy lenths at a defined age class.Mean lengths as well as length range in each age class for males, females and combined sexes for anchovy in the middle Adriatic are presented in table 1.

Table 1. Number of fish sample size (n) and their mean length ($\bar{x}_1$) ± standard deviation in centimetres as well as length range in each age class for males, females and combined sexes for anchovy in the middle Adriatic in 1979.

Age class	Male n	Male $\bar{x}$ s	Female n	Female $\bar{x}$ s	Combined sexes n	Combined sexes $\bar{x}$ s	Length range (cm)
1	25	11.8 ± 0.90	65	12.4 ± 0.56	90	11.9 ± 0.98	10.2 - 14.1
2	310	14.7 ± 0.26	295	15.2 ± 0.27	605	14.8 ± 0.28	11.8 - 16.7
3	215	16.5 ± 0.32	540	17.0 ± 0.33	755	16.8 ± 0.36	13.1 - 17.7
4	5	17.3 ± 0.95	55	17.8 ± 0.34	60	17.6 ± 0.97	16.8 - 18.4
Total	555		955		1 510		

Calculated growth parameters for anchovy population from the middle Adriatic are:

Male	Female	Combined sexes
L_∞ = 18.6 cm.	19.3 cm.	19.4 cm.
K = 0.58	0.56	0.57
t_o = -0.6	-0.7	-0.5

According to these parameters, exponential growth equation for anchovy population in the middle Adriatic has this form,

for male:

$$l_t = 18.6\left[1-e^{-0.58\ (t\ +\ 0.6)}\right]$$

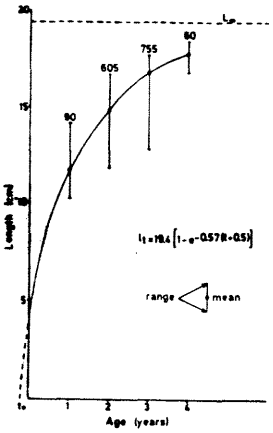
for female:

$$l_t = 19.3\left[1-e^{-0.56\ (t\ +\ 0.7)}\right]$$

and for combined sexes:

$$l_t = 19.4\left[1-e^{-0.57\ (t\ +\ 0.5)}\right]$$

Growth rate varied with area as well as with sex. Namely, anchovy from Vis and Biševo area grew faster than those from Kaštela Bay. Males grew faster too (K = 0.58) but attain to lower asymptotic length (L_∞ = 18.6 cm) than females (L_∞ = 19.3 cm).



Growth curve of anchovy

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Paramètres de croissance de Sardina pilchardus (Walbaum, 1792), de la baie de Béni-Saf (Algérie)

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SUMMARY : Growth of Sardina pilchardus of Béni-Saf has been studied by scales reading of 212 specimens sampled from april to end of june 1986,(fork-length: 63 to 171 mm). A sexual dimorphism during the growth has been found in favor of females. Parameters of the VON BERTALANFFY growth equation are given.

Dans l'ouest du pays , Sardina pilchardus pond de la mi-novembre à la fin février, début mars, selon l'année. La maturité sexuelle est atteinte pour une longueur à la fourche LF(50%) de 111 mm, (BOUCHEREAU, 1981).

Les poissons échantillonnés du 20 avril au 26 juin 1986 ont été sexés et rangés par classe de taille d'un demi-centimètre (LF: 6,0 à 17,0 cm). Trois à six écailles intactes, par specimen, ont été prélevées à l'aplomb de la nageoire dorsale. Ces écailles ont été examinées à plusieurs reprises par les deux auteurs. Quand les écailles prélevées sur un même poisson ne présentaient pas la même allure ou étaient illisibles, nous les avons rejetées. Finalement, les lectures d'écailles de 212 individus sur 242 ont été retenues (tab 1): 57 mâles (M), 72 femelles (F) et 81 juvéniles (J). Les données des juvéniles ont été cumulées tour à tour avec celles des mâles puis celles des femelles. Les poissons ont été pesés au dixième de gramme; les longueurs totale (LT) et à la fourche (LF) ont été mesurées au millimètre inférieur pour le calcul des relations LT-LF et masse-taille.

La relation LT-LF pour les deux sexes confondus,est :
LT = 1,115.LF - 1,542 ; n = 238 ; r = 0,99 ; 62 mm < LF < 172 mm
L'équation reliant la longueur (LF) à la masse (M), les deux sexes confondus, est du type $M = a.LF^b$, avec :
$a = 1,154.10^{-6}$; b = 3,434 ; r = 0,99 ; n = 238 ; 1 < M (g) < 53
Sur les écailles de Sardina pilchardus de Béni-Saf, apparaissent saisonnièrement des anneaux de ralentissement de croissance très nets, en accord avec ceux décrits en Méditérranée occidentale pour cette espèce. Ces anneaux sont mieux marqués et plus lisibles dans la région de Béni-Saf que dans celle d'Oran (BOUCHEREAU,1981).
Fin avril,début mai 1986, la reprise de croissance se manifeste par un net accroissement marginal de l'écaille, principalement chez les juvéniles.
Les paramètres de la courbe de croissance de VON BERTALANFFY ont été calculés par la méthode de TOMLINSON et ABRAMSON (1961):

mâles	: LF_∞ = 176 mm ; K = 0,258 ; to = -2,00 ,
femelles	: LF_∞ = 199 mm ; K = 0,191 ; to = -2,34 ,
sexes confondus	: LF_∞ = 187 mm ; K = 0,225 ; to = -2,09 .

Il existe une différence significative entre les courbes de croissance des mâles et des femelles. A partir de la cinquième année, les femelles atteignent une plus grande taille que les mâles (tab 2). Le plus vieux mâle et les plus vieilles femelles capturées ont 7 ans et respectivement 166 et 171 mm de LF. Nous n'avons pas récolté

: Ans :	1		2		3		4		5		6		7	
:LF mm:	M	J F:	M	J F:	M	J F:	M	J F:	M	F:	M	F:	M	F:
: 60 :		1 :		:		:		:		:		:		:
: 70 :	3	3:		:		:		:		:		:		:
: 75 :	1	3 7:		:		:		:		:		:		:
: 80 :	2	11 15:		:		:		:		:		:		:
: 85 :	15	7 10:		:		:		:		:		:		:
: 90 :	10	10 14:	1	2:		:		:		:		:		:
: 95 :	10	13 15:	1	1 2:		:		:		:		:		:
: 100 :	8	9 4:	8	2 9:		:		:		:		:		:
: 105 :	7	21 2:	10	1 18:	1	:		:		:		:		:
: 110 :	1	3 1:	14	3 16:	1	2:		:		:		:		:
: 115 :		3 :1	3	1 13:	5	1 10:	1	:		:		:		:
: 120 :		:	6	2 7:	12	10:		:		:		:		:
: 125 :		1:	4	4:	16	1 15:		1 4:		:		:		:
: 130 :		:	1	1:	9	12:	6	7:	1	:		:		:
: 135 :		:		:	8	11:	16	14:		1:		:		:
: 140 :		:		:	2	4:	23	19:	4	7:		:		:
: 145 :		:		:	1	1:	5	13:	15	11:	1	1:		:
: 150 :		:		:		:	3	3:	8	10:	6	2:	1	:
: 155 :		:		:		:		:	1	6:	2	7:	1	:
: 160 :		:		:		:		:		1:	1	2:	1	1:
: 165 :		:		:		:		:		:		2:		2:
: 170 :		:		:		:		:		:		:		2:

Tab 1-Résultats du rétrocalcul par classe de taille et selon le sexe.

: Ans :	1	2	3	4	5	6	7
: n :	139	68	57	55	29	10	3
: LF♂ :	95,69:	112,60:	127,72:	139,88:	147,80:	154,61:	158,88:
: σ :	10,11:	8,29:	7,33:	5,96:	4,00:	3,20:	4,08:
: LFc :	95,1 :	113,6 :	127,9 :	139,0 :	147,6 :	154,2 :	159,3 :
: n :	153 :	83 :	67 :	81 :	36 :	14 :	5 :
: LF♀ :	93,65:	112,60:	128,47:	140,03:	149,08:	157,74:	166,93:
: σ :	10,75:	8,63:	7,65:	6,34:	5,54:	5,27:	3,63:
: LFc :	94,0 :	112,3 :	127,4 :	139,9 :	150,2 :	158,7 :	165,7 :
: n :	210 :	141 :	122 :	115 :	65 :	24 :	8 :
: LFt :	93,72:	112,68:	128,25:	140,09:	148,51:	156,44:	163,84:
: σ :	10,34:	8,51:	7,48:	6,03:	6,79:	4,61 :	5,52:
: LFtc :	93,8 :	112,7 :	127,7 :	139,7 :	149,3 :	157,0 :	163,1 :

Tab 2-Moyennes des longueurs individuelles observées (LF) et calculées (LFc), selon le sexe et pour l'ensemble des individus (LFtc).

d'adultes plus grands et plus âgés au cours de la période d'échantillonnage. Nos résultats montrent que S. pilchardus de Béni-Saf a un taux de croissance assez voisin de ceux de la sardine de la mer d'Alboran (LARRANETA,1979;BIAZ et RAMI 1978;BOUCHEREAU,1981).

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Age et croissance de Platichthys flesus Linné, 1758 dans le golfe du Lion (Méditerranée)

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Abstract :
Age and growth of *Platichthys flesus* living in the gulf of Lion have been studied, periodicity of growth rings in the otoliths determined and the theorical growth equation calculated. The results have been compared with those obtained by other authors in the Atlantic ocean and the Baltic sea.

1/ Matériel et méthode : L'étude porte sur 585 spécimens dont la longueur totale (L) est comprise pour les mâles entre 50 et 340 mm et pour les femelles entre 50 et 450 mm. Après extraction, les otolithes (sagitta) ont été observés à la loupe binoculaire en lumière réfléchie,immergés, *in toto*, dans du glycérol. Les anneaux opaques et hyaliens ont été dénombrés.

2/ Age : Le suivi de l'évolution de la structure de l'otolithe nous a permis de déterminer la chronologie d'apparition des anneaux hyalins et opaques. De Mai à Octobre la majorité (90%) des otolithes présente une zone marginale hyaline. De Décembre à Avril une zone opaque succède progressivement à la zone hyaline (85% en Mars). Il se forme donc, au cours d'une année, un anneau hyalin et un anneau opaque. Notons chez 35% des individus 0^+ la présence d'un anneau opaque très fin au milieu du premier anneau hyalin. Cet anneau surnuméraire se dépose en Juin-Juillet, le poisson étant alors âgé de 4 à 5 mois.
La ponte du flet débutant dans le golfe du Lion dès le mois de Janvier et se terminant en Mars, nous avons fixé la date de naissance au 1er Février. La formation de l'anneau opaque de la sagitta coïncide donc assez bien avec la période de ponte. La date de capture étant connue, le dénombrement des anneaux opaques permet de donner l'âge des individus étudiés au mois près.
Les femelles observées étaient âgées de 3 à 84 mois et les mâles de 3 à 60 mois.

3/ Croissance : La croissance en longueur et en masse pour les 12 premiers mois de vie, ont été décrites par QUIGNARD et al (1984). Nous donnons ci-après les équations concernant des individus âgés de 5 à 84 mois.

a) relations âge (t en année et 1/12 d'année) - Longueur totale (L en mm)

mâles	:(5-60 mois)	$L = 304,52\ (1-e^{-0,99\ (t+0,037)})$
femelles	:(5-84 mois)	$L = 386,85\ (1-e^{-0,70\ (t+0,015)})$
m. + f.	:	$L = 380,76\ (1-e^{-0,44\ (t+0,64\ )})$

b) relations masse brute (W en g) - taille (L en mm) - coef. de correlation (r)

mâles	: $W = 6,45 \times 10^{-6}$	$L^{3,10}$	r = 0,99
femelles	: $W = 4,36 \times 10^{-6}$	$L^{3,19}$	r = 0,99
m. + f.	: $W = 8,58 \times 10^{-6}$	$L^{3,05}$	r = 0,98

4/ Comparaison avec les populations de l'Atlantique et de la Baltique

La période de formation des anneaux opaques et hyalins est décalée du golfe du Lion à la Manche, mer du Nord et Baltique. Dans cette dernière mer (Draganik et Kuczynki, 1984) comme dans d'autres secteurs de l'Atlantique Nord-Est (Hartley, 1940; Lillelund, 1961; Deniel, 1981), l'anneau opaque se forme en été alors que dans le golfe du Lion il apparaît en hiver.
La croissance des 0^+ est meilleure dans les lagunes méditerranéennes (Quignard et al., 1984) qu'en Atlantique (Deniel, 1981) et que dans la Baltique (Lillelund, 1961; Draganik et Kuczynski, 1984). En effet, à l'âge de un an les flets mesurent L = 197 mm en Méditerranée contre seulement L = 140 mm dans l'Atlantique. Le taux de croissance linéaire est élevé dans tous les secteurs jusqu'à 2 ans puis il diminue rapidement. Cette diminution est plus importante dans le golfe du Lion qu'en Atlantique et Baltique.

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V

Observations sur la détermination de l'âge du Chinchard de la Méditerranée dans l'Adriatique moyenne

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Cette étude préliminaire fait partie d'un travail plus vaste sur la biologie de l'espèce Trachurus mediterraneus mediterraneus (Steindachner, 1868) en Adriatique. Ces observations ont pour but de trouver une méthode eprouvée pour la détermination de l'âge. Ces âges vont être employés pour déterminer les paramètres de croissance et de mortalité de la population de cette espèce.

Les échantillons proviennent de la pêche commerciale. Les premiers échantillonnages furent realisés à la fin de l'été et au commencement de l'automne 1986, c'est-à-dire, quand la période du frai était deja terminée. Les autres échantillonnages ont été recueillis vers la fin de l'hiver, quand se termine la période de repos sexual. La longueur relevée est la longueur total. L'âge et l'âge--longueur ont été determinés par analyse de distribution de fréquences de longueur, de la lecture des otolithes et de l'otolithomètrie.

D'après des données de la distribution des fréquences de taille, prises au commencement de l'automne, il existe une certaine superposition des groupes de taille. Seul un groupe se distingue vers le mode 200 mm ($\bar{L}$ = 202,85, s = 2.921). Les données correspondant à la fin de l'hiver ont donné de meilleurs résultats:

Groupe d'âge	1+	2+	3+
Longueur moyene	188.33	212.74	236.82
Écart-type	3.819	4.238	1.962

Les zones hyalines se forment vers la fin de l'hiver et les opaques en été. Le rayon de l'otolithe est mesuré du centre du nucléus au bord posterior de chaque zone hyaline. Les poissons pêchés au commencement de l'automne montraient des zones opaques au bord des otolithes. On leur a assigné l'âge de n ans, où n est le nombre de zones hyalines totales quand une zone opaque est sur les bords. On a assigné n+ ans aux otolithes recueillis vers la fin de l'hiver. La figure 1 montre la frequence de longueur-âge obtenue.

La longueur moyenne du rayon des otolithes a été calculée. La longueur moyenne theoritique pour chaque âge a été evaluée au moyen du rétrocalcul. On les a comparé aux valeurs des tailles observées:

Âge	N	Longueur moyenne du rayon	s	Taille moyenne observée	s	Taille moyenne retrocalculée	Ratio rayon/taille x 10^4
1+	60	2.812	0.181	188.27	12.714	183.76	149
2	95	2.968	0.175	200.80	12.012	199.27	148
2+	53	3.230	0.097	217.37	6.489	223.65	149
3	39	3.375	0.126	230.32	8.233	236.16	147
3+	35	3.465	0.124	237.14	4.403	243.75	144
4	16	3.594	0.093	252.64	6.495	254.22	142
4+	12	3.642	0.132	264.09	4.957	258.61	135
5	5	3.750	0.115	270.33	2.824	267.26	139

On a estimé la taille du poisson au moment de la formation de la première zone hyaline a 128 mm. La longueur moyenne du rayon à la première zone hyaline fait 2,345 mm. On trouve très rarement des jeunes groupes d'âge dans des pêches commerciales. De même les groupes âges y sont faiblement représentés. La longueur maximale des échantillons etait de 274 mm et l'âge maximale était de 5 ans.

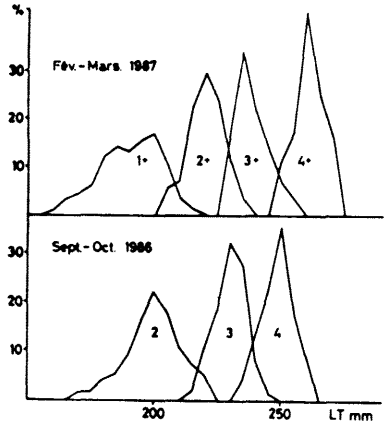

Fig. 1. Polygones de fréquences des longueurs et âge (LT = longueur totale)

La taille maximale de T.mediterraneus dans l'Adriatique est de 40 cm (MUŽINIĆ, 1986). Pendant les pêches experimentales de 1969-1970 on a capturé des individus de 39 cm. Il est évident que l'accessibilité des poissons est différente selon l'âge.

En général, les résultats obtenus s'accordent bien avec des valeurs longueur-âge, déterminés pour 4 groups d'âge chez T. mediterraneus pris dans l'Adriatique en 1982. (ARNERI et TANGERINI,1983.). DARDIGNAC (1963) a déterminé des valeurs longueur-âge plus basses pour la population du Golfe du Lion.

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Relationship between otolith to total lengths of Merlangius merlangus euxinus (Nordmann, 1840) in the Black Sea

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RESUME: Nous avons etudié la relation entre l'otolithe et la longueur totale de l'espèce de **Merlangius merlangus euxinus** (Nordmann, 1840) qui a été récoltée des côtes turques de la Mer Noire centrale.

In this work, the species of **Merlangius merlangus euxinus** (Nordmann, 1840), from the central Black Sea of Turkish coast, was investigated to obtain the relationship between otolith and total lengths.

Fish samples were collected during the cruises of Spring and Fall 1986 with R/V K. Piri Reis belonging to the Institute of Marine Sciences and Technology (İzmir) using an otter trawl off the Turkish coast in the central Black Sea.

300 fish were sorted according to their sex and their total lengths were measured up to the nearest milimeter accuracy. Both saccular otoliths (sagittae) were extracted on board and stored in the paper envelopes for laboratory measurements and age determinations. Sagittae were measured through the anterior-posterior with a micrometric binocular and milimetric scale.

This relationship between otolith and total lengths of a fish is useful for two reasons (Echeverria, 1987).

- Fish size can be estimated from otolith lengths measured from otoliths encountered in predator stomachs, etc.

- The length of a fish can be verified when the age determined from the otolith lies outside expected values. It can be extrapolated from otolith length. Growth rate could also be determined (Spartt, 1975).

Linear regressions (Ricker, 1973) were run on total length versus otolith length for 300 fish.

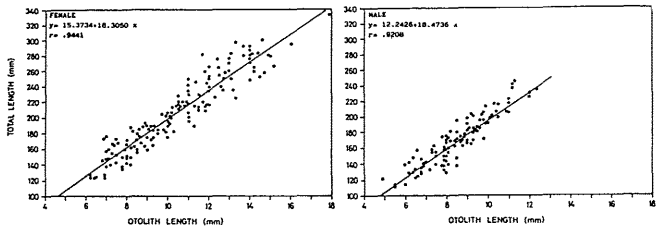

Fig. Otolith - Total length linear regressions for female and male.

Regression equation for female is :
y= 15.3734 + 18.3050 x
r= 0.9441
Standart error of coefficient = 0.4683
Regression equation for male is :
y= 12.2426 + 18.4736 x
r= 0.9208
Standart error of coefficient = 0.7526
Where x= Otolith length, and y= total length and
r= corelation coefficient.

There is no difference between the female and male sexes according to regression analysis results. The maximum otolith size was measured 18 mm for 330 mm female fish. Naturally, otolith lengths increase with total length.

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V-II24

The reproductive niche of an isolated population of the mesopelagic Fish Maurolicus pennanti (Walb.) LTKN

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An isolated population of the mesopelagic fish species Maurolicus pennanti has been detected because of its spawning activity. This population occupies the Western deep basin of the Saronikos Gulf, Aegean Sea. The reproduction takes place from December to June, with a regular peak around March. Four reproductive cycles have been observed, during the exploitation period and the maximum egg densities seem to vary, from year to year, considerably. This fact could signifies that, either drastic alterations of the population size, take place, or, the reproductive niche of the species, has not been adapted to the peculiar environmental conditions of the basin.

This study has been based on zooplankton samples, collected with a WP-2 nylon net, mesh size 0.24 mm, during 19 oceanographic campaignes in the Saronikos Gulf, Aegean Sea, from December 1972 till March 1976.

The marine ecosystem of the Western basin presents several special features; an underwater ridge, at a depth varying from 50 to 80 meters, forms this boundary and keeps it isolated from the rest of the Saronikos Gulf. In fact, this elevation, together with the cluster of the surrounding islands, prevents the usual water circulation. The flow levels are low and almost close to zero, when the deeper layers of the basin are considered. A stagnant water mass is present all year round, below the 350 meters approximately. Another important factor is the low concentrations of the dissolved oxygen, close to the bottom layers of the main basin where the maximum depth is 400 meters. This decline is more severe during the Summer period (fig. 1). Primary and secondary production presents very low values, in comparison with the other vicinities of the Saronikos Gulf, in spite of the higher ammounts of nutrients, at the layers below 100 meters.

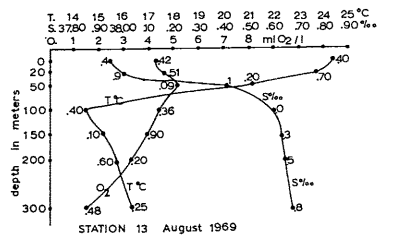

Fig. 1. (Yannopoulos et Yannopoulos, 1973)

In the main basin where the maximum depth and the location of station A is, the eggs of Maurolicus pennanti have been obtained, on a regular basis, during the forementioned spawning period (fig. 2). This fact, together with the simultaneous absence of Maurolicus pennanti eggs, from the other stations, most of the sampling periods, when reproduction occurs, signifies that the main reproduction site is the one of station A, even if the numbers of the eggs deposited are not very high.

During January and December 1973, an extremely high abundance of Maurolicus pennanti eggs has been observed, but their presence do not coincide with the vicinity of the main basin. In these two cases, the eggs of M. pennanti are scattered at considerable distances from A station.

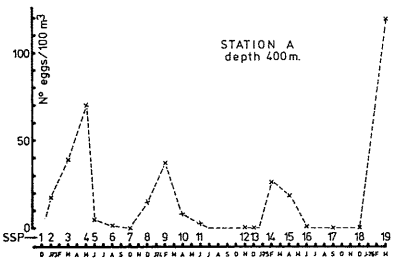

Fig. 2

Figure 3, presents the distribution and abundance of Maurolicus pennanti eggs during January 1973. It is difficult to understand the appearance of M. pennanti eggs, in such densities, at the Eastern Saronikos Gulf. These eggs must have been deposited there, as it comes from the study of the embryonic stages. From the same figure, the distribution and abundance of M. pennanti eggs, during December 1973 is given; the egg displacement towards the northern direction is clear. The possible explanation for these egg distributions out of the boundary of the basin, may be that either M. pennanti performs small scale spawning migrations out of its main habitat, or, that short lasting but strong surface water movements are the cause for these egg displacements.

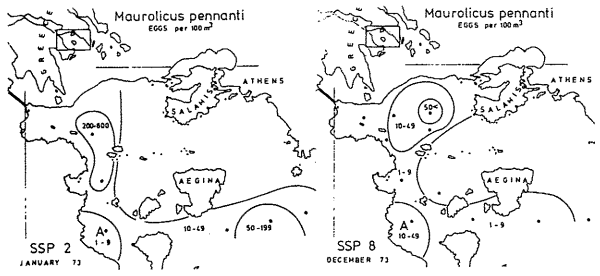

Fig. 3

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V-II25

Maturity of family Sphyraenidae in the South Eastern Mediterranean Sea

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Abstract

This study is concerned with the reproduction of the important economic fishes belonging to family Sphyraenidae in the south-eastern Mediterranean ; Sphyraena sphyraena (Linnaeus, 1758) and Sphyraena chrysotaenia (Kluzinger, 1884).

We adopted a modified scheme comprising five maturity stages immature ; mature ; nearly ripe ; ripe and spent.

Analysis of the monthly distribution of maturity stages showed that in Sphyraena sphyraena, the spawning season lasts from April to September, while for Sphyraena chrysotaenia, the breeding season extends from May to October. The monthly variation of the gonadosomatic index revealed that for both sexes, the index increases towards the spawning season. The maximum values for Spyraena sphyraena are found in May and June while for Sphyraena chrysotaenia, the maximum value of gonadosomatic index is observed in June and July. Sphyraena sphyraena and Sphyraena chrysotaenia are fractional spawners with prolonged spawning season (mainly characteristic of tropical and subtropical fishes).

Our results revealed that the analysis of ova diameter could predict the breeding cycle of a fish and determine whether the species has short or prolonged spawning.

The minimum size at first sexual maturity is detected by monthly analyses of maturity stages. The males and females of Sphyraena sphyraena attain their first sexual maturity at lengths 23.0 and 26.0 cm respectively while for Sphyraena chrysotaenia, males and females reach their first sexual maturity at 19.0 and 20.5 cm respectively. It was found that males and females of Sphyraena sphyraena are sexually mature at slightly less than one year old, whereas both sexes of Sphyraena chrysotaenia reach their sexual maturity at age over than one year old.

The absolute fecundity of Sphyraena sphyraena varies between 27,093 and 121,927 at lengths from 28.0 to 42.0 cm respectively. The absolute fecundity of Sphyraena chrysotaenia fluctuate from 68,783 and 225,971 for lengths from 23.0 and 27.0 cm respectively.

In Sphyraena sphyraena the absolute fecundity increases at a rate slightly more than one time the weight of the fish, while it increases to about three times (3.4) the length of the fish.

The relation between relative fecundity and gutted weight in Sphyraena sphyraena showed that the number of ova per gram body weight varied between 345 and 535. In Sphyraena chrysotaenia the total fecundity increases at a rate twice the weight and seven times the length of fish.

The relation between absolute fecundity and age (determined by otolith) revealed that the average number of eggs increased as the fish gets older, however in a certain age group, the number of eggs produced varied from one fish to another. These individual variations depend on ecological conditions and genetic factors (Bagenal, 1978).

Sexualité et reproduction du Sparaillon Diplodus annularis des îles Kerkennah (Sud-Est Tunisien)

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Pour réaliser cette étude sur la sexualité et le cycle reproducteur de *Diplodus annularis* , nous avons eu recours à l'examen macroscopique et microscopique des gonades et au suivi mensuel du rapport gonadosomatique (RGS) et hépatosomatique (RHS) d'individus de 5 à 19 cm de longueur totale capturés sur les hauts fonds des îles Kerkennah durant les années 1986-1987.

Proportions numériques des sexes

Les 5161 individus examinés se répartissent en 560 hermaphrodites (10,8 %), 1986 mâles gonochoriques (38,5 %) et 2615 femelles gonochoriques (50,7 %). Les individus bisexués ont une taille moyenne de 9,3 cm et des tailles limites oscillant entre 5 et 14 cm. La taille des mâles est comprise entre 6 et 17 cm avec une moyenne située à 11,2 cm tandis que celle des femelles varie entre 6 et 19 cm et présente une moyenne égale à 12 cm. La distribution des fréquences des groupes sexuels en fonction de la taille montre une diminution constante du nombre des hermaphrodites et un accroissement régulier de celui des femelles gonochoriques . Quant aux mâles, leur fréquence s'accroit jusqu'à la taille de 10 cm puis subit un fléchissement continu jusqu'à 17 cm taille à laquelle ils disparaissent complètement. Suivant que la taille est inférieure ou supérieure à 10 cm, il est possible de grouper les individus en deux catégories. La première renferme un fort pourcentage d'hermaphrodites (24,2 %) et des mâles (40,4 %) numériquement dominants sur les femelles (35,4 %), ce qui laisse supposer que la différenciation des gonades dans le sens mâle a lieu plus précocement que pour les femelles. La deuxième catégorie composée d'individus de grande taille se caractérise par un très faible taux d'hermaphrodites (3,7 %) et par une très nette prédominance des femelles (60,4 % contre 35,9 % pour les mâles). Ce phénomène peut s'expliquer par la grande longévité des femelles d'une part et par la présence d'hermaphrodites protandriques d'autre part. Ainsi les sparaillons seraient suivant un ordre décroissant, des gonochoriques secondaires, des hermaphrodites rudimentaires et des hermaphrodites protandriques.

Taille de première maturité

La détermination de la première maturité sexuelle a été effectuée sur des exemplaires pêchés pendant l'époque de reproduction au moment où les gonades sont à leur développement maximum. Le plus petit mâle et la plus petite femelle mûrs que nous ayons observés avaient respectivement 8 cm et 9 cm de longueur totale. La taille à laquelle 50 % des individus sont aptes à se reproduire se situe à 9,5 cm pour les mâles et 10 cm pour les femelles. Cet écart bien que minime est bien réel. Il s'estompe au niveau des tailles supérieures puisque à partir de 14 cm tous les individus qu'ils soient mâles ou femelles sont adultes.

Cycle sexuel

L'activité sexuelle annuelle se distingue par une phase d'accroissement lent des gonades extrêmement longue au cours de laquelle le RGS moyen augmente faiblement passant de 0,38 en juillet à 0,88 en janvier pour les femelles et de 0,09 en septembre à 0,32 en janvier chez les mâles. Elle est suivie d'une phase d'accroissement brutal du volume des gonades et une maturation rapide des produits sexuels. Pendant cette phase qui ne dure que trois mois, le RGS moyen atteint son maximum en avril, il est alors égal à 6,71 pour les femelles et 5,4 pour les mâles. Ainsi les ovaires grandissent nettement plus que les testicules. La ponte est de courte durée et a lieu en avril-mai.

Les variations annuelles du RHS attestent du rôle non négligeable que joue le foie dand les phénomènes de la reproduction en accumulant les réserves lipidiques durant les phases de repos sexuel et d'accroissement lent des gonades et en les libérant au moment de l'accroissement rapide des glandes sexuelles.

Fécondité

Nous avons évalué la fécondité de 195 femelles de 10 à 19 cm de long récoltées au mois d'avril par dénombrement des ovocytes dont le diamètre est supérieur à 200 µ. Quatre équations de régression reliant la fécondité absolue à la longueur totale (LT), au poids total (Wp), au poids éviscéré du poisson (We) et au poids des gonades (Wg) ont été établies :

$$F = 2{,}674\ LT^{3{,}832}$$

$$F = 400\ Wp^{1{,}277}$$

$$F = 537\ We^{1{,}252}$$

$$F = 17358\ Wg^{1{,}048}$$

Dans les limites de taille indiquées, la fécondité varie de 18.000 à 212.000 oeufs. La fécondité relative étant égale à 400 oeufs par gramme de poids corporel et 17.000 oeufs par gramme d'ovaire.

A note on the spawning of Saurida undosquamis in the Northern Cilician Basin - Turkish Coast

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Samples of Lizard fish collected between July 80-September 81 with a bottom trawl net were iced on board and kept deep frozen in the laboratory. The weights of the ovaries were determined at an accuracy of 0.01 g and the mean ovary weight for each month were used to determine the spawning periods.

KUHLMORGEN-HILLE (1973) had found two main spawning periods (May-June and September) in Thailand waters. LATIF and SHENOUDA (1973) have stressed that in Suez Canal region the maximum gonad indices both for male and female were reached in May and established that Lizard fish spawn 3-4 batches during a spawning period. BUDNICHENKO and DIMITROVA's (1979) histologic investigation has shown stage-by-stge maturation of several generations of oocytes during the spawning period. This provide evidences of a unbroken type of maturation and BEN-YAMI and GLASER, 1973) noted that ripe and nearly ripe and partly spent females occur almost all year long.

In the study period in both stations (Tirtar and Goksu) on the Mediterranean coast of Turkey the measured ovary weights showed two clear and distinct spawning seasons. As it could be seen from Figure 1 these periods coincide with September-October and June-July. The prolonged season of spawning can also be seen here (Figure 1)

Probably two of four portions indicated by LATIF and SHENOUDA (1973) are spawned in one period and the following two in the next main period of spawning. Present data plotted in figure 1 indicate that there are probably early, intermediate and late spawners of the two main spawnin periods. It may also be possible that riping of the ovary somethihes is slowed down because of an eventually unfavorable conditions. Thus on the other hand may also be a reflection of intermitted spawning.

The sex ratios for the study period and stations are found 37.95 % males and 62.05 % of females in Goksu and 34.83 % for male and 65.18 % for female in Tirtar. Based on present data and informations given by LATIF and SHENOUDA (1973) and AVSAR (1987) the sex ratios of Lizard fish in the Levantine Basin can be established as 1.19 (for male) and 2.62 (for female). In contrast to this BUDNICHENKO and DIMITROVA (1979) note that males prodominate over the females considerably and the sex ratio is 2:1 in the Arabian Sea. Therefore it is here assumed that the sex ratios are eventually different in large geographical areas or it changed later in the Mediterranean during adaptation to the modern environment after emigration through the Suez Canal.

Going further on this promisses the present results imply that approximately one male serve two female individuals in the spawning ground in the northern Cilician Basin although the sex ratios may vary temporaly and spatially.

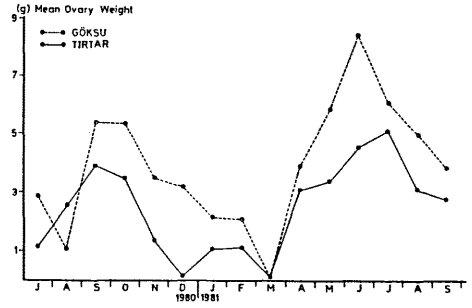

Figure 1: Mean ovary weights in two different stations. Northern cilician Basin-Turkish coast.

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-II28

Estimation of energy budget for gonadal development migration and spawning of Anguilla anguilla L. inhabiting the Egyptian Lagoons

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BSTRACT. The total energy of European silver eel ; the start of migration is sufficient to fulfill .l biological activities which begin with active .grations. We used the model of Boetius and Boetius 980) after our modification to became :

$$ = E_G + E_D + E_S + E_M$$

Material of the present work (100 alive samples non-migrating yellow eels and migrating silver ls) were collected in lagoon Edku (Egypt) in the riod from August 1986 to March 1987. Hormonal duction of gonad maturation was carried out on 30 mples. Contents of water, lipid, protein and ash muscles, liver, skin, intestine, bones and gonads re determined.

Lipid and protein are the main components of eel dy. Furthermore, lipid is considered as the princi- l source which supply most of required energy . otein, on the other hand, represents the second urce of energy.

Lipid energy in percent of total energy was lculated as 58.21 for male and 67.91 for female llow eel. These two values were significantly aller than those calculated for male (76.31) d female silver eel (80.07). In contrary to pid energy, the protein energy higher for both le (41.28) and female (32.09) yellow eel than ose of non injected male and female silver eel ing calculated as 23.69 and 19.93 respectively.

Lipid energy of immature testes amounted to .53 %, while immature ovaries was found to be .90 %. Further gonadal development showed a gnificant increase in lipid energy up to the rmation spermatozoa in ripe male (80.28 %) and .44 % at the time of appearence ripe ova in e female ovary.

About 25.08 % and 20.28 % from the total energy emed to be utilized in oogenesis and spermato - nesis respectively. 17.07 % and 15.78 % being ilized for ovulation and spermiation respectively. achieve migration and simultaneous routine tabolism,energy values of about 35.75 and 34.19% the total energy seemed to be utilized by female d male silver eel (Table 1). The energy of routine tabolism (E_R) is considered as a part of the energy migration was found to be higher in male 1.40 X 10^6 kg than that in female 0.97 X 10^6 J/kg.

Table 1- The determined values of energy of E_G, E_D, and E_M of ripe female and male European eel Anguilla anguilla

ex	E_T J X 10^6	E_G J X10^6	E_G % of E_T	E_D J X10^6	E_D % of E_T	E_M J X10^6	E_M % of E_T
♀	16.11	2.75	17.07	4.03	25.08	5.76	35.75
♂	14.45	2.28	15.78	2.93	20.28	4.94	34.19

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V-II29

Induced maturation of female Silver Eel (Anguilla anguilla L.) leaving the brackish delta lakes for spawning

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ABSTRACT. The European silver eel (Anguilla anguilla) gave positive results when the females treated with a combination of(HCG) human chorionic gonadotropin hormone and (CP) carp pitutary or with carp pitutary only.

Migrating female were obtained from lake Edku (Egypt), in winter, from October 1986 to November 1987. Females were selected according to size and colour. After acclimatized in sea water the experiments was started under the previously described conditions (Amin, 1986).

Injected females with a combination of HCG and CP attained their ripe condition after 11 injections within a period of 40 days. Injection with CP only gave the same results but the period was extended to 54 days and number of injections increased to 16 times. In both conditions ripe ova could be detected.

Several external and internal changes took place with increasing the number of injections. Colour of the body became more dark, eye diameter changed from 10 mm in non-injected silver eel to 16 mm in injected ripe eels (Fig. 1). Urogenital opening became more wide and bulged over the body surface (Fig.2). GSI changed

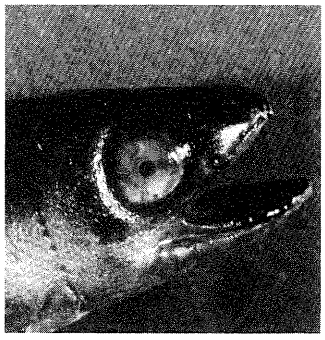

Fig. 1

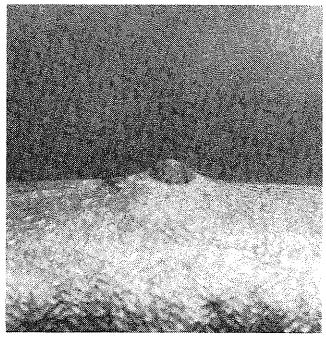

Fig. 2

Fig. 3

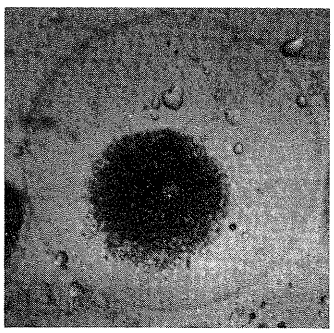

Fig. 4

from 1.66 when immatured to 31.41 in ripe condition (Fig.3).

Mean egg diameter measured 1.12 ± 0.06 mm, eggs were small, spherical with centrally positioned oil droplet (Fig. 4), fecundity was found to be 1.46 X 10^6.

Amin,E.M. 1986- Induced gonadal maturation of male European eel (Anguilla anguilla L.) inhabiting the Egyptian lakes. Arab.Gulf.J.Scient.Res. 4(1),293-301.

V

Some data on the reproductive biology of Sardina pilchardus from the Coast of Malaga (SW Spain), (March 1983-May 1984)

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Biological studies on *Sardina pilchardus* from the Alboran Sea have been carried out in the past by authors such as: Bardán y Navarro (1948,1950,1952); Bardán, Navarro y Rodríguez (1949).

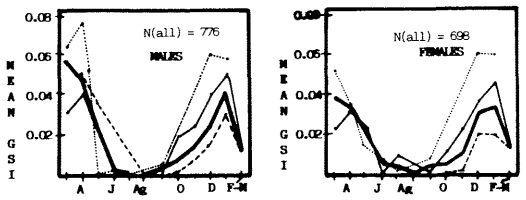
A total of 24 samples proceeding from local Málaga purse seine fleet have been realized, with a thorough examination of 1.981 specimens during this period (♂♂ =854, ♀♀ =804, indetermined sexes =323); including data on: body weight, gut free total weight, total length, sex, maturity stage, somatic fat content; and gonadal length, weight and volume.

The present paper will only take into consideration some of the biological aspects in relation with the periodicity of *Sardina pilchardus'* reproduction through a biological sampling of this species during a period of 15 months (March 1983-May 1984).

Gonosomatic Index: (GSI = gonad weight/gut free total weight).
The analysis of this index, widely used to know gonadal activity and spawning preparedness, has been calculated for each sex considering the following size classes (cms.): < 13.5, 13.5-16.5, >16.5 (Figs. 1 & 2), in order to analize possible variations of GSI in relation to length, as observed by Pérez et al. (1985). The only size class that have appeared in the sampling throughout the year has been 13.5-16.5.

Monthly mean GSI indicate a gonadal inactive period during constricted to the summer period (June to September), although an analysis of the maximum monthly GSI present, complemented with the maturity stages show, that this species can actually have some reproductive activity in the months of June and September.

Generalized spawning begins in the month of October, attaining peak GSI values for all size classes considered in the month of January and another spring peak that can occurr in March-April.



Figs. 1 & 2: Monthly variations of GSI in relation to length, for each sex. (all=——, < 13.5=---, 13.5-16.5=———, >16.5=.....

The present analysis has been complemented with the following related parameters:
-Maturity stages: The maturity scale used in the sampling is that proposed by Pérez et al. (1985). Fig. 3 shows the evolution of maturity stage "3" and over (pre-spawning stages onward). There is a good correspondance with the results previously commented through the GSI values, showing that during the resting period, 77.7% sex indetermined specimens were found in the period between July to October.

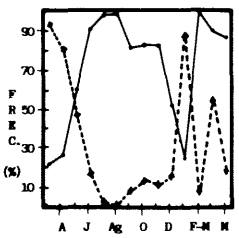


Fig.3. Monthly variation in maturity stages and somatic fat content for both sexes. (Maximum fat content, stages≥III=—— Maturity stage ≥3=+--+).

The *proportion of sexes* have been analized by groups of three months during the sampling period. The mean female proportion comprehending the whole period was 48.2%, but a rather low percentage value (34.6%) was found for the period extending from March-April-May.

Through a cumulative frequency representation, an estimation of *size at first maturation* has been realized considering the spawning period from October on to February-March. This parameter is of 15 cms. for females (N=53), 13.8 cms. for males (N=84), and with a combined value of both sexes of 14.4 cms.. Although, we must remark that mature specimens of 11-12 cms. have been found, in accordance with the results from Larrañeta (1976) based on the sardine of the spanish mediterranean coasts of Castellón.

-Somatic fat cycle: Fat content begins its increase in April attaining its maximum during July-August. From that period on, there is a steady decrease, in time with the begginning of sexual maturation. Minimum fat contents occurr during peak spawning periods observed (Fig. 3).

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L'hermaphroditisme et le cycle sexuel de la Gerle Spicara flexuosa (Centracanthidae) dans le golfe de Patraikos, Grèce

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INTRODUCTION: Le problème de l' hermaphroditisme et du cycle sexuel de la gerle (Spicara flexuosa), a occupé depuis longtemps plusieurs auteurs (Zei,1949; Planas & Vives, 1955; Salekhova,1979), qui ont mis en évidence l'existence, chez cette espèce, d'un hermaphroditisme protérogyne et d' une inversion sexuelle. La gerle est très commune dans les eaux de Grèce, mais sa biologie peu étudiée (Mytilinéou,1987).
Ce travail est une étude préliminaire du cycle sexuel et de l'hermaphroditisme de la gerle dans le golfe de Patraikos.
MATERIELS ET METHODES: 2837 gerles ont été récoltées par un chalutier commercial pendant quatre campagnes saisonnières (Novembre 1984 - Septembre 1985) dans le golfe de Patraikos. La longueur à la fourche de chaque poisson a été mésurée et les gonades ont été enlevées afin d' effectuer des observations macroscopiques et microscopiques. L' âge a été déterminé par les otolithes.
RESULTATS and DISCUSSION: 1.Hermaphroditisme. L' étude des gonades a indiqué que parmi eux, existaient des gonades bisexuelles (hermaphrodites), constituées d' une zone (tissue) ovaire et d' une zone testiculaire. Les différents stades de maturation de ces gonades ont montré que les deux zones se développaient et fonctionnaient séparement l'une de l'autre:la zone ovaire développée au début, commençait à se reduire en donnant place à l'augmentation de la zone testiculaire. Selon le stade de développement de ces deux zones,les individus ont été caractérisés comme suit:
- femelles (**femelles fonctionnelles**): individus dont la zone ovaire de la gonade hermaphrodite était fonctionnelle.
- mâles (**mâles fonctionnels**): individus dont la zone testiculaire de la gonade hermaphrodite était fonctionnelle.
- **hermaphrodites**: individus dont la zone ovaire de la gonade hermaphrodite commençait à se réduire, tandis que la zone testiculaire commençait à se développer; ils peuvent être caractérisés comme individus en inversion sexuelle.

La distribution des fréquences des gerles en foction de la taille (Fig.1) a montré que: a) les femelles étaient présentes jusqu' à la taille de 15 cm (âge V). En general, elles étaient de petite taille, avec un pic dans la classe 10.5-11.5cm (âge I) et avaient par rapport aux mâles, une prédominance numérique aux tailles inférieures à 12cm (âge II), b) les mâles étaient de grande taille et par rapport aux femelles dominaient aux longueurs supérieures à 12.5cm et c) les hermaphrodites étaient présents aux longueurs 11.5-14.5cm (âge II-V), avec un pic dans la classe 12 - 13cm.

Les résultats de l' examination des gonades et de la répartition des deux sexes en foction de la taille et de l'âge, mentionnés au-dessus, ont confirmé l'existance de l' hermaphroditisme protérogyne et de l' inversion sexuelle chez la gerle. Pourtant, parmi les individus de nos échantillons, à part les mâles provenus de l' inversion des **femelles (mâles secondaires)**, on a reconnu des mâles qui, dès le debut de leur vie, avaient développé des testicules (**mâles primaires**). Ces **mâles étaient** de petite taille, 7.0-12.5cm en longueur (âge 0-II), tandis que les mâles secondaires avaient une taille supérieure à 11.5cm (âge II-V). L' existence des mâles primaires, parmi les individus, a indiqué que les gerles ne commencent pas leur vie, toujours comme femelles (fonctionnelles). En cette raison on se pose

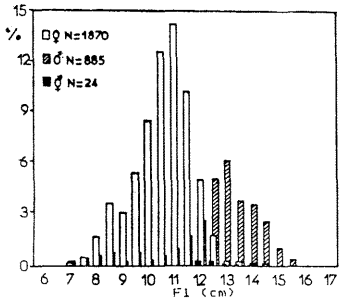

Fig.1. Disribution des sexes en fonction de la taille de S.flexuosa du Golfe de Patraikos.

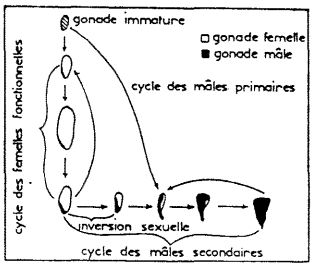

Fig.2.Diagramme du cycle sexuel de S.flexuosa du Golfe de Patraikos.

la question si l' hermaphroditisme protérogyne et l' inversion sexuelle n' est pas un phénomène général affectant l' ensemble de population de cette espèce. Le cycle sexuel de la gerle, propose par ce travail, est présenté par le schéma de la figure 2.
2.Rapport sexuel. L' ensemble des individus était constitué par 1870 femelles(65.9%), 885 mâles(31.3%), 24 individus en inversion sexuelle (0.9%) et 59 individus immatures dont le sexe n' a pas été déterminé (2%). Le rapport sexuel entre les femelles et les mâles était 2.1:1, d' où une dominance statistiquement significative des femelles par rapport aux mâles. Cette répartition des deux sexes restait inchangeable durant les différentes époques de l' année, sauf au mois de Juin ou le rapport sexuel était presque 1:1. Il est important de signaler que pendant cette période les hermaphrodites présentaient un pourcentage élevé. Le sex ratio en foction de la taille a presenté aux petites tailles, inférieures à 12.5cm (âge II), une dominance statistiquement significative des femelles par rapport aux mâles. A la longueur de 12.5cm le pourcentage pour chaqun des deux sexes était 50%, tandis qu' au-dessus de cette longueur le pourcentage des mâles augmentait successivement pour dévenir finalement 100%.
3.Période de reproduction et taille de première maturité. L' étude des différents stades de maturation des gonades des deux sexes a indiqué que la gerle, dans la région étudiée, se reproduisait pendant le printemps, dès le mois de Mars jusque à Juin, avec un pic en Avril-Mai. La taille de prémière maturité, calculée selon Ashton (1972) et Gunderson (1977), était 9.1cm de longeur pour les femelles et 10.2cm pour les mâles, d' où on pourrait dire que la gerle se reproduit dès la prémière année de sa vie.

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-II32

La fécondité des Sélaciens ovipares

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La reproduction des Sélaciens ovipares est permanente en Méditer-
née. Il est donc difficile d'évaluer avec précision la fécondité
ces animaux (Capapé et Quignard, 1975; Holden,1975). Le dénombre-
nt des ovocytes mûrs ou en voie de maturation apporte une solution
rtielle à ce problème.
ns ce travail nous donnons le nombre maximum annuel d'ovocytes que
on peut considérer comme prêts à être ovulés dans un laps de temps
sez court. Cette expression de la fécondité ne donne pas la quantité
oeufs pondus annuellement par un individu mais elle permet quand
me de comparer les fécondités interspécifiques et intraspécifiques
tentielles à un moment donné, pour une taille donnée.
tableau n°1 indique pour les plus petites et les plus grandes femel-
s de dix espèces pêchées sur les côtes de Tunisie le nombre maximum
ovocytes recencé dans les ovaires. De ces observations on peut dé-
ire que les espèces de grande taille ont généralement une fécondité
périeure à oelles de petite taille et que chez toutes les espèces
fécondité augmente avec la taille.

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TABLEAU 1

Relation entre la fécondité et la taille chez 10 Sélaciens (taille: Pleurotrêmes, longueur; Hypotrêmes, largeur en cm)

Espèces	Taille maximale	Tailles extrêmes	Nombre d'ovocytes
Scyliorhinus canicula	53	46-50	26-33
S. stellaris	115	78-85	38-57
Galeus melastomus	66	39-45	15-25
Raja miraletus	33	22-38	15-25
R. clavata	58	53-60	68-75
R. asterias	45	41-48	34-55
R. radula	42	31-39	22-55
R. polystigma	47	35-45	41-60
R. melitensis	24	19-21	19-25
R. alba	128	94-117	60-90

V-II33

La fécondité des Sélaciens vivipares

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Chez les Sélacienx vivipares la fécondité annuelle est fonction de l'importance numérique des portées et du nombre de cycles de reproduction au cours de ce laps de temps. A ce point de vue on peut distinguer trois groupes d'espèces :

Groupe 1 : espèces à cycle court d'environ 4 mois (Tab. 1). On peut admettre dans ce cas l'existence de trois portées par an (*Dasyatis pastinaca, D. marmorata...*). En effet, chez ces Sélaciens il y a synchronisme entre vitellogenèse et gestation. A la parturition fait suite immédiatement une nouvelle ovulation. Donc les gestations se succèdent presque sans interruption.

TABLEAU 1 : Fécondité des espèces à cycle de reproduction court (4 mois)

ESPECES	Taille max.	Limite des tailles	Fécondité ovarienne	Fécondité utérine	Fécondité utérine annuelle possible
Rhinobatos rhinobatos	162	90-108	6	4-6	18
Rh. cemiculus	215	118-138	6-9	5-8	24
Gymnura altavela	162	138-162	8-14	3-6	18
Dasyatis pastinaca	68	35-44	6-8	5-7	21
D. tortonesei	79	43-63	7-14	3-8	24
D. marmarata	40	42-61	1-5	2-3	9
D. centroura	160	125-144	4-9	3-4	12

Groupe 2 : espèces à cycle annuel (Tab. 2). Dans ce cas, fécondité par portée et annuelle sont confondues.

TABLEAU 2 : Fécondité des espèces à cycle annuel

ESPECES	Taille max.	Tailles extrêmes	Fécondité ovarienne	Fécondité utérine
Heptranchias perlo	139	103-108	15-20	13-18
Galeorhinus galeus	195	140-195	12-50	13-38
Mustelus asterias	128	98-123	11-45	16-32
Carcharhinus plumbeus	248	174-205	4-17	3-14
C. brevipinna	250	160-191	6-15	2-11
Torpedo torpedo	60	25-60	1-15	1-9
Pteromylaeus bovinus	120	87-236	1-6	1-3

Groupe 3 : espèces à cycle pluriannuel (Tab. 3) : *Centrophorus granulosus* (Schneider, 1801) a un cycle de deux ans. L'espèce ne produit qu'un seul ovocyte et qu'un seul nouveau-né. *Torpedo marmorata* (Risso, 1810) a un cycle trisannuel et donne à chaque mise bas 5 à 6 individus.

TABLEAU 3 : Fécondité des espèces à cycle pluriannuel

ESPECES	Taille max.	Tailles extrêmes	Fécondité ovarienne	Fécondité utérine
Centrophorus granulosus	125	110-128	1	1
Torpedo marmorata	58	39-55	3-15	2-13

Pour traduire la fécondité de ces animaux nous donnons (Tab. 1 à 3) la fécondité ovarienne (nombre d'ovocytes mûrs ou en voie de maturation) et la fécondité utérine (nombre d'oeufs, d'embryons ou de foetus). La fécondité ovarienne est toujours légèrement supérieure à la fécondité utérine. Ceci s'explique par le seul jeu des ovulations manquées (atrésie des ovocytes évolutifs) et des avortements.

Nos observations montrent enfin que, pour une espèce donnée, la fécondité augmente avec la taille des femelles mais qu'elle n'est pas liée, au sein d'une famille, à la taille maximum des espèces. Chez les Squalidés par exemple, *Centrophorus granulosus* est moins prolifique que *Squalus blainvillei* pourtant de plus petite taille.

V

Les relations de nutrition entre femelles et embryons au cours de la gestation des Sélaciens vivipares

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Ranzi (1932 et 1934) a mis en évidence que la croissance embryonnaire d'un certain nombre d'espèces de Sélaciens vivipares dépend partiellement d'un apport maternel en substances nutritives. Ces substances sont élaborées par l'utérus pendant la gestation sous forme de sécrétions diverses que l'embryon absorbe, digère et assimile. Le calcul du rapport poids de l'oeuf sur poids du foetus à terme donne une mesure simple mais assez fidèle de la contribution maternelle. On distingue alors trois groupes de Sélaciens vivipares :

groupe 1 : rapport peu élevé compris entre 0,02 et 0,05 (Triakidae, Carcharhinidae, Dasyatidae, *Pteromylaeus bovinus*).

groupe 2 : rapport compris entre 0,2 et 0,5 (Squalidae en général, Rhinobatidae, Torpedinidae, *Heptranchias perlo*).

groupe 3 : rapport élevé proche de 1 (Sqatinidae, *Centrophorus granulosus*).

TABLEAU 1

Poids de l'oeuf (PO) et du foetus à terme (PFT).

Rapport PO/PFT de 15 espèces de Sélaciens vivipares des côtes tunisiennes.

Espèces	Poids de l'oeuf	Poids du foetus à terme	PO/PFT	Viviparité	Familles
Heptranchias perlo	16,8	64,5	0,26	aplacentaire	Hexanchidae
Mustelus asterias	5,9	110,5	0,26	aplacentaire	Triakidae
M. mediterraneus	3,6	120,5	0,03	placentaire	Triakidae
Carcharhinus plumbeus	10,5	396,5	0,03	placentaire	Carcharhinidae
Squalus blainvillei	26,6	54,4	0,49	aplacentaire	Squalidae
Centrophorus granulosus	320,5	347,5	0,92	aplacentaire	Squalidae
Etmopterus spinax	3,75	12,15	0,33	aplacentaire	Squalidae
Squatina squatina	207,5	201,3	1,03	aplacentaire	Squatinidae
Squ. oculata	178,7	179,1	0,99	aplacentaire	Squatinidae
Rhinobatos rhinobatos	48,6	116,5	0,26	aplacentaire	Rhinobatidae
Rh. cemiculus	55,7	135,1	0,20	aplacentaire	Rhinobatidae
Dasyatis tortonesei	3,6	112,6	0,03	aplacentaire	Dasyatidae
D. marmorata	3,2	98,5	0,03	aplacentaire	Dasyatidae
D. centroura	4,7	147,5	0,03	aplacentaire	Dasyatidae
Pteromylaeus bovinus	17,3	290,8	0,06	aplacentaire	Myliobatidae

Ce rapport ne permet pas de séparer les vivipares placentaires des vivipares aplacentaires.

V

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Activité vitellogénétique et gestation chez les Sélaciens vivipares

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Les modalités de reproduction des Sélaciens vivipares présentent une extrême diversité d'une espèce à une autre. Parmi les variables inter-spécifiques, deux jouent un rôle fondamental dans la stratégie démographique des vivipares : la durée du cycle et le synchronisme entre la vitellogenèse et la gestation. La durée du cycle dépend, en fait, plutôt de l'espèce : un minimum de deux mois pour *Dasyatis violacea* (Bonaparte, 1832), un maximum de trois ans pour *Torpedo marmorata* (Risso, 1810) etc... En revanche, le synchronisme entre la vitellogenèse et la gestation nous permet de considérer trois groupes de Sélaciens vivipares bien tranchés (fig.

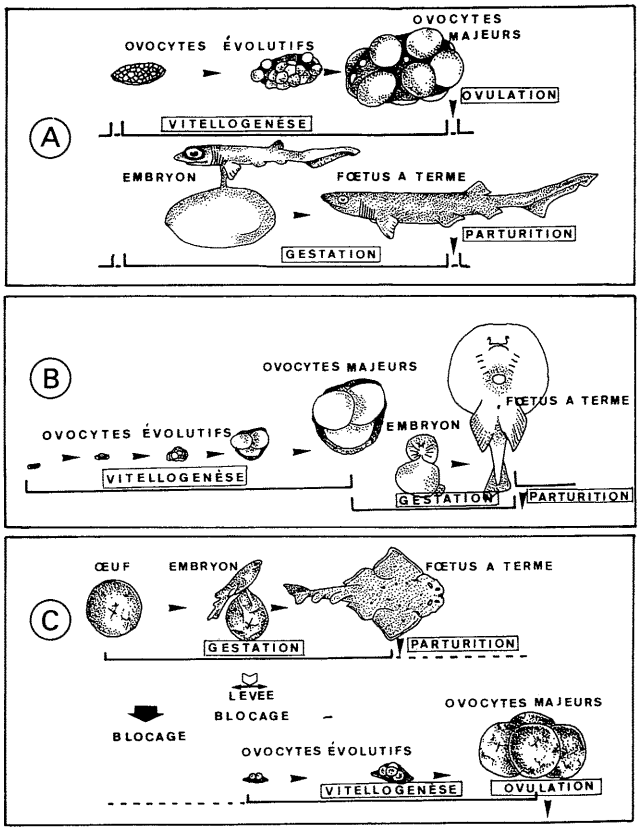

FIGURE 1

A. Espèces avec vitellogénèse et gestation synchrones. Ex. : Heptranchias perlo.
B. Espèces avec vitellogénèse et gestation successives. Ex. : Torpedo marmorata.
C. Espèces avec vitellogénèse et gestation décalées. Ex. Squatina squatina.

Groupe A : Espèces avec vitellogenèse et gestation synchrones (fig. 1 A) : la formation des ovocytes est concomitante du développement des embryons. La vitellogenèse débute immédiatement après l'ovulation qui suit presqu'aussitôt la parturition. Ce groupe concerne les Sélaciens vivipares placentaires et de nombreux Sélaciens Sélaciens vivipares aplacentaires, Pleurotrêmes (Hexanchidae, Triakidae, Squalidae...) et Hypotrêmes (Rhinobatidae, Dasyatidae, Gymnuridae, Myliobatidae...)

Groupe B : Espèces avec vitellogenèse et gestation successives (fig. 1,B) : L'activité vitellogénétique est interrompue durant toute la gestation, elle ne redémarre qu'après la parturition. Ce groupe ne comprendrait à notre connaissance que des représentants de la famille des Torpedinidae.

Groupe C : Espèces avec vitellogenèse et gestation décalées (fig. 1,C) : L'activité vitellogénétique est bloquée pendant une partie de la gestation et ne reprend que vers la fin. A la parturition, les ovocytes n'ont pas atteint la moitié de leur diamètre définitif. Ceci paraît caractéristique des Squatinidae.

V-II36

Mapping the nurseries of Merluccius merluccius in the Ligurian Sea : seasonal aspects of the distribution of recruits

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During trawl surveys in the Ligurian Sea financed by the Ministero della Marina Mercantile (1982-83; 1985-87) data were collected about the timing of recruitment of *M. merluccius* (Orsi Relini et al. 1986) and the location of its nurseries (i.e. the bottoms where the fish lives during its first year of life). These notes are concerned with the latter problem and their purpose is to give a brief account of the distribution of recruits recorded in different seasons in the years 1985-87.

In an area of about 915 square miles a total of 168 one-hour daytime trawls were effected, half in the period March-May and half in the period August-September. The hauls were divided into five depth strata (delimited by the levels 0; 50; 100; 200; 450; 700 m) in numbers proportionate to the extension of the bottoms in each stratum. The net had 500 meshes at the cod end of 7.5 mm side. Length frequency distributions of *M. merluccius* in each catch were used to identify the 0 group fish and more in general to assign it an age on the basis of a linear model of growth in this early phase (Orsi Relini et al. 1986).A total of 11,256 recruits were recorded in the first four strata. The fraction of weight due to the recruits was calculated using a specific length/weight relationship (Cappanera e Fiorentino 1986).

The numbers of recruits collected in one hour of trawling were very variable, varying from very few units to 2138 (cf. Pereiro and Fernandez 1983) and also the totals were very different for the three years (the 1986 values were double the others). However some general features in the overall distribution can be delineated (table 1): 1) the highest values of density were recorded in the summer sampling; this is due to the spring recruits (i.e. the fish which arrived at the bottom in April, May and June) which are the most abundant of the year. 2) The spring sampling produced considerably lower values, due to those fish which reached the bottoms in the period October-February. Among these the November recruits constitued half the number. In general the previously observed recruitment intervals of about six months (Orsi Relini

Table 1. Distribution of recruits of *M.merluccius* (numbers and percent.);recruitment index (number per hour of trawling) and incidence of recruits in the catch.

	March - May				August - September			
Strata	recruit number	percent. distrib.	recruitm. index	percent. weight	recruit number	percent. distrib.	recruitm. index	percent. weight
0-50	33	2.7	8.2	1.9	891	8.9	111.4	48.6
50-100	709	58.7	41.7	6.1	893	8.9	68.7	16.4
100-200	454	37.5	50.4	9.3	5364	53.3	536.4	73.4
200-450	13	1.1	0.5	0.4	2908	28.9	126.4	48.0
Totals	1209	100			10056	100		

et al. 1986) were confirmed. As a consequence of 1) and 2) the proportion of recruits in the total weight of *M. merluccius* in the catch was equal to 5.1% in spring and 41.3% in summer. 3) In spring the recruits were distribuited mainly in the range 50-200 m (96%); in summer mainly between 100 and 300 (82%) table 1 and fig. 1).

These results show that the fish choose different bottoms according to the season in this early phase of life. Future research could examine several hypotheses about the causes of this seasonal variation in behaviour: these range from the influence of abiotic factors such as temperature and light to biotic factors such as food availability and competition with other fish: for example, *Phycis bleinnioides* of comparable size have their spring nurseries on epibathial levels (Fanciulli and Relini Orsi 1980).

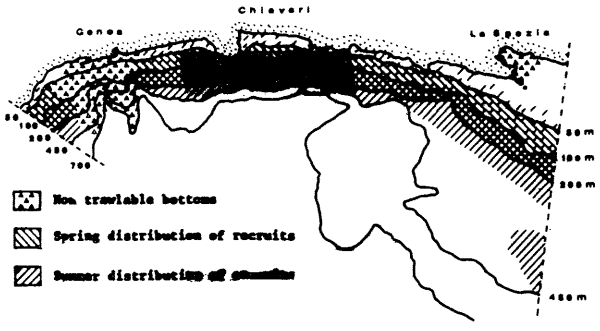

Fig. 1. Nurseries of the hake (hatched areas) in different seasons.

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V-II37

Effects of meteomarine parameters on Fish fry migration in the Lake of Fusaro (Naples) : first results

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Text: The preliminary results of data elaboration recorded in the development of a methodological test for a sistematic investigation on the influence of environment conditions on fish fry migration are reported in this paper.

The area selected is the lake of Fusaro (Naples, Italy), due to previous data on this particular coastal lagoon available in literature (Carrada, 1973; Renzoni, 1963; Sacchi & Renzoni,1962).

The sampling station selected was the most efficient, in terms of water exchange, of the three mouths of the lake (fig.1).

The sampling period started on January 17th, 1986 to March 3rd, 1986 with a weekly sampling rate,which could have given the possibility of evidencing tidal influences on fish fry migration in connection channels of coastal lakes and lagoons in general. An interval of 30 minutes was allowed for the samples (sampling time: from 10:00 A.M. to 4:00 P.M.).

To approximate the physical-chemical features of the whole channel all the data were collected at the depth of 60 cm. (depth of the station 120 cm.). A currentmeter with magnetic recording, supplied with a temperature and conductivity sensor (0.02 °C and mmhos/cm. respectively of precision), was employed to detect the values of direction and velocity of the stream, temperature, and conductivity of the water. Winkler's method was used to obtain oxygen data and cross-parallel analysis were carried out to consider also the probable presence of ferric and ferrous iron, organic substances and free chlorine in the water (Rodier, 1975).

The fish fry was caught by a hand trawl net which was modified in respect to the peculiarities of the sampling station and to the need of catching the fry present in the least time possible (5 sec. max).

The gathered material was composed mainly of Mugilidae that were identified using morphological characters (Farrugio, 1977) after narcotization in situ. Number and form of the piloric caeca (Perlmutter et al., 1957) were utilized in the uncertain cases.

With regard to the three species of the genus Liza (aurata, ramada and saliens) considered in this study, a quite consistent migration of their fry in the lake of Fusaro has been pointed out in the aforementioned period.

A preliminary analysis of hydrological data, reported in fig. 2 (a & b),in respect of Mugilidae fish fry abundance in the channel under observation, reported in fig. 3 (a & b), seems to reveal a consistent L. ramada fry migration in quite rapid incoming flow cases. For L. saliens fry, instead, a slow incoming flow seems to favour its migration.

Regarding the water temperature influence lower values seem to favour L. ramada fry migration, both in incoming and outgoing flow cases. For L. saliens instead lower values of water temperature seem to hinder its fry migration.

For the oxygen influence, finally, while in the incoming flow oxygen content of the water does not seem to influence L. ramada fry migration, in the outgoing flow a higher percentage of dissolved oxygen in the water of the channel seems to favour its fry migration.

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V

Argentina sphyraena and Glossanodon leioglossus : partially niche-overlapping species

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ABSTRACT: A three-year trawlsurvey carried out off Tuscany coast gives a large amount of data upon argentinids CPUE and depth distribution. The geographical occurrence and respective abundance suggest a typical example of competition between two species.

Recently, these Argentinidae have been matter of study in the Tyrrhenian Sea both for their possible commercial exploitation and their biological interest. Along a ground-fish trawl survey carried out in 1985-1987, the whole area between Elba Island and La Spezia was sampled by means of 150 randomized tows: total yield of argentinids raised over 200 kg and 19,000 individuals.

Species presence was observed between 80 and 460 m depth for Argentina sphyraena and into a weakly reduced range (120-430 m) for Glossanodon leioglossus. Even if the depth range of presence is approximately the same, fish abundance and individual size are quite dissimilar: G. leioglossus is mainly concentrated between 100 and 250 m depth with catch rates up to 26 Kg/tow and uniform medium size (10 g); on the other hand, A. sphyraena gives lower CPUE (up to 7 Kg/tow) but on a wider area, ranging between 150 and 350 m (fig.1), and it shows a size increase with the depth from 15 to 25 g.

Further species differences are due to spatial distribution: biomass indices (μ) and related variance (σ^2) show a larger population homogeneity in the A. sphiraena (μ=85, σ=12) than in G. leioglossus (μ=58, σ=22). The immediate meaning of such a large differences is a typical clumped distribution in G. leioglossus and a relatively more uniform one in A. sphyraena (see the evidence in fig 2).

Along the 200 m isobath, G. leioglossus overwhelm A. sphyraena even if also the A. sphyraena maximum concentration site locates in the same points; elsewhere is always the opposite.

These abundance differences cannot find a reason neither in depth tolerances of the species (both live between 100 and 450 m) nor in the predation (it is very unlikely an hake, a withing or an angler fish able to distinguish the two species and selectively catch one or the other).

The only possibility is a partially overlapping niche which came out in total agreement with the Lotka-Volterra competition theory. Along the 200 m depth G. leioglossus has a higher live-efficiency: it is a more specialized species. As soon as the depth changes, A. sphyraena shows its stronger fitness with different environments and it results more abundant than the other species. Food habits may represent the original reason, since preliminary analyses of stomach content show a larger occurrence of ophiuroids in A. sphyraena than in G. leioglossus, while in both species crustaceans are the dominant food.

Further diet studies and life-history investigations can validate and better support the competition hypothesis even if no other likely reason has been yet found to explain the distribution pattern of the two species.

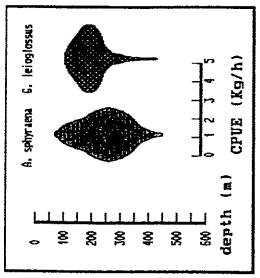

Fig.1

Fig.2:Spatial distribution and average catch per tow of A.sphyraena (left) and G.leioglossus (right).

An investigation on the deep sea (bathyal) Fishes of Gökova Bay, Aegean Sea

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SUMMARY

In the August of 1987, three beam-trawl hauls were performed in the deep waters of Gökova Bay, Aegean Sea and 10 fish species were obtained. Of these, the following species; Nezumia sclerorhynchus, Hymenocephalus italicus, Gadiculus argenteus, Phycis blennoides, Hoplostethus mediterraneus, Microichthys coccoi and Lepidorhombus whiffiagonis, are reported for the first time from Turkish seas.

MATERIAL AND METHODS

This study is realised by means of the research vessel, R/V K. Piri Reis, utilizing a Hydrobios beam-trawl with a mesh size of 10 mm. The hauls were performed at the three stations chosen in Gökova Bay (Fig. 1).

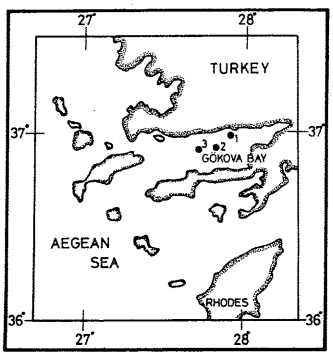

Fig. 1: Stations in Gökova Bay samples were collected

To prevent the beam-trawl net from filling-up with mud and bursting the hauls were made in short periods of 10-15 minutes and the obtained species were fixed in 5 % formalin and then kept in 70 % ethanol.

RESULTS

The results of our investigation is summarized in following Table 1.

SPECIES (n)	STATION NUMBER	GEOGRAPHIC LOCATION	DEPTHS in (m)	TYPE OF BOTTOM
(1) Capros aper (Linn, 1758)	1	36°59'N 27°50'E	300	Sand
(3) Lesueurigobius friesii (Malm, 1874)				
(2) Hymenocephalus italicus (Giglioli, 1884)	2	36°53'N 27°44'E	430	Mud
(3) Gadiculus argenteus (Guichenot, 1850)				
(1) Micromesistius poutassou (Risso, 1826)				
(1) Phycis blennoides (Brünnich, 1768)				
(3) Lepidorhombus boscii (Risso, 1810)				
(2) Hymenocephalus italicus (Giglioli, 1884)	3	36°53'N 27°39'E	600	Mud
(2) Nezumia sclerorhynchus (Valenciennes, 1838)				
(1) Hoplostethus mediterraneus (Cuvier, 1829)				
(1) Microichthys coccoi (Rippel, 1852)				
(3) Lepidorhombus boscii (Risso, 1810)				
(2) Lepidorhombus whiffiagonis (Walbaum, 1792)				

Table 1: The species obtained from three beam-trawl hauls in Gökova Bay and their distribution to the stations.

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V-II40

Distribution biogéographique et statut systématique des taxons du groupe Solea vulgaris/aegyptiaca/senegalensis

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Les études entreprises depuis le début des années 80 à l'aide des techniques d'électrophorèse des enzymes (ou autres protéines) en gel d'amidon ont permis de réviser les relations génétiques et phénétiques existant entre les taxons *vulgaris*, *aegyptiaca* et *senegalensis* du genre *Solea*.

Les recherches réalisées dans nos laboratoires ont porté sur des échantillons d'adultes prélevés (1) en Atlantique, sur les côtes du Sénégal (Dakar), du Portugal (Lisbonne), de France (Baie de Vilaine, Charentes Maritimes, Cotentin-Est), et (2) en Méditerranée, sur les côtes d'Espagne (Ebre), de France (Golfe du Lion), de Tunisie (Golfe de Tunis et golfe de Sfax), d'Egypte (Canal de Suez, Ismailia) et de Grèce (Golfe de Thessalonique).

Solea vulgaris et *Solea senegalensis*. Ces espèces se distinguent grâce à la différence de coloration de leur nageoire pectorale. Par contre, il y a un recouvrement du nombre de vertèbres (43-46 pour *senegalensis* et 45-52 pour *vulgaris*). Les études électrophorétiques ont permis de vérifier leur isolement génétique en deux endroits où elles vivent en sympatrie : Golfe de Tunis (GOUCHA,1982) et Delta de l'Erbre (SHE et al.,1987a). Ces taxons sont de "bonnes" espèces se différenciant par des allèles au niveau de 8 locus (diagnostiques) sur 29 étudiés (27,6%).

Solea vulgaris et *Solea aegyptiaca*. *Aegyptiaca* a été distinguée de *vulgaris* par CHABANAUD (1927) qui la considérait comme une sous-espèce de *vulgaris*. La situation de ces taxons n'a été éclaircie que récemment parce qu'il est difficile de les différencier par leur morphologie externe, le critère le plus discriminant étant le nombre de vertèbres (39 à 44 pour *aegyptiaca* et 45 à 52 pour *vulgaris*).

Leur isolement génétique qui a été mis en évidence dans tous les échantillons de Méditerranée étudiés (Golfe de Tunis (GOUCHA et al. 1981), Golfe du Lion (QUIGNARD et al. 1984), Canal de Suez (SHE et al. 1987b) et dans le Golfe de Thessalonique (présente note)) a permis d'élever *aegyptiaca* au rang d'espèce. Nos études de ces taxons montrent (a) qu'ils se distinguent par 9 locus diagnostiques sur les 29 étudiés (31,03%), et (b) que *vulgaris* existe dans toutes les localités où *aegyptiaca* est présente.

Solea senegalensis et *Solea aegyptiaca*. Ces taxons vivent en sympatrie dans le golfe de Tunis et dans le golfe du Lion (QUIGNARD et al. 1986). L'étude du polymorphisme enzymatique des populations de ces régions suggère que leur isolement n'est pas total. En effet, les populations d'*aegyptiaca* et de *senegalensis* provenant de régions éloignées de ces zones de contact possèdent des allèles différents, donc totalement diagnostiques, au niveau de 5 des 9 locus étudiés (17,24%). Dans les zones de contact, ces 5 locus ne sont plus diagnostiques : les allèles spécifiques d'*aegyptiaca* sont présents à faible fréquence dans les échantillons de *senegalensis* de Tunisie, et les allèles spécifiques de *senegalensis* dans les échantillons d'*aegyptiaca* du golfe du Lion. Nous avons montré par différentes méthodes que ces allèles sont fortement associés chez les individus qui les possèdent. Ces associations multiples s'expliquent au mieux par une introgression très récente, voire actuelle.

L'introgression dans les deux zones de contact est dissymétrique; dans le golfe du Lion, elle semble se faire de *senegalensis* vers *aegyptiaca* (indice d'hybridation I = 13%) et, dans le golfe de Tunis, d'*aegyptiaca* vers *senegalensis* (indice d'hybridation I = 16,1%).

Les données sur les variations du nombre des vertèbres peuvent s'expliquer par l'hybridation. *Senegalensis* a 45-46 vertèbres dans toute son aire de répartition en Atlantique comme en Méditerranée et *aegyptiaca* de 39 à 43 vertèbres. Ce n'est que dans le golfe de Tunis que certains individus de *senegalensis* ont un nombre de vertèbres intermédiaire (43-44), fait qui peut être mis en relation avec le sens du flux génique précédemment décrit.

En conclusion, *Solea vulgaris* est une espèce distincte des taxons *aegyptiaca* et *senegalensis* qui peuvent être considérés comme des semi-espèces puisque, malgré l'hybridation dans les zones de contact, elles gardent dans l'ensemble leur identité génétique.

Le scénario le plus vraisemblable de l'origine de ces trois taxons est le suivant : *vulgaris* se serait séparée de l'ancêtre du groupe *senegalensis/aegyptiaca* il y a très longtemps, le premier occupant essentiellement le Nord de l'Atlantique-Est, le second le Sud. Au contraire, la séparation de *senegalensis* et *aegyptiaca* est beaucoup plus récente. Leur ancêtre commun aurait colonisé la Méditerranée. La séparation de l'Atlantique et de la Méditerranée pendant une des glaciations, aurait permis aux deux populations d'évoluer indépendamment, aboutissant aux différences génétiques observées aujourd'hui dans les régions qui ne sont pas des zones de contact. Récemment, *senegalensis* aurait recolonisé la Méditerranée. L'isolement sexuel n'étant pas complet, nous assistons dans les zones de contact à des phénomènes d'introgression secondaires. Ces hypothèses concordent bien avec la distribution géographique actuelle des trois taxons.

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V-II41

Geographical and depth distribution of Rays in Northern Tyrrhenian Sea

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ABSTRACT: The six commonest species of rays have been analysed in relation with the geographical and bathymetrical distribution. The catch abundance and the individual average weight per tow indicate some particular differences between these species.

The rays represent an important part of fishing product of Tuscany: their economical value is quite high, and in the marine environment, they represent the top level of the trophic web, because of their predator habit upon crustaceans decapods, polychetes and fishes.

In 1985-87, five trawl surveys of experimental fishing were devised to assess the Northern Tyrrhenian demersal resources: 30 tows each survey have been carried out with a bottom trawl of 81 TSL and 420 HP in the depth range between 10 and 700 m.

Altogether, during the five surveys, the yield of rays has reached 265 kg (679 specimens) with catches of the following six species, where percent values represent the relative CPUE: Raja clavata (66 %), Raja miraletus (18 %), Raja polystigma (7 %), Raja asterias (6 %), Raja montagui (2 %) and Raja oxyrinchus (1 %).

The six species of rays can be divided into three groups belonging to three main bathymetrical zones (Fig.1) :

A first group of shelf (10-150 m depth) includes R.asterias, R.montagui and R.miraletus.

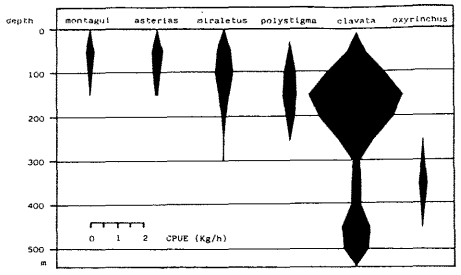

Fig. 1:Abundance of the six North Tyrrhenian sea rays.

The second zone of shelf-edge (100-200 m) groups the two species R.Polystigma and R.clavata into a level which is characterized by the community of the detritic assemblage.

The third group is representative of the slope where the community of bathyal mud is the characteristic one: typical rays are R.oxyrinchus and R.clavata.

In respect to the average fishing yield, R.clavata is the predominant species with CPUE over 4 kg/hour; this is also confirmed by the studies carried out on the daily landing of fish in Livorno: R.clavata actually represents 60-70 % of the traded rays whereas the presence of other rays in the fish market is just occasional: Some commercial importance are also due to R.miraletus, R.asterias and R.Polystigma (CPUE up to 1 kg/h).

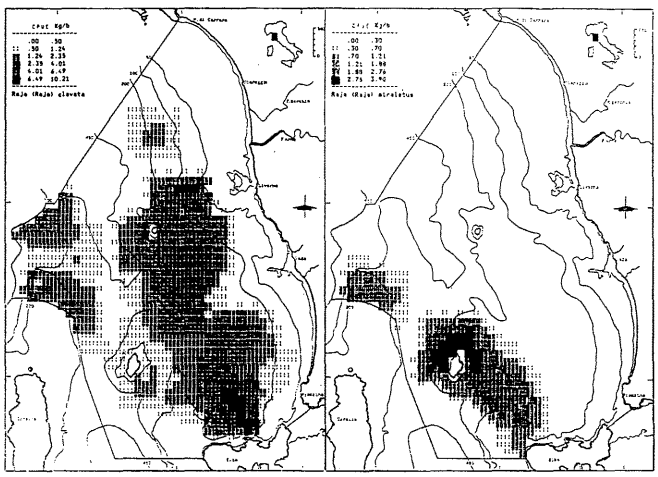

Fig. 2:Geographical distribution of the most important rays in the surveyed area.R.clavata (left), R.miraletus (right).

The geographical analysis (fig.2) brings to conclude that the Corsican shelf and the surrounding slope-edge show the presence of all the six species of rays: the only exception is R.montagui which is characteristic in the coastal zone, south of the Secche di Vada: R.miraletus is common in the shelf off the Capraia Island too, and R.clavata is distributed in the whole surveyed area.

The greatest concentrations usually correspond to the zones where the medium individual weight is higher, and the average weight of fished specimen do not exceed 0.5 kg: exceptions are R.montagui (2 kg) and R.clavata at higher depth. Actually the R.clavata has to face an intense fishing pressure along the shelf-slope edge (200-300 m), where the fishery is particularly attracted by high yield of cephalopods, gurnards, gadoids etc., where the fishing effort is lower (i.e. 400- 700 m) the medium individual weight of R.clavata raises over 5 kg.

Trawl catches off the Western Greek Coast

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Information is provided on trawl catches in the gulfs of Patraikos and Korinthiakos and in the Ionian Sea, from September 1983 to June 1984.

Gadidae species predominated in the three areas, particularly in the Korinthiakos Gulf, where they reached 90% of the total number of individuals (Fig.1). In the Patraikos and the Ionian, Centracanthidae and Sparidae came next throughout the year. Carangidae seemed to be numerous in September and December and Triglidae exhibited maxima in

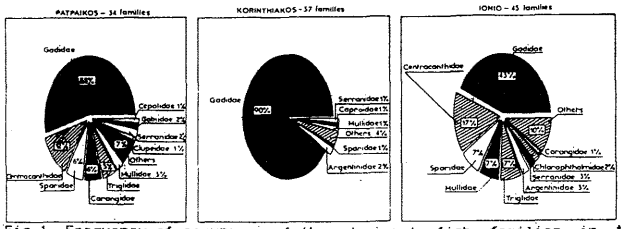

Fig.1. Frequency of occurence of the dominant fish families in the gulfs of Patraikos and Korinthiakos and in the Ionian Sea (1983-1984).

December in the Patraikos, while in the Ionian Mullidae, Triglidae, Argentinidae and Serranidae appeared with a certain regularity. In the Korinthiakos, Mullidae, Sparidae, Argentinidae, Caproidae and Macrouridae were also present, while all other families were represented by very few individuals.

During the summer there were 69 species in the Ionian and 50 in the Patraikos, while in the winter they became 36 and 37 respectively. In the Korinthiakos the number of species was between 47-52. The main species of the Patraikos (Fig.2) was Merluccius merluccius, which predominated during all four cruises, diminishing from December till

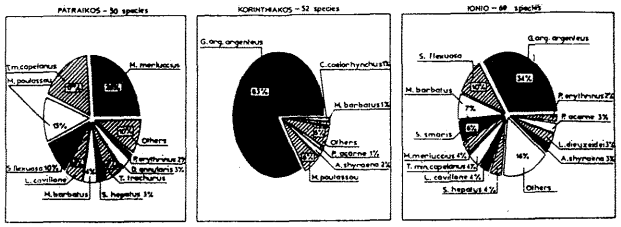

Fig.2. Frequency of occurence of the dominant fish species in the gulfs of Patraikos and Korinthiakos and in the Ionian Sea (1983-1984).

June. Trisopterus minutus capellanus and Spicara flexuosa appeared in relatively high proportions; Micromesistius poutassou, having very few individuals from September till April, made a strong contribution in June up to 52% in the total catches. In the Korinthiakos (Fig.2), Gadinculus argenteus argenteus dominated; all other fish represented a small percentage of the catch. Species with limited, but constant appearance were Pagellus acarne, Mullus barbatus, Argentina shyraena and Coelorhynchus coelorhynchus. M. poutassou accounted for a significant portion of the December catches in this area, while its presence remained to quite low levels during the other three sampling months. The abrupt increase in the number of individuals of this species in the Patraikos in June and in the Korinthiakos in December, in combination with the fact that it exists there in very small numbers during the rest of the year leads to the assumption that this fish shifts from one gulf to the other. In the Ionian (Fig.2), G.argenteus also predominated, except December, when no G.argenteus was caught. S.flexuosa, M.barbatus and S.smaris represented an important part of the Ionian catches. Generally, in the Patraikos and in the Ionian the numbers of species and individuals were rising during the June - September period, fact related to the prohibition of trawl fishing in those areas after June.

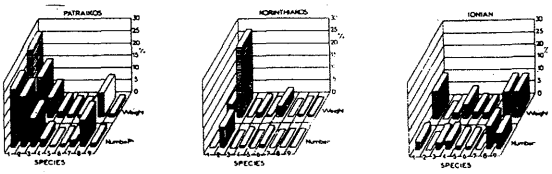

Fig.3. Proportions of numbers and weights of the commercial species in the gulfs of Patraikos and Korinthiakos and in the Ionian Sea (1983-1984):1:M.merluccius, 2:M.poutassou, 3:T.capellanus, 4:M.barbatus 5:P.erythrinus, 6:P.acarne, 7:D.annularis, 8:S.flexuosa, 9:S.smaris.

Figure 3 shows the numbers and weights of the commercial species of the three areas. In the Patraikos they reached 70.8% of the total in weight and 79.5% in number. Hake was the most important. The Korinthiakos exhibited low proportions of commercial species, with the exception of M.poutassou in the December catches. In the Ionian, the catches held mostly S.smaris and S.flexuosa, then M.merluccius M.barbatus and T.capellanus. These observations indicate that, of the three areas, the Patraikos has the highest fishing interest. The fact that, in this area, the proportions in weight of the commercial species are quite larger than the proportions in numbers in comparison with the Patraikos, where the two proportions were nearly the same, corroborates the view that the latter is an area of concentration of young individuals(Papaconstantinou et al.,1987).

The index of similarity (Qs) was used as a measure of difference between catches from the three areas and was calculated according Jardas (1985). ws ranged between 73.1-77.3 and was higher in areas geographically closer, thus presenting the lowest value (73.1) between the Korinthiakos and the Ionian and the highest between the Patraikos and the Korinthiakos (77.3).

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La pêche en Catalogne (NE Espagne)

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La presente étude fait partie du programme "La pesca en Cataluña" subventionné par la Direction Générale XIV de la Communauté économique Européene.

La côte catalane presente 552 Km. de littoral, avec un profil topographique très irrégulier. La ligne côtière est parallèle à celle de l'orographie, et 62% du littoral presente une topographie de côte basse avec des plages de sable. Le relief de la zone plus septentrionale (jusqu'à Blanes) est très escarpé, le largeur de la plateforme continentalle oscille entre 3 et 11 milles et la pente du talus, parfois très prononcée, est située près de la ligne côtière. Le reste de la côte présente, en general, une plateforme continentale de 35 milles de largeur, le début de la pente du talus est pourtant plus eloigné de la côte et plus faible. Il y a 25 villes avec port de pêche en Catalogne, mais l'activité maritime se concentre dans 11 ports seulement. Il existe aussi 12 villes sans port de pêche mais ou l'activité maritime n'est pas négligeable.(Fig. 1). La pêche en Catalogne est multispecifique, avec une grande variabilité d'engins de pêche qu'on peut classer en trois groupes: les chaluts, les filets tournants, et les petits métiers (le filet trémail, la palangre, le "cadup", la "sonsera", le "rastell", etc.). Les deux premiers groupes représentent 75% des captures totales, et les petits métiers 25% seulement, alors que ces derniers représentent 60% de la flottille. La composition de la flottille de Catalogne (d'aprés l'Annuaire des Pêches Maritimes, 1983) est de 2018 bateaux (458 pour le chalut, 240 pour les filets tournants et 1320 pour les petits métiers), avec un TRB de 27806 et un HP de 198115.

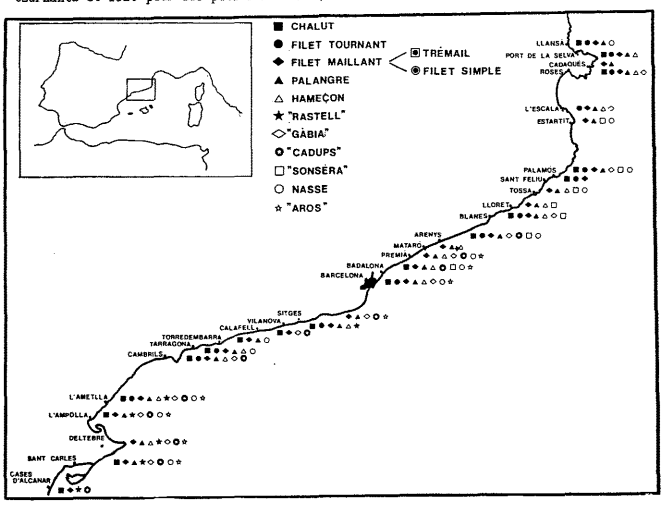

Fig. 1.- Relation des différents arts utilisés en la côte catalane

ROTATION DES ARTS DE PÊCHE. Les petits métiers sont utilisés, en general, d'une façon alternative, ou bien complementaire, les uns par rapport aux autres (Fig. 2). Les trémails sont utilisés pendant le printemps et l'été pour Penaeus kerathurus, le grand rouget (Mullus spp.), la dorade (Sparus aurata), le loup (Dicentrarchus labrax), la petite sole (Solea V. vulgaris), la langouste Palinurus elephas) et en automne-hiver pour le petit rouget, le grand sole, et la seiche (Sepia officinalis). Les filets simples sont utilisés au printemps et en été pour pêcher le rouget, le pageot (Pagellus acarne), et le merlu (Merluccius merluccius), celui ci jusqu'à l'automne, et en automne-hiver pour la dorade, le loup, et le marbre (Lithognathus mormyrus). Les palangres sont calées pendant toute l'année, seul le "palangró" (petit palangre de fond) est utilisé en hiver pour la pêche des loup, daurade et des autres Sparidae. Ces trois arts de pêche sont les plus utilisés dans les petits métiers. D'une façon complementaire il y a les "cadups" pour la pêche du poulpe (Octopus vulgaris) en automne-hiver, les nasses pour le poulpe et la langouste en automne et pour la seiche au printemps et en été, et les "aros" pour Nassa variabilis pendant l'automne, l'hiver et le printemps. Le "sonso" (Gymnammodytes cicerelus) est pêché à la senne pendant toute l'année, sauf en Decembre et Janvier. Les "gàbies" et les "rastell" (sorte de dragues) sont specifiques de la pêche aux mollusques bivalves et gasteropodes. Elles sont utilisées d'une façon indépendante par rapport aux autres petits métiers.

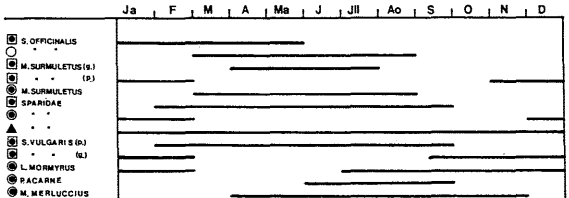

Fig. 2.- Alternance des petits metiers groupes par espèces cibles.

LES PLUS IMPORTANTES ESPÈCES CAPTURÉES. La capture totale pendant l'année 1985 en Catalogne fut de 52036.703 Tn. (d'aprés Annuaire Pêche Maritime, 1985). Les plus importantes prises par rapport au poids total des captures furent les poissons (59.5% les petits pelagiques et 30% les demersaux), suivis des mollusques (8.5%) et des crustacés (2%). Ce sont les poissons pelagiques, principalement la sardine (Sardina pilchardus) (40.2% des prises de poissons) et l'anchois (Engraulis encrasicolus) (10.9%), qui sont les plus pêchés. Quant aux espèces demersales ce sont le merlu (4.5%) et le merlan bleu (Micromesistius poutassou) (5.5%) les plus capturées. Chez les mollusques ce sont les cephalopodes (O. vulgaris et Eledone cirrhosa) (50.3% des prises de mollusques) et les moules (Mytilus spp.) (14%) qui proviennent la plus part d'élevage, qui sont pondérants. En fin chez les crustacés les plus captures sont constituées de crabes (Macropipus spp.) (31.5% des prises de crustacés) et de crevette rose (Aristeus antennatus) (30.5%).

REMERCIEMENTS: Nous remercions à Mme. E. Henrich la traduction du manuscrit.

La pêche dans la région de Valence (Espagne-Est)

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La presente étude fait partie du programme "La pesca en Valencia" subventionné par la Direction Générale XIV de la Communauté économique Européene.

La communauté Valencienne a un littoral de 463 Km. Près de Valence il y a la lagune Albufera, et à Sta Pola, Calpe, Torrevella, la Mata on trouve des Salines. Il existe aussi de petites îles comme celle de Tabarca, et l'archipel des Columbretes. Il y a au total 21 ports, bien que certaines zones de pêche en soient dépourvues. Les activités sont dirigées par des confréries au nombre de 22. La pêcherie est multispécifique, avec une grande diversité, non seulement par rapport au nombre des espèces, mais aussi par rapport aux engins de pêche, et à la façon de les utiliser. (Fig. 1) La production totale de la Communauté Valencienne était en 1987 de 45.000 Tn. La capture des crustacés est fondamentale dans la partie sud du littoral de la communauté (de Sagunto à Guardamar). Dans la zone Nord (de Vinarós à Borriana) c'est l'espèce *Penaeus kerathurus* la plus importante; la pêche de cette crevette est en train de diminuer actuellement. En ce qui concerne les mollusques, la zone la plus importante est celle comprise entre Cullera et Gandia, et c'est à partir de Denia que cette pêche commence à se practiquer. Dans la province de Castellón, le port le plus important en volume de captures est celui de Castellón, qui a une des flottilles plus importante. On peut remarquer une augmentation de l'intérêt pour le secteur de la pêche dans le port de Borriana; la diminution du nombre d'embarcations dans le port de Vinarós, et la grande variabilité des captures dans les autres ports avec une pêche peu importante de mollusques et de crustacés. Dans la province de Valence, le port le plus important au niveau des captures est celui de Valence. Cullera et Gandia sont remarquables pour leur flottille, en dominant les trémails, et les "gàbies" (espèce de drague) pour la capture de *Chamelea gallina*. Dans la province d'Alacant, la criée qui a le volume le plus important des ventes est celle de la capitale. Celle ci accueille des flottilles d'autres ports sourtout des palangres de *Xiphias gladius* qui representent le 40% de la totalité de ventes. Le port de Sta. Pola a la flottille la plus importante en TRB, HP et en unités de pêche.

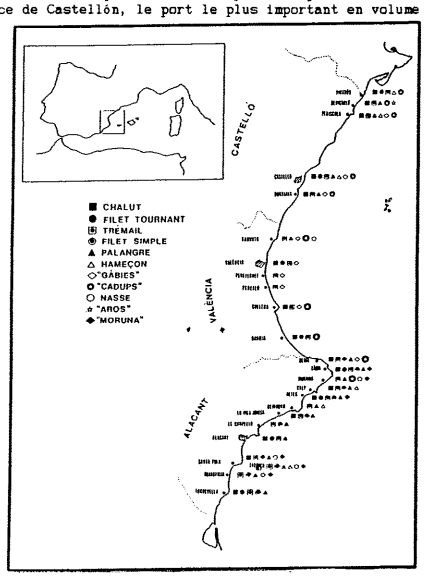

Fig. 1.- Relation des arts utilisés.

FLOTILLE: Selon les sondages dans la Communauté Valencienne, les engins qui representent le plus forte nombre d'embarcations sont les petits métiers (51.7%): filet

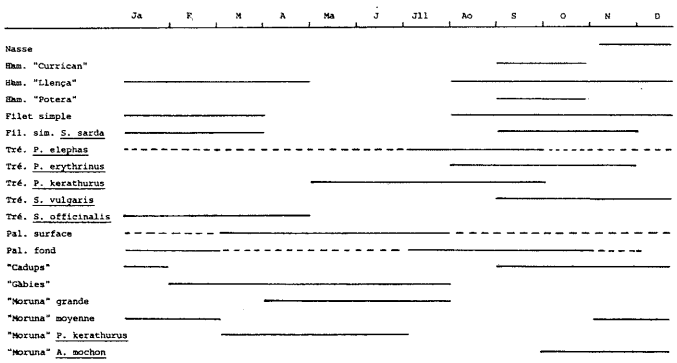

Fig. 2.- Alternance des petits metiers pendant l'année.

trémail, palangre, etc. Le chalut (39.3%) est la deuxième modalité de pêche de la communauté, et le premier pour les captures. Le filet tournant (9%) est peu pratiqué, et il est utilisé par des barques provenant d'Andalousie et de Murcia. L'âge moyen de cette flottille est de 20 années. La composition de la flottille de la Communauté Valencienne (d'aprés 1987) est de 1090 bateaux (458 pour le chalut, 240 pour les filets tournants et 1320 pour les petits métiers), avec un TRB de 31885.89 (82.8% pour le chalut, 11% filet tournant et 6.2% petits metiers) et un HP de 187092 (79.4% chalut, 10.9% petits metiers et 9.7% filet tournant).

PETITS METIERS: Les pêcheurs aux petits metiers changent d'engins de pêche tout au long de l'année selon l'époque, et les espèces cibles. Il existe une grande diversité de petits métiers qui augmente vers le sud, sourtout en filets maillants. Le poulpe (*Octopus vulgaris*) est pêché avec des engins denommées "cadups" et *Chamelea gallina* avec des "gàbies". (Fig. 2)

ESPECES: Les prises par rapport au poids en 1987 furent: 88.9% les poissons, 8.4% les mollusques et 2.7% les crustacés. Le nombre d'espèces commerciales est de 25-30.Les plus importantes sont la sardine (*Sardina pilchardus*), l'anchois (*Engraulis encrasicolus*), *le merlan bleu* (*Micromesistius poutasou*), le rouget (*Mullus sp*), le merlu (*Merluccius merluccius*), et la sole (*Solea vulgaris*). Il y a des espèces saisonnières comme l'anchois (*Engraulis encrasicolus*), et le merlan bleu (*Micromesistius poutasou*) qui sont deux des espèces les plus importantes en volume de pêche conjointement avec la sardine. La pêche du rouget est très forte à la fin d'été et au debut d'automne. Le bonite (*Sarda sarda*), le thon (*Thunnus thynnus*) et *Chamelea gallina* sont aussi des espèces saisonnières.

REMERCIEMENTS: Nous remercions à Mme. E. Henrich la traduction du manuscrit, et à nous collègues M. Demestre, P. Sánchez, L. Recasens et P. Martín pour nous aide dans la confection de cet note.

Note préliminaire concernant la pêche de Gymnammodytes cicerelus en Catalogne (NE de l'Espagne)

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Le presente étude fait partie du programme "La pesca en Cataluña" subventionné par la Direction Générale XIV de la Communauté économique Européene.

DESCRIPTION DE L'ENGIN ET MANOEUVRE DE PêCHE. C'est une senne (*) utilisée presque uniquement pour la pêche du lançon (*Gymnammodytes cicerelus*). Cette senne a une structure de chalut (1 poche et 2 ailes) mais sa manoeuvre en pêche est celle d'un filet tournant. La longueur total de l'engin est d'environ 150 m, avec des ailes de 80 à 100 m de long sur 12 m de haut, et une poche de 20 à 50 m de long. La poche a une maille plus bouchée appelée "mantellina" qui permet sa ouverture.

Les fonds de pêche sont couverts de sable grossiere et ont une profondeur de 2 à 15 m. L'engin est lesté pour que le bourrelet touche le fond et que la relingue de flotteurs reste en surface. On detecte le lançon avec une sonde puis on verifié qu'il s'agit du lançon et non de juveniles de sardine ou d'anchois à l'aide d'une instrument appelé "mirall" (cône qui porte un verre à sa base). Après, on cale le filet en immergeant progressivement une aile puis la poche et finalement l'autre aile pour entourer le banc de lançon. L'engin est alors tiré par un cabestan placé dans l'axe longitudinal ou transversal de la barque. Durant la manoeuvre on moulle une petite ancre dans le sens opposé à la traction pour éviter que le bateau ne passe sur le filet. La "sonsera" est l'unique senne autorisée par la loi de 1987.

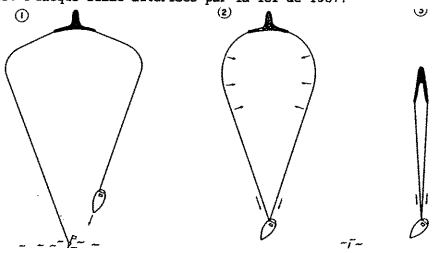

Fig.-1. Schéma du fonctionnement de la senne.

LA FLOTTILLE DE PêCHE.

En Catalogne on a denombre seulement 26 barques pêchant lançon. Elles sont reparties dans les ports suivants: Palamòs, Blanes et Arenys et sur les plages de Tossa, Lloret et Calella. La zone de pêche atteint L'Estartit (Fig. 2). Les embarcations ont 7 à 8 m de long et uns puissance de 40 à 70 H.P. L'equipage est de 2 ou 3 hommes.

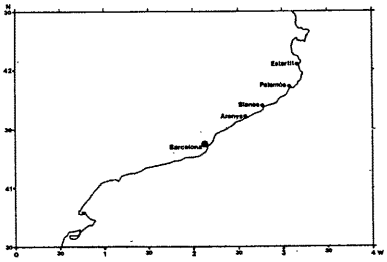

Fig.-2. Zone de pêche du "sonso".

LA PêCHERIE DE *GYMNAMMODYTES CICERELUS*. La pêche est localisée à quelques endroits de la côte catalane. Elle n'est pas pratique ailleurs en Méditerranée. Le lançon est capturé toute l'année, sauf pendant la période de reproduction (decembre-janvier). Durant ces mois on pêche alors la "llengueta" (*Crystallogobius linearis*) parfois jusqu'en avril. Dans les captures on peut aussi trouver d'autres espèces comme le pageot (*Pagellus spp.*), le calmar (*Loligo vulgaris*), la vive (*Trachinus spp.*), le poulpe (*Octopus vulgaris*), la barbue (*Scophthalmus rhambus*) et la bogue (*Boop boops*). Au cours de una journée de pêche on cale de 3 à 10 fois le filet, chaque manouvre dure 15 à 45 minutes.

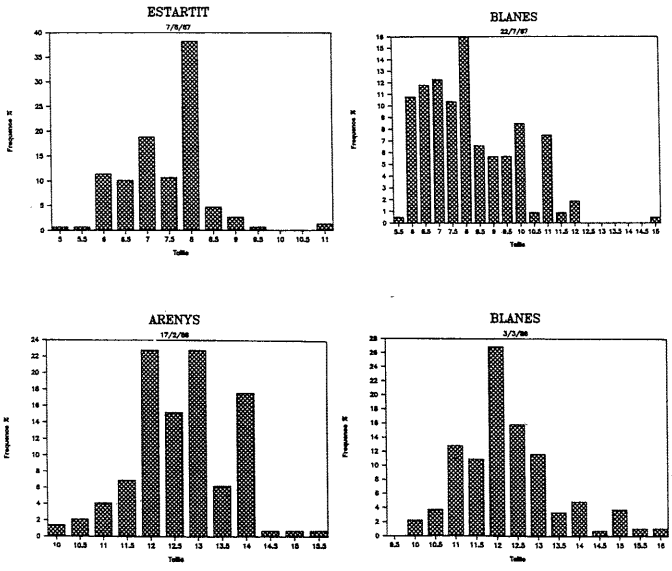

Fig.-3. Frequences des tailles du lançon en l'été et en l'hiver.

FREQUENCE DE TAILLES. Dans les zones echantillonnées les exemplaires pêchés en hiver sont plus grands que ceux récoltés en été mais les individus ont la même taille s'il sont pêches à la même époque. (Fig. 3)

REMERCIEMENTS: Nous remercions à Mme. E. Henrich la traduction du manuscrit.

* Nomenclature d'aprés Catalogue des engins de pêche artisanale. FAO,1975.

On the dynamics and management of the 0 group Hake (Merluccius merluccius) off the W. Coast of Greece

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INTRODUCTION

The hake (Merluccius merluccius L.) ranks among the most important commercially species in Greek Seas, amounting to some 1200 tonnes annually. The biology and the feeding habits of the species have been studied intensivelly for the last years (Caragitsou & Tsimenidis, 1977; Tsimenidis et al., 1978; Tsimenidis et al., 1985; Papaconstantinou et al., 1986; Papaconstantinou & Caragitsou, 1987). This paper presents results on the seasonal migration and fluctuation in abundance of 0 group hake in the Patraikos Gulf (nursery ground), and their implications to fishing management.

MATERIAL AND METHODS

A general fishing survey of the study area started in June 1983. From June 1983 to June 1985, year round trawl samples were taken at collecting stations, at approximately three month intervals. Trawl samples were taken in three areas, the Patraikos Gulf, the Korinthiakos Gulf and the Ionian Sea, by means of a 425 HP commercial trawling vessel. A 60 m trawl, with 28mm stretch mesh bag, was used to make 30- 45 min hauls at each stations. Age was determined from otolith readings. Total mortality estimates were obtained from the catch-curve methods (Ricker, 1975; Pauly, 1980), while natural mortality from Pauly's (1980) method.

RESULTS AND DISCUSSION

The abrupt reduction of the abundance of 0 age group between September and December in Patraikos Gulf, can not be attributed to the trawl fisheries, because the samples were taken in September, as also just before (end of November) or after the start of the fishing season which, in this area, extends from 1st December to 31th March. Therefore, the reduction of hake must be attributed to reasons, except fishery, as movement in neighbouring region or natural mortality.

From the seasonal distribution of the 0 group any substantial movement of the group from the Patraikos to Korinthiakos Gulf or Ionian Sea between September and December can be concluded. Limited movement to- wards Ionian Sea seems to take place with the start of the next spring and particularly towards the sea area close to Patraikos, with depth up to 130 m. This area, as the seasonal length distribution analysis proved, is the mixing area between two different hake population coming one from the Patraikos gulf and the other from the Ionian. These two populations differ almost by six months at the time of recruitment.

Movement of the 0 group from Patraikos to Korinthiakos Gulf seems to be rather improbable due to the geomorphology of the area (strait Rio - Antirio); also hake with length between 160-190 mm was found during winter simultaneously in the whole area of the korinthiakos Gulf, which is rather large, something which indicates that the hake was born in the Korinthiakos area.

The recruitment of the 0 group in Patraikos starts in June, becomes maximum in September and reduces substantially in December, despite the fact that the area is not fished (Table 1); therefore this reduction can only be attributed to the natural mortality. This conclusion is very important because it allows the evaluation of the

TABLE 1. Total mortality of 0 and 1 group hake in the Patraikos Gulf.

Round	No specimens	Total mortality	Round	No specimens	Total mortal
June 1983	399	0.845	June 1984:	1228	0.887
September	6363	1.302	September:	4276	1.502
December	760	1.089	November :	1812	1.011
March	576	1.020	March :	976	1.133
June 1985	1448	0.788	: - :	-	-

seasonal variation of abundance. Natural mortality, which is by definition constant, depends on two factors (a) number of hake recruits and (b) environmental factors. The first factor seems to be variable in time as low natural mortalityis observed in summer and high mortality in autumn which is mainly attributed to the high densities of young hake. In November - December a sharp decline in the abundance of young hake occurs as shown by the slope of the catch -curve. This decline is associated with the decreasing abundance of young hake with size, as the number of mature hake is small and does not undergo seasonal oscillations. The second factor is considered rather constant. There are indication that the natural mortality of the 0 group in Patraikos Gulf is due to the feeding habits and to food shor- tage. Young- of-the-year hake preyed mainly on euphausiids and mysids. The abundance of the last two invertebrates is the reason making this area the nursery ground for the hake. As a result of the continous incre- ase of the abundance of the 0 group and the growth of each individual, euphausiids and mysids are not enaugh for their feeding and therefore increase fish mortality. Besides, in the area the presence of decapods and fishes which form the main prey of the larger hake is rather limited to support such a large population.

These findings have significant value for the fisheries management of the Patraikos Gulf, because this substantial quantities of the 0 group hake should fished and not left to natural mortality.

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The relations of the Hake (Merluccius merluccius /L./), the Blue Whiting (Micromesistius poutassou/Risso/) and the Poor Cod (Trisopterus minutus capelanus/Lac./) to the depth and bottom in the Adriatic

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The catches of the studied fishes were obtained within the otter-trawling of the "Hvar" Fishery biological expedition, 1948 and 1949, mainly in the central and southern offshore Adriatic, at depths from 20 m to 382 m and at a mean depth of 125 m (KARLOVAC,O., 1956; MUŽINIĆ and O.KARLOVAC, 1975). The means between the initial and final bottom depths of the hauls were used. Most of the hauls lasted 50-70 min. As small catches (<500 g) were omitted (KARLOVAC,O., 1959), the data on catches of blue whiting and poor cod are incomplete. Extreme total lengths for the hake catches were available (KARLOVAC, O., unpublished data). Lower limits in the 1 cm classes were applied. The standard deviations are used with the means.

The hake was present in 98% of the "Hvar" catches (MUŽINIĆ and O.KARLOVAC, 1975). In the 150-199 m interval 23% of the catches with 50% of the individuals were taken and in the 100-149 m interval 34% of the catches containing only 25% of the individuals; 25% and 8% of the catches from the 50-99 m and 200-249 m intervals included only 8% and 9% of the individuals (from unpublished data of O.KARLOVAC). Thus, the greatest number of the catches was recorded in the 100-149 m interval and that of the individuals in the 150-199 m interval.

The unique or dominant mode in most of the larger hake catches did not exceed 20 cm (KARLOVAC, J. and O. KARLOVAC, unpublished data). Some relation of the length range to the depth in the "Hvar" area was recorded (MUŽINIĆ and O. KARLOVAC, 1975). The hake from the waters exceeding 150 m showed the mean lower and upper lengths of 6.6 ± 4.87 cm and 56.2 ± 16.54 cm, and those from the waters of less than 100 m 13.7 ± 6.73 cm and 38.5 ± 10.00 cm (from unpublished data of O. KARLOVAC).

The 47 catches containing blue whiting were recorded at depths from 141 m to 382 m, mostly from the 150-249 m interval and at a mean depth of 201 m (MUŽINIĆ, 1984).

In 24 catches with blue whiting from the 150-199 m interval 50% of the individuals were found and in 14 catches from the 200-249 m interval 22% of the individuals; however, only 3 catches from the 300-349 m interval included 25% of the individuals. In spite of the small number of catches and extremely variable numbers of individuals in them, a preference of the species for greater depths is obvious. The catches were made in the wider Jabuka Pit area (31) and southwards (16). However, the blue whiting was recorded in the shallow north-eastern channels (ZEI, 1949; CRNKOVIĆ, 1959, 1970).

In the wider Palagruža I. waters the length of the blue whiting was 7-26 cm (rare exceptions >22 cm) (MUŽINIĆ, 1984) and it might have been rather small in the whole "Hvar" area too.

The 121 catches with poor cod were made at depths from 46 m to 258 m, mostly from the 100-199 m interval and at a mean depth of 140 m (MUŽINIĆ, 1984).

The 36% of the poor cod catches from each of the 100-149 m and 150-199 m intervals contained 28% and 48% of the individuals; in the 17% and 8% of the catches from the 50-99 m and 200-249 m intervals 9% and 14% of the individuals were found. However, the fish is also caught in the shallow inshore waters of the eastern Adriatic.

In the wider Palagruža I. waters the poor cod showed a length of 3-19 cm (MUŽINIĆ, 1984) and it might also have been rather small in the whole "Hvar" area. From an early sexual maturity in the poor cod from the north-eastern channels (KOTTHAUS and ZEI, 1938; ZEI, 1940) a separate dwarf population was presumed (MUŽINIĆ, 1984).

The catches of the hake, the blue whiting and the poor cod were taken above sandy and muddy bottoms. 53%, 87% and 67% of their catches realized above a muddy bottom included 69%, 73% and 75% of the individuals respectively. In the "Hvar" area the muddy bottom was recorded, with a few exceptions, at mean depths from 150 m to 199 m (data of MOROVIĆ, 1951). Therefore, a preference for such a bottom could not be presumed.

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V-II48

Effets des perturbations hydrologiques et climatiques sur la production halieutique du lac Ichkeul (Tunisie)

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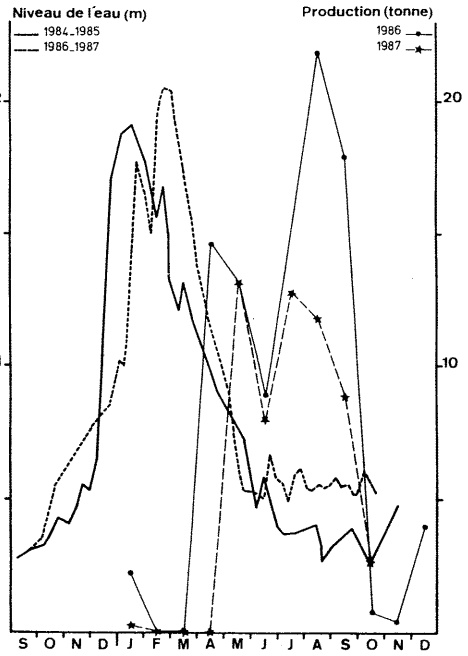
Le lac Ichkeul qui fait partie du complexe lagunaire du nord de la Tunisie est une dépression allongée de 15 km de long et 7,5 km de large couvrant une superficie moyenne de 95 km2 avec un profondeur d'environ 1,30 m.

Il est alimenté en eau douce principalement par les apports des oueds qui drainent un vaste bassin versant (1500 km2) qui lui est associé et en eau marine par l'intermédiaire du lac de Bizerte auquel il est relié par l'oued Tinja. Ces apports d'eau, régis suivant des cycles saisonniers par les conditions climatiques, se font de la manière suivante : en hiver et au printemps (de décembre à mai) lorsque les apports d'eau douce sont supérieurs à l'évaporation, le niveau du lac monte et on assiste à un courant sortant de l'Ichkeul vers le lac de Bizerte. En revanche, pendant l'été et l'automne (de juin à octobre) quand l'évaporation l'emporte sur les apports d'eau douce, le niveau d'eau baisse et il y a un courant entrant d'eau marine.

Cette alternance du sens du courant se traduit entre autres par une variation saisonnière importante de la salinité qui oscille entre 3,5 et 36‰.



Variations annuelles du niveau de l'eau et de la production halieutique dans le lac Ichkeul

Du point de vue de la pêche, le lac Ichkeul assure une production dont la valeur moyenne calculée pour la période 1961-1988 a été estimée à 128 tonnes de poissons, notamment des muges (68%) et des anguilles (25%). Les muges étant capturés le long de l'année au moyen de filets trémails mais surtout à la bordigue au moment de leur migration reproductrice vers la mer principalement en août-septembre. Les anguilles étant pêchées essentiellement à l'aide de barrages de nasses.

L'édification, en cours, de barrages sur les oueds alimentant le lac introduira inéluctablement des modifications du régime hydrologique et, par là même, du fonctionnement de l'écosystème dans son ensemble. Déjà des perturbations consécutives à la construction du barrage Joumine ont pu être observées. La sous-exploitation de ce barrage ainsi que les fortes pluies d'hiver de 1987 ont été à l'origine d'une trop forte accumulation d'eau, ce qui a nécessité la diminution de la charge du barrage par des lachures d'un important volume d'eau (185 millions de m3). Ces lachures se sont traduites par une montée inhabituelle du niveau de l'eau dans le lac ; le courant est resté sortant jusqu'à fin septembre, date de l'arrêt des déversements. De même, la salinité a beaucoup baissé prenant des valeurs estivales et automnales inférieures à la normale, entre 4 et 8 ‰. Quant à la production en poissons de la bordigue, elle a subi une diminution nette (voir figure), vu que les muges, n'éprouvant pas le besoin ou n'ayant pas la possibilité de répondre à l'appel de la mer pour aller s'y reproduire ont échappé aux chambres de capture de la bordigue. Autres conséquences : la présence sur les berges du lac d'une quantité importante d'orphies mortes en juillet et août très vraisemblablement dûe au fait que ces poissons n'ont pu supporter une trop forte dessalure des eaux. Cette même dessalure semble au contraire avoir été bénéfique pour les potamogetons qui ont envahi de grandes étendues du lac durant l'été et l'automne.

V-II49

Allocation of gadoid fishery in Greek waters, 1964-1985

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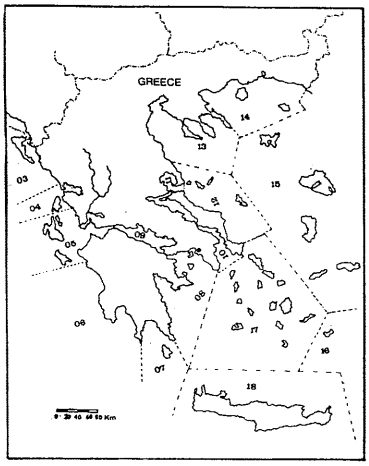
ABSTRACT

The gadoid fishery in Greek waters is reviewed for 1964-1981. The mean 1964-1981 gadoid catch amounted 1824 t. Catches fluctuated between 1010 t in 1967 and 2735 t in 1978. Catches in western Greek waters are low, less than 8% of the total catch, which is attributed to the restricted trawling activity in these areas mainly due to the restricted continental shelf and the predominance of great, steep depths. Catches are high in subareas where fishing docks exist. Mean catch along the northern rim of the Aegean Sea, where conditions for trawling are favorable, make up 37% of the mean total catch.

MATERIAL AND METHODS

Greek fishery statistics have been maintained on a monthly basis since 1964[1]. For a better evaluation of the available data, Greek waters have been divided into 16 fishing subareas (Fig. 1). Subareas 1 and 2 are referred to the Atlantic ocean and North coast of Africa respectively. Data are collected for each fishing vessel separately through the local custom authorities. The catches of the inland water and sport fisheries are not included in the grand total. In addition, since 1969, the catches of the small ring-netters, drifters and liners, with engine horsepower less than 19HP are not recorded by the local authorities (their total landings amounting some 12,000 t)[1]. Here the catches of gadoids (hake, blue whiting and poor cod) per fishing area in Greek waters is reviewed for 1964-1981. Catches for that period are referred to gadoids as a group. Since 1982 separate statistics are available for hake and blue whiting.



RESULTS AND DISCUSSION

The mean 1964-1981 gadoid catch amounted 1824 t and catches fluctuated between 1010 t in 1967 and 2735 t in 1978 (Table 1). The catches of hake rose to 2353 t, 2614 t and 3062 t in 1983-1985 respectively. Blue whiting amounted 1076 t, 837 t and 693 t during the same period. The mean gadoid catch of trawlers in 1971-1981 was 1719 t[2] which is more than 78% of the total catch in the same period (Table 1). The variation of the catches is generally high as this is indicated by the coefficient of variation (CV, Table 1). Catches in western Greek waters (subareas 3 throughout 7) are low representing together less than 8% of the total catch, which must be attributed to the restricted trawling activity in these areas mainly due to the restricted continental shelf and the predominance of great, steep depths. Mean catch along the northern rim of the Aegean Sea (subareas 13 and 14), where conditions for trawling are favorable, make up together 37% of the mean total catch. Trawling is not allowed in subarea 9 (Pagasitikos Gulf) and the northern part of subarea 10 (N. Eyboikos Gulf). The gadoid resources (hake especially) are highly overexploited in Greek waters as it is indicated by models based on biological[3] and catch-effort data[2]. Abiotic factors may also be of primary importance in driving gadoid population changes[4,5]. It has been shown[6] that catches of hake in Greek waters in 1928-1939, a period characterized by minimal exploitation pressure, were highly correlated with the air temperatures at Northern Greece. Such a relation is important in the context of the complex biohydrometeorological interactions that have been described for the Eastern Mediterranean[7,8].

TABLE 1. Catches of gadoids in Greek waters during 1964-1981. CV = coefficient of variation

YEAR	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL
1964	18	11	75	13	2	83	20	84	35	149	216	286	85	12	41	6	1138
1965	18	14	78	14	1	116	31	91	29	203	164	210	114	1	92	13	1190
1966	22	5	68	7	0	141	28	110	18	168	130	173	91	0	86	9	1058
1967	30	3	65	7	0	130	22	113	19	132	158	205	70	0	46	9	1010
1968	29	2	41	10	1	166	29	246	32	187	203	184	146	4	81	14	1374
1969	33	7	49	13	1	265	43	234	68	237	223	203	137	2	106	12	1632
1970	33	5	47	0	0	172	35	62	10	86	194	396	113	0	112	19	1283
1971	24	8	41	0	0	152	26	112	20	107	238	378	105	1	64	14	1289
1972	26	3	52	1	1	168	76	218	34	142	175	440	124	3	68	6	1537
1973	13	7	69	0	0	266	121	209	17	203	346	524	200	12	113	12	2111
1974	13	10	94	14	0	246	138	216	12	287	354	606	275	3	68	19	2352
1975	6	3	163	13	0	317	138	107	13	347	285	402	241	2	47	15	2098
1976	18	4	107	15	0	346	133	207	45	319	476	417	204	7	89	26	2415
1977	34	5	174	13	0	397	112	211	95	281	445	525	213	5	28	25	2563
1978	27	23	96	23	24	589	106	182	56	285	517	501	204	7	63	33	2735
1979	26	19	85	31	13	521	94	124	42	286	455	439	145	0	60	29	2370
1980	28	38	66	16	20	481	80	223	53	347	464	375	105	3	70	25	2395
1981	9	36	124	24	12	404	124	150	48	128	568	446	113	4	58	31	2278
mean	23	11	83	12	4	276	75	161	36	216	312	373	149	4	72	18	1824
%	<1	<1	5	<1	<1	15	4	9	2	12	17	20	8	<1	4	1	
min	6	2	41	0	0	83	20	62	10	86	130	173	70	0	28	6	1010
max	34	38	174	31	24	589	138	246	95	347	568	606	275	12	113	33	2735
CV	36	93	45	72	177	53	59	37	61	38	44	35	38	98	33	49	

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Spectral analysis of Pilchard catches in Greek waters, 1964-1982

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ABSTRACT

Spectral analysis of Greek monthly catches of pilchard for 1964-1982 revealed a strong seasonal pattern and a 3.3-year periodicity. The latter is common for the Mediterranean pilchard, and probably reflects variations in both abiotic and biotic variables that affect pilchard recruitment and exhibit oscillations of similar frequecies.

INTRODUCTION

The fishery of pilchard in Greek waters for 1964-1982 has been reviewed by STERGIOU[1]. Mean annual catch amounted 11,390 tons, 87.6% of which is attributed to the purse seine fishery (=34.8% of the total purse seine catch) and 12.4% to the trawl fishery. The present work presents a spectral analysis of monthly catches (1964-1982) of pilchard in Greek waters in order to identify significant frequencies in the variability of the catches.

MATERIAL AND METHODS

Monthly catches of pilchard for 1964-1982 were gathered from the National Statistical Service of Greece[2]. Spectral analysis subdivides the variability of a time series among frequency bands. The technique used in the present study is Fast Fourier Transform. The mean has been subtracted from the series. The periodogram is scaled such as if the mean of the series is zero then the sum of the periodogram ordinates will equal the sum of the squares of catches.

RESULTS AND DISCUSSION

Pilchard catches exhibit a marked seasonal pattern (Fig.1). From the periodogram of the monthly catches (Fig.2) it is evident that there is a large major peak at 12 months (the fundamental frequency). The seasonal pattern of variation is mainly related to the behavior of pilchard and the nature of the purse seine fishery in Greek waters. The area where fishing by means of purse seiners takes place is mainly determined by the fact that catches must be brought to fishing docks early in the morning in order to be supplied to the market in time[3]. Hence, fishing activity does not extend to the open sea but it is rather restricted to coastal areas where schools of pilchard (and anchovy) migrate on a seasonal basis. The mass occurrence of pilchard in the coastal areas takes place in March-May, schools disperse in summer and appear again in September[3].

The amplitude of the seasonal changes is larger than the year-to-year changes (Fig.1) and hence harmonics with frequencies less than 1 cycle/year are produced (Fig.2) which indicate the non-sinusoidal character of the main cyclical component. The periodogram of the catches after seasonal differencing (=removal of the seasonal effect by subtracting the catch that occured one season prior to the current catch) exhibits a prominent peak at 3.3 years (Fig.3). A 3-year periodicity in the abundance of pilchard has been found also in the Adriatic Sea, although fluctuations with periods of 8 and/or 11 years were considered prominent[4,5]. Oscillations of periods of 3 years have been also identified for other biotic (e.g. zooplankton,[6] fish[7]) and climatic variables (e.g. air pressure and temperature,[6,7] sea temperature and salinity[6]).

The phenomenon of periodicity exists on a widespread scale and is propably related to abiotic factors[7]. Zupanovic[4] suggested that the 3-year periodicity of pilchard catches in the Adriatic Sea is related to cold winters, whereas periodicity with longer wavelengths is associated with world wide climatic trends and changes in the advection of Mediterranean waters into the Adriatic Sea, which greatly affect productivity and, hence, influence the spawning and survival of the early stages of pelagic fish in that area[4,5]. It is worthy of mention that a 3-year cycle is also suggested for zooplankton temperature and salinity in the Adriatic Sea[11]. The 3-year cycles in plankton abundance in the NE Atlantic -North Sea was found, using cross spectral analysis, to be associated with surface heat exchange phenomena[7].

Although the information hitherto presented is not complete, it seems that 3-year periodicity in the abundance of pilchard is common in the Mediterranean and probably reflects variations in the abiotic and biotic variables that affect recruitment of pilchard (temperature, productivity, etc) and exhibit oscillations with similar frequecies.

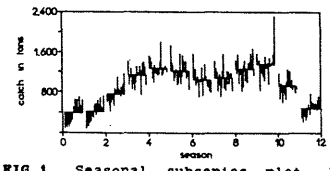

FIG. 1. Seasonal subseries plot. Each data group represents all values for one period for all months. Horizontal lines represent the average values all months. Vertical lines are plotted from the averages to the actual values for each observation

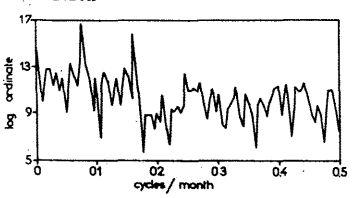

FIG. 2. Periodogram of monthly catches

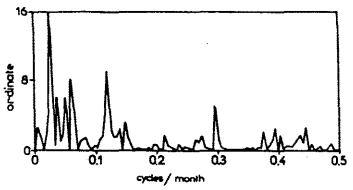

FIG. 3. Periodogram of the seasonally adjusted series

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Espèces cibles dans les petits métiers de la mer d'Alboran

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INTRODUCTION

Les pêcheries artisanales, envisagées dans le contexte méditerranéen, ont des caractéristiques bien définies sur la Mer d'Alboran (Camiñas et al., 1987). Toutefois, il ne faut pas les séparer du reste des pêcheries côtières de la Méditerranée dont elles présentes de grandes ressemblances.

Sur le littoral que s'étend entre Punta Europa, sur le Détroit de Gibraltar et le Cabo de Gata, il existe de très nombreux et très importants engins et attirails de pêche groupés de la façon suivante:

1. Filets à la traîne (1); 2. Filets à la main (4); 3. Filets maillants (14); 4. Hameçons (11); 5. Râteaux (6); 6. Nasses (2); Filets souleves (1); et 8. Autres (2).

Il y a en tout quarante et une variétés d'engins (nombres entre parenthéses) groupés en huit catégories. Cette diversité est notamment subordonnée dans la Mer d'Alboran par les faits suivants:

a) Masses d'eau de différentes caractéristiques.
b) Diversité de milieux pélagiques et benthiques.
c) Phénomènes atmosphériques.
d) Proximité au Détroit de Gibraltar.
e) Rendement des pêcheries.

- a). Nous savons fort bien que la Mer d'Alboran et le détroit de Gibraltar servent de trait d'union entre l'Océan Atlantique et la Mer Méditerranée, et qu'il se produit dans cette région d'importants échanges de masses d'eau, du fait que la Méditerranée agit en tant que bassin de concentration, ce qui enrichit la zone en question.
- b). Cet enrichissement provoque des milieux pélagiques avec des conditions de température et de salinité différentes dans les zones relativement proches, en augmentant la variété des écosystémes pélagiques. Par ailleurs, les caractéristiques des fonds ne sont pas homogénes, le plateau continental ayant une trés petite étendue. En outre, il faut y ajouter la présence, bien que sur des surfaces réduites, de toujours importantes phairies de phonérogames marines.
- c). En raison de la présence de diverses masses d'eau, et du fait des processus se rapportant á des phénomènes atmosphériques, il se produit des zones d'afleurement côtier dans le secteur compris entre "Punta Europa" et le cap "Cabo Sacratif" (sensu lato) originant un refroidissement des couches superficielles avec un accroissement de la biomasse et de la variété biologique.
- d). Finalement, par suite de la proximite du Détroit de Gibraltar, la zone dont il s'agit constitue un important lieu de passage pour un grand nombre d'espèces pélagiques migratoires qui, para ses mouvements périodiques, sont tenus de se déplacer á travers la zone d'Alboran, et se transforment en espéces objectif au cours de certaines époques de l'année.
- e). Un grand nombre du peuplement des espéces objectif des pêcheries artisanales est surexploité, ce qui fait que leur rendement soit généralement trés bas. Cet aspect conditionne aussi une rotation des engins ou leur emploi multispécifique, puisque que l'on peut même utiliser dans une seule journée de pêche de trois á quatre engins différents.

PRINCIPALES ESPECES CIBLES PAR CATEGORIES D'ENGINS

Quoique pas souvent assez sélectifs, ils sont préparés pour pêcher une ou plusieurs espéces d'intérêt commercial. Sur le tableau I sont indiquées les cibles pour chaque classe d'engin. Les filets á la main sont peu sélectifs, le but étant la pêche du "Chanquété" (alevins des anchois et sardina), mélange d'espéces des fois juvéniles et d'autres fois adultes (dites parafois fretin, en espagnol "morralla").

Les filets maillants sont les plus importants et les plus assortis qui s'emploient sur toute la région. L'on ne cherche qu'une seule espéce ("pejerreyera", "sardinal" y "pijotera"), ou bien l'on capture beaucoup d'espéces prises dans les mailles de la méme façon que les "Soltas".

Les hameçons sont eux aussi nombreux et variés, la sélectivité étant en fonction de l'hameçon employé, surtout entre les rochers ou dans les fonds de sable ou de vase.

Les râteaux ont comme espéces objectif certains mollusques bivalves, selon l'espéce objectif de leur forme et leurs dimensions, de méme que la profondeur oú la pêche est exercée.

Les autres engins, tels que nasses, filets souleves ou ceux inclus á l'Alinéa "Autres" constituent des espéces objectif trés précis, et ils sont assez sélectifs.

En résumé, l'on peut dire que sous une plus grande ou plus petite proportion et avec une importance plus ou moins grande, les espéces objectif des pêcheries artisanales du littoral sud-méditerranéen espagnol sont au nombre dúne quarantaine au minimun, et si bien presque toutes les espéces son exploitées commercialement, nous ne devons faire ressortir qu'une vingtaine (signalées d'une + sur le tableau ci-aprés).

1.- Filets á la traîne
De fond: Ratera

Besugo (Pagellus spp.)
Herrera (Lithognathus mormyrus)
Lenguado (Solea spp.)
Salmonete (Mullus surmuletus)

2.- Filets á la main
Birorta

Sardina (Sardina pilchardus)
Boquerón (Engraulis encrasicholus)

Boliche

Sardina, Boquerón
Chanquete (Aphia minuta)
Jurel (Trachurus trachurus)

3.- Filets á maillants
Fixés á une nappe ("Soltas")

Besugo (Pagellus acarne)
Boga (Boops boops)
Jurel (Tranchurus tranchurus)
Pijota (Merluccius merluccius)

Fixés á 3 nappes (Trémails)

Salmonete (M. surmuletus)
Jibia (Sepia officinalis)
Brotola (Phycis blennioides)
Jurel (T. trachurus)
Langosta (Palinurus vulgaris)

Filets derivants

Sardina (S. pilchardus) (SARDINAL)
Bonito (Sarda sarda) (BONITERA)
Volador (Cheilopogon spp.) (VOLAERA)

Filets en cercle

Pejerrey (Atherina spp.) (PEJERREYERA)

4.- Hameçons
A main: Ligne

Thonidés (Thunnus, Auxis,...)

Potera: Turluttes

Calamar (Loligo vulgaris)

Palangre

Besugo (P. acarne, P. bogaraveo)
Pargo (Sparus pagrus)
Brótola (Phycis spp.)
Cóngrio (Conger conger)
Mero (Epinephelus guazza)

5.- Dragues

Concha fina (Callista chione)
corruco (Cerastoderma tuberculata)
Chirla (Chamaelea gallina)
Almejas (Venrupis spp.)
Peregrina (Pecten maximus)
Ostra (Ostrea edulis)
Coquina (Donax trunculus)

6.- Nasses

Gamba (Aristeus antennatus)
Camarón (Plesionika spp.)
Pulpo (Octopus vulgaris)
Besugo (Pagellus acarne)

7.- Filets Souleves

Búsano (Murex brandaris)
Cañailla (Trunculariopsis trunculus)

8.- Autres

Pulpo (O. vulgaris) (PULPERAS)
Búsano (Murex brandaris) (BUSANERA)

V-II52

La pêche artisanale dans la région sud-méditerranéenne Espagnole (Méditerranée occidentale). Méthodologie et résultats

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En 1987 a été entamée l'étude des pêcheries artisanales de la région sud-méditerranéenne espagnole (1), zone délimitée entre le cap "Punta Europa" et "Cabo de Gata", intégralement comprise sur le littoral Nord de la Mer d'Alboran, division statisque 37.1.5 du C.G.P.M.

La conception de pêcherie artisanale varie largement de certains endroits à d'autres, puisque définie en fonction des qualités de la flotte, des engins utilisés et de l'infrastructure qui y est associée. Le fait détermine que, malgré de nombreux points en commun, la méthodologie employée pour atteindre les objetifs proposés est variable d'une région à une autre.

L'énorme dissimination de la flotte dans de nombreuses cales d'échouage tout au long d'une côte de plus de 350 km., l'absence d'une statistique fiable sur la composition et l'état de celle-ci, ainsi que de son activité et des variations spatio-temporelles et l'usage de différents engins de pêche par un seul pêcheur dans le courant de l'année, ont fait que les méthodes utiliser régulierement en matière d'aménagement de la pêche n'ont pas été effectives pour l'étude des pêcheries artisanales de la region faisant l'objet d'étude.

Pour avoir accès à cette information il fut convenu d'employer une méthodologie d'échantillonnage stratifié au moyen d'enquêtes de deux genres: les unes faites auprès des organismes officiels ayant des relations avec l'activité artisanale, et les autres auprés des pêcheurs eux-mêmes sur les plages et les points d'echouage.

La stratification s'est réalisée à différents niveaux afin d'optimiser l'échantillonage:
- Au niveau géographique: comme premier niveau de stratification, la région a été distribuée en sept zones géographiques avec quelques caractéristiques différenciatrices.
- Au niveau de la flotte: Celle-ci a été divisée en diverses sortes de bâteaux en fonction de sa longueur et de son tonnage.
- Au niveau des engins de pêche: Chaque groupe de bâteaux de chacune des sept zones d'échantillonnage a été à son tour sous-divisé en raison des classes d'engins employés.

Après avoir effectuées 550 enquêtes, un total de 190 plages (268,1 Km,) ont été échantillonnées. L'analyse de cette information a démontré les résultats suivants:

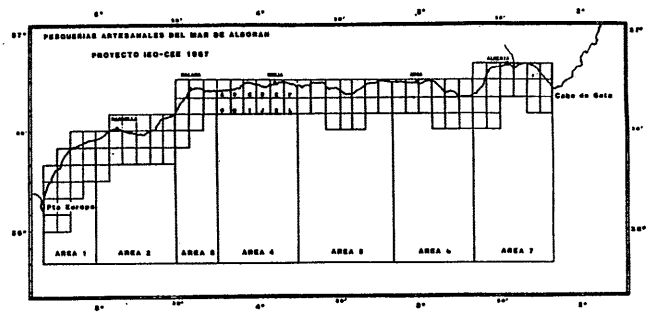
Bâteaux.- La flotte artisanale active consacrée à la pêche dans la zone échantillonnée est de l'ordre de 1.740 embarcations. Celles-ci présentent une vaste gamme de toutes formes et dimensions qui dépendent de facteurs tellement hétérogènes comme la profondeur des plages, la pêcherie à effectuer, le niveau économique du pêcheur, le constructeur et la tradition ou la coutume. Son à distinguer quatre variétés générales: "jábega", "chalana", "bote" et "motora". Le 62,7 % des bâteaux consacrés à la pêche ont une ancienneté de moins de 20 ans.

Engins.- Sont à différencier un total de 41 engins, classés conformément aux normes de la Statistique Internationale Uniforme des Engins de Pêche (I.S.S.C.F.G.) afférente à l'année 1980, et groupés en cinq grands groupes différents. Ces groupes sont les suivants: Traîne (5 engins différents). Filet maillants (14 engins); Hameçons (11 engins); Râteaux (6 engins) et "Autres" (5 engins).

Treuils.- La présence de treuils sur les plages constiue un des éléments qui distinguent le mieux la pêcherie artisanale. Il s'agit de structured rendant plus facile les besognes de mise à sec des embarcations sur les plages. L'existence plus ou moins nombreuse de treuils au long de la plage est un signe indicatif de l=activité de pêche artisanale qui s'y déploit.

Les résultats de cette étude ont permis d'évaluer d'importance que les pêcheries artisanales représentent dans la région sud-méditerranéenne espagnole, d'ou l'on peut faire ressortir comme conclusion des plus importantes que:

- Les enquêtes se sont montrées comme un facteur élémentaire pour arriver à l'informatio de base.
- L'ensemble de la population de pêche artisanale forme un groupement social très renfermé, avec une transmission, notamment oral, de tout ce qui concerne le monde de la pêche: saison de pêche, sorte d'engins, etc...
- Parmi les caractéristiques techniques de la pêche artisanale dans la Mer d'Alboran, sont à signaler le faible registre brut des embarcations et l'manque de puissance des moteurs, et comme élément fondamental l'emploi alternatif de plusiéurs genres d'engins par bâteau.
- En ce qui concerne les engins de pêche, les filets maillats se détachent en tant que groupe d'engins les plus importants existant dans toutes les zones. Les engins à râteau sont particulièrment importants sur le secteur occidental (Gibraltar-Málaga).
- Quant aux caractéristiques socio-économiques, il y a lieu de sinaler notamment le cacartère éminemment familial de la structure de l'entreprise artisanale, la vente des captures sur les palges ou directement aux restaurants et bars, et la composition hétérogène de la population composée de professionnels, de retraités y de personnes deployant une autre activité qui exercen celle-ci comme solution de choix.



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V-III1

Stratégies de reproduction chez les Tortues marines : effet de la température sur la différenciation sexuelle

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Chez les Reptiles, animaux poikilothermes, la température joue un rôle prépondérant parmi les facteurs climatiques intervenant dans la reproduction. Elle agit non seulement sur le cycle sexuel et le comportement reproducteur mais aussi sur le développement et la différenciation sexuelle. La sensibilité à la température de la différenciation sexuelle a été mise en évidence chez une vingtaine d'espèces de Tortues, deux espèces de Lézards ovipares et deux de Crocodiles (bibliographie in Rimblot-Baly et al., 1987). Toutes les espèces de Tortues marines étudiées jusqu'à présent (5 sur les 7 actuelles) se sont révélées sensibles à la température.

En ce qui concerne Dermochelys coriacea, l'incubation artificielle des oeufs à des températures inférieures ou égales à 28,75°C donne à l'éclosion 100% de mâles phénotypiques alors que 100% de femelles potentielles sont obtenues à des températures supérieures ou égales à 29,75°C. La température critique, celle où on obtient les deux sexes à partir d'une même ponte, est 29,5°C $\pm$ 0,25 (Rimblot-Baly et al., 1987).

La température critique est de 30°C pour Caretta caretta (Yntema et Mrosovsky, 1980) et probablement aussi pour Lepidochelys olivacea (Mc Coy et al., 1983). Elle est voisine de 28,75°C chez Chelonia mydas, selon Mrosovsky et al. (1984) et donc plus faible que chez les autres Tortues marines (références in Rimblot-Baly et al., 1987).

Les résultats obtenus dans la nature font apparaître une relation entre les sex-ratios observées à l'éclosion et la température du sable (à la profondeur du nid : 80 cm) pendant la période thermosensible du développement embryonnaire chez Dermochelys coriacea. Les données recueillies en Guyane française pendant quatre années mettent en évidence une variation saisonnière de la sex-ratio. Les oeufs des premières pontes se développant pendant la saison des pluies, relativement fraîche, donnent surtout des mâles ; ceux des dernières pontes pendant la saison sèche, plus chaude, donnent des femelles.

Chelonia mydas a une stratégie de reproduction différente : elle pond généralement avant la Luth pendant des mois pluvieux. Plus leste, elle se déplace entre les arbres et creuse son nid à leur ombre. Dans ceux-ci, le nombre de femelles sera réduit en saison sèche. Dermochelys coriacea fréquente rarement ces petites aires de sable entre les palétuviers, elle a des difficultés pour y circuler et risque même de s'y blesser et de mourir coincée entre les troncs d'arbre ; elle pond généralement sur des plages découvertes, donc plus chaudes.

Dans une zone, où la Luth occupe massivement les plages dégagées pour pondre, la Tortue Verte vient avant elle ou dans des secteurs ombragés, c'est-à-dire à des périodes ou dans des lieux plus frais. Elle conserve cependant la possibilité de produire les deux sexes car elle a une température critique plus basse que Dermochelys coriacea. Ces différences spatiotemporelles dans la stratégie de reproduction entre les deux espèces provoque une relative dispersion des nids qui diminue l'éventualité de leur destruction par des femelles venant creuser leur nid aux mêmes endroits.

Il en résulte aussi pour les deux espèces une sex-ratio voisine de 1 mâle : 1 femelle. Etant donné que chaque femelle pond 4 - 5 fois (jusqu'à 7 pontes chez la Luth) à une dizaine de jours d'intervalle pendant la même saison, il est probable que cette sex-ratio soit obtenue dans la descendance de la plupart d'entre elles.

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Considérations sur la présence de Tortues Luth, Dermochelys coriacea (Linnaeus, 1758), dans la Méditerranée occidentale

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Parmi les espèces de tortues marines présentes en Mediterranèe, la tortue luth (Dermochelys coriacea) est une des plus connues, principalement grâce à sa présence peu habituelle dans cette mer. La révision de l'information existente sur cette espèce en Mediterranée, indique a priori la concentration des observations et d'echouages de cette espèce dans une aire comprise entre les Balèares et la côte de Lybie, bien qu'il existe des observations isolées dans des zones voisines (Bruno, 1978). Selon la bibliographie consultèe on peut dire qu'elle est pratiquement inexistente dans les eaux de la mer d'Alboran, objet principal de notre travail.

En considérant la côte mediterraneènne de la Pèninsule Iberique et de l'archipel des Balèares il existe quatre références anciennes de cette espéce (Navarro 1941). Dans la pèriode comprise entre Aôut 1975 et Dècembre 1987, un total de 35 observations des individus de cette espéce a été recueilli parmi lesquelles dixsept (17) sont des rèfèrences nouvelles aportées dans ce trabail. De ces dixsept individus, huit (8) furent capturés avec des filets ou des palangres, six (6)furent observés, nageant dans des eaux libres. La description des rècents rèferences sera faite dans un travail posterieur, actuellement en redaction.

Car les observations de la T. L. sont saisonières, on a divisè l'année en trois pèriodes, en fonction d'une simillitude des conditions océanographiques mediterranèennes: 1. Hiver (Novembre-Fèvrier); 2. Printemps (Mars-Juin); 3. Etè (Juillet-Octobre).

A partir des 35 observations espagnoles en Mediterranée il a été effectué l'analyse suivante:

Dans le secteur compris entre le détroit de Gibraltar et la limite est de la mer d'Alboran, vingt individus ont ètè observè dont 17 pendant la pèriode d'hiver et près du dètroit de Gibraltar.

Seize tortues furent trouvées mortes, la plupart en hiver.

Dans le secteur Levante Balears la majoritè (7) des 15 observations effectuées correspond à des rèferences de la pèriode d'etè dans le triangle Cap de Gata-Baleares-delta del Ebro.

La plupart des individus out etè capturès dans cette zone avec des palangres de surface destinès à la pêche du poisson-scie et puis liberès. En pèriode d'hiver il y a deux rèfèrences d'individus morts d'echouages et au printemps on trouve certains individus capturès vivants et d'autres morts d'echouages.

En considèrant les observations de toute la mediterranèe (Oliver, De Metrio, entre autres) en plus des nôtres, le nombre total de rèfèrences est de 138 elles se distribuent gèographiquement de la façon suivante:

Mediterranèe occidentale: 108 rèfèrences; M. centrale: 27 rèfèrences; M. orientale: 3 rèfèrences et Mer noire: 0 rèfèrences.

La plupart des individus a etè observès dans le bassin occidental, le nombre tendant à diminuer à meaure que l'ou progresse vers l'est mediterranèen.

Le comportement est commun à d'autres espèces atlantiques qui sans être mediterranèennes s'introduisent dans cette mer, en se distribuant en fonction des principales ramifications du courant superficiel de lAtlantique qui penètre accidentellement en Mediterranèe, et continue vers les côtes plus septentrionales de la Mediterrànèe occidentale (côte de France, Italie et nord d'Espagne). Les rèferences plus au nord se trouvent dans le Golfe du Lion pendant les mois d'etè.

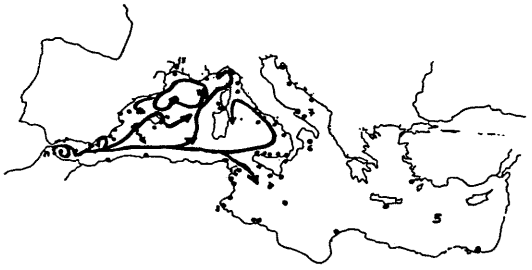
D'après Duron (1978) la principale source d'alimentation est la mèduse R. pulmo, qui aparait principalement en Mediterranèe à la fin du printemps et pendant l'etè en suivant le courant atlantique superficiel. Il paraît evident que le T.L. profite de ce courant pour se dèplacer et pour nourrir en même temps.

Toutes ces considerations nous font penser que les T.L. observeés en Mediterranée vienent de l'Atlantique et qu'elle commence à penètrer à la fin du printemps et début de l'eté.

D'aprés l'information recueillie pendant les derniéres années dans toute la Mediterranée on arrive á la conclusión que dans les mois qui vont de Mars a Juin cette espéce s´observe largement distribuée depuis la mer d´Alboran jusqu´en Egypte dans la Mediterranée orientale. A partir du mois de juillet, la plupart des références correspondent á l´aire septentrionale de la Mediterranée Centrale et Orientale, avec une présence majeure sur les côtes du Golfe de Lion et mer Jonique. Finalement, dans les mois d´hiver la plupart des observations, ont été registrées dans la mer d´Alboran prés de la madrague de Ceuta, sur la côte africaine et principalement á proximité, du détroit de Gibraltar. A cette époque on trouve aussi des références en direction á la Tunisie.

Le schéma général du comportement de l´espece, elaboré a partir de cette information serait le suivant:

Les individus qui pénétrent en Mediterranée, généralement des adultes, et en petit nombre se dévient du chemin migratoire atlantique du printemps pour rentrer en Mediterranée. Ce phénomene a lien á partir du mois de Mars. Pendant les mois de la période été-automne il atteint la distribution maximale en Mediterranée occidentale et centrale surtout sur les côtes italiennes et francaises et dans les zones affectées par les branches les plus importantes du courant atlantique penétrant. A partir du mois d'Octobre ou peut-être avant, commencerait une migration vers l'Atlantique par le détroit de Gibraltar. Tout ce processus aurait lien essentiellement en suivant les voies principales du courant atlantique superficiel qui penètre en Mediterranée.



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Post-nesting movements of loggerhead Sea Turtles tagged in Greece

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The loggerhead sea turtle Caretta caretta (L.), an endangered species in the Mediterranean, breeds regularly in Greece. The most important nesting areas are found on the island of Zakynthos and on Peloponnesus (Fig. 1). Apart from conservation measures at the nesting sites, a research project, including tagging of the nesting females, is conducted since 1982 on both areas. Tagging provides valuable information on the inter-nesting interval (Margaritoulis, 1983) and on remigration patterns of the nesting population. Furthermore, at-sea recoveries of tagged individuals might reveal feeding and wintering areas as well as migration routes in the Mediterranean, all of extreme importance in attempting to protect effectively the species.

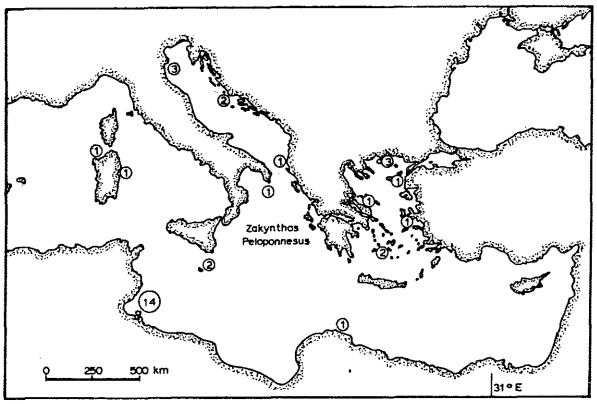

Fig.1. Sketch map of the Mediterranean showing recoveries of loggerhead turtles tagged, while nesting, on Zakynthos and Peloponnesus.

Tagging was done at night when female turtles come ashore to nest. Monel metal or plastic tags were clipped through the proximal part of the trailing edge of the fore flippers. All tags were imprinted on one side with a series number or with a combination of a letter and a series number, and on the other with the address of the Hellenic Society for the Protection of Nature or of the Sea Turtle Protection Society of Greece. During six nesting seasons (1982-1987), 1525 loggerhead turtles have been tagged on Zakynthos and Peloponnesus nesting beaches. In an effort to aware fishermen on the possibility to encounter a tagged turtle, the project was announced to relevant authorities and scientific institutions in the Mediterranean countries through the Greek Ministry of Foreign Affairs. In Greece, a poster was distributed to fishermen cooperatives, port police stations and fisheries authorities.

Up to March 1988, 34 loggerheads (2.2% of the total tagged) were recovered in various parts of the Mediterranean (Fig. 1). Most of them were captured by fishermen. About half of the captured turtles were reportedly released; the others were found dead in fishing tools or were killed. As it is seen from Fig. 1 , turtles after their nestings on Zakynthos and Peloponnesus seem to spread out in various directions. Two individuals appeared in the western Mediterranean at distances of about 1500 km from Zakynthos. Average speeds of travel, for the specimens that were recovered within 2 months from their last observed nesting, range from 10 to 40 km/day which is comparable to migration speeds of marine turtles in other parts of the world (Pritchard, 1973). Fourteen turtles (41% of the total recovered) were reported, most of them during winter months, at the Gulf of Gabés in Tunisia. Assuming that this high percentage is not an articraft due to intense fishing activities, the Gulf of Gabés might represent a wintering area of the loggerhead turtle populations which nest in Greece. The implications of this in the conservation efforts of the species in the Mediterranean must be investigated.

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V-III4

Incidental captures of Caretta caretta (L.) with surface long-lines in the Western Mediterranean

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The existence of loggerhead in the western Mediterranean its seems to indicate that's a generalized event, at least in some restricted areas around Balearic islands, however the bibliography about this subject it is not abundant. Recently other authors (Salvador, 1985; Mayol, 1986), have begun new works in the field of mediterranean marine turtles, in Balearic islands and Alboran Sea.
In 1986 the I.E.O. (Spanish Oceanographic Institute) started to collect information among the spanish long-liners that were fishing in the area limited between Gibraltar Strait and the 6º East. The amount of turtles catches with surface long-lines could be evaluated sampling in the landing. The most of these turtles are liberated in the same moment they are fished. The surface long-line it is a fishing gear used to fish swordfish (Xiphias gladius) formed for a nylon line of different longness with 1000 or 2000 hooks, already described for the spanish longliners by Rey and Alot, (1984). This fishing gear is used along the whole year, although in the period June-September the highest effort is registered (Camiñas et al., 1986). Also turtles are fished along the whole year. Moths with higher captures, it coincided with months of major fishering effort. Most important captures of loggerhead were on July 1986 as well as 1987.
Alicante's port, placed in the middle of the Spanish mediterranean coast, is the main point in swordfish's landings. The percent of the total mediterranean swordfish's capturas landing in Alicante is showed in table 1. The estimation of loggerhead total captures could be obtained from Alicante's data.

Table 1

Año	% Alicante	Nº Turtles.*
1986	42.74	7.478
1987	41.00	8.389

* Incidentaly captured turtles and released. Fleet landing in Aicante's port.

Probably the increase observed in the loggerhead's incidental captures in 1987 can be due to a bigger size of the mediterranean population according to directs observations of the fisherman.

Relation existence between incidental captures and fishering effort.-

Month variation of longliners fishering effort in the Spanish Mediterranean, bases on number of hooks x fishing days/1000, is showed in table II.

Table II

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1986	2	4	7	12	308	634	3664	2497	219	82	49	73
1987	-	1	22	115	739	2732	2906	1438	385	29	21	1
f1986 Tot. Med.	252.8	378.7	381.9	509.9	1172.7	823.9	1385.1	1356	1224.9	761.3	658.5	690.6

The effort values, lower in the beggining of the year, are increased on May-August, descending later until December. The maximum value become in August, with 1385 thousands the captures for turtles have a paralel variation to the anual increase of the effort, the maximun become on July, been lower on August and September, in wihich the efforts are still elevated.

Fishing area.-
The fishing area is very wide, but do not include the whole spanish mediterranean. Thanks to the fishing area was included in the surveys to the fisherman, it has been possible to delimitate, in a general way, the area where loggerhead are captured. In general, this area is the samen in which the longliners ase fishing, though there are some areas, i.e. Alboran Sea, with only a few capture's data. Waters around Balearic islands can be considerated like the most important area, howear we cannot forget that also in this waters is localizated the

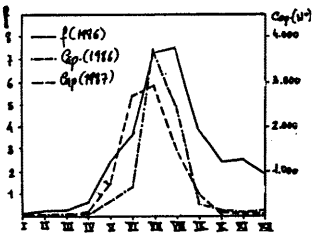

Fig. 1. Longliners effort and loggerhead capture relationship.

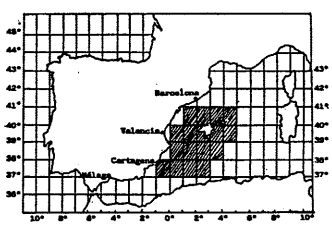

Fig. 2. Incidental loggerhead fishing area in 1987 Spanish Mediterranean longliners.

biggest number of longliners. In the grid situated south Ibiza is where more turtles are captured. (Fig.2)

Mortality.-
Although a great number of loggerheads are captured with long-lines, only a few specimens appear dead in the beach . During 1986 and 1987 we have founded only two dead turtles in Alboran Sea beaches, one of them with a hook in the month. In a experiment realized by J. Mas (Pers. com.) with 6 turtles captured with long-lines, only one died during the way to the Recuperation Center, the rest could throw up the hook and later were liberated. In the same way, two turtles captured in Fuengirola, both with a hook, that were extracted were feeded normaly during three months and after to take same measurement were liberated.

Spawnings areas.-
Although there are not spawnings areas in Alboran Sea of Caretta caretta, the 29th of April in 1986 was captured a female turtle when was getting beach near Malaga, probably to search a place to sawning or to other reasons. It was liberated after to take some measurements. This event is important because in Zakynthos the spawnings period starts on June and the turtle was captured on the last days of May. (Margaritoulis, 1985).

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V-III5

Mortality of Marine Turtles (Caretta caretta L. and Dermochelys coriacea L.) consequent to accidental capture in the Gulf of Taranto

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A large number of marine turtles, prevalently of the Caretta caretta species with few specimens of Dermochelys coriacea, are present in the Gulf of Taranto and its immediate vicinity in the summmer and autumn months. Trophic and reproduction factors are probably the cause of this. Although the phenomenon concernes the whole area it appears more evident off the Calabrian coast, probably due to the vast areas of sandy beach where the animals go to reproduce, even if this has yet to be demonstrated. Unfortunately the presence of the Cheloni in the area coincides with the fishing period for Big Pelagic (swordfish and albacore) which is carried out with long-line and travelling net and consequently causes the catch of high numbers of turtles which, although accidental, determines the death of many specimens for two main reasons. Firstly the flesh of Caretta caretta is considered a delicacy in some areas (Ionic coast of Apulia) for which consumers are willing to pay high prices so inducing fishermen to break the law (M.D. 21/5/1980 – U.G. nº 156 9/6/1980 forbidding the catch and sale of turtles) and land the captured animals. Secondly, the specimens caught with long-line generally swallow the hook which sticks in their oesophagus or stomach even after they have been freed, with obvious consequences (bleeding, starvation). It is difficult to say how many animals, freed in these conditions, manage to survive after the trauma. The travelling net, widely used by fishermen on the Ionic coast of Calabria, where fortunately the Cheloni are not eaten, causes death by suffocation of a certain percentage of captured animals. From our observations carried out directly on board vessels with this equipment, mortality resulted at 30%, mainly in the case of small to middling-sized specimens. Of the 31 specimens of caretta taken from the net in our presence, 9 were already dead. We believe that data and observations collected during our investigation on Big Scombroidei fishery in the Gulf of Taranto (DE METRIO et al., 1986;1987) may give an idea of the entity of catch and consequently of mortality of Caretta. Big Scombroidei fishery is carried out seasonally here by 88 vessels from Apulian and Calabrian harbours as well as by an unknown number of boats from Sicilian harbours. Of these 88 vessels, 59 are equipped with long-line while 29 have travelling nets. For the long-line fishery, data were collected on landing in the harbour of Porto Cesareo on the Ionic coast of Apulia and those relative to the four-year period 1978-1981 have already been reported (DE METRIO et al., 1983). We reproduce here the number of individuals caught for each single year for a comparison with the figures for the following five-year period:

year	no vessels	no C. caretta	no D. coriacea
1978	36	226	0
1979	27	964	4
1980	32	286	1
1981	23	341	1
1982	31	139	1
1983	27	0	0
1984	29	110	0
1985	36	29	0
1986	34	6	0

A reduction of catch in the last five years appears evident by we are not convinced that the data for these years are completely accurate. The fact that no specimen was caught in 1983 is totally impossible. Actually with the coming in force of the above-mentioned law and the resulting control by the authorities together with active propaganda campaigns by protection bodies induce fishermen to keep the real entity of catch from even researchers and we believe the catch to be much greater than that reported. Frotunately the phenomenon is not generalized to all the ports in Apulia in fact at S.Maria di Leuca, a harbour a few miles from P. Cesareo, the fishermen collaborate enthusiastically with Prof. ARGANO in the marking and freeing of the turtles caught. Bigger catches are obtained with travelling nets but they are difficult to assess as all the animals caught in the nets are freed by the fishermen, indiscriminately, when they are brought in and are not found in the landed catch. However, from personal observations directly on board and from what trustworthy, expert fishermen say we have calculated that the 29 vessels studied, working with nets along the Ionic coast of Calabria, catch (and re-catch?) 16000 specimens totally for each season. One vessel with 12000 metres of net, catches from 3 to 50 specimens on an average in one trip. Calculating that for every fishing season a vessel totals 60 working days it is evident that our figures are lower than might be calculated. Calculating only a 10% mortality and therefore 2/3 inferior to that observed, the result is still alarming. We believe that this phenomenon is not to be overlooked when studying the numerous cases of stranded turtles which the media have only just started to report, superficially attributing the cause to hypothetical problems of pollution. The high mortality due to accidental catch together with other causes of death which we will report in an in extenso work, and with the increasing anthropization of even the remotest beaches constitute a difficult problem for the survival and protection of the species in question. On the other hand the great importance of Big Scombroidei fishery for the economy of southern Italy cannot be ignored.

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V

V-III6

Conservation of the endangered Sea Turtles Chelonia mydas and Caretta caretta in Israel

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Four species of sea turtles occur on the sea-shores of Israel. Two of these, the Green Turtle Chelonia mydas and the Loggerhead Caretta caretta, nest regularly on the Mediterranean coast. The Hawksbill Eretmochelys imbricata occurs occasionally on the Red Sea shore in Elat, and the Leatherback Dermochelys coriacea is observed on rare occasions on both the Mediterranean and Red Sea coasts.

Since 1979, both Caretta caretta and Chelonia mydas are monitored in Israel by the Nature Reserves Authority. During the breeding season (May-September), the Mediterranean sandy shores are surveyed once or twice a week (either by vehicle or on foot), in order to study nesting habits, preferred habitats, environmental factors and the survival rates of eggs and hatchlings.

Any tracks which are discovered are checked for "false" or "true" nests, and environmental features, e.g. habitat type, distance from the sea, phase of moon are recorded accordingly. Nests found are marked with an inconspicuous sign, and are checked again around the estimated hatching date. During the hatching process (24-48 hrs), the nest is being guarded by rangers until all hatchlings have reached the sea. Unhatched eggs or dead hatchlings are collected and checked.

Each year, 5-20 nests of both species are found. Of 86 nests that were checked over the years, 75.7% were found to be Caretta caretta and 24.3%, Chelonia mydas. Clutch size is x=76.3, Sd=15.2, n=31 and x=105.9, Sd=31.2, n=12, for Caretta caretta and Chelonia mydas respectively. Incubation period in most of the nests in situ, is 50-55 days.

During the 1986 nesting season, several nests were monitored for physiological features such as air and nest temperatures, and humidity and oxygen content of nest during the incubation period.

The best hatching successes in Caretta caretta nests, were obtained in egg pits at 27 cm depth, with 2-6% humidity in nest air and 2-3% in nest sand. Nest temperature rises by 6°C during the incubation period. The temperature gradient in the egg pit is about 1°.5°C (Silberstein, 1988).

During 1979-1984, artificial incubation and indoor raising and marking experiments were carried out. Hatching success of artificially incubated eggs was found to be lower (x=51.3%, Sd=29.4, n=8 and x=32.3%, n=2) than of eggs hatched in situ (x=91.0%, Sd=7.0, n=13 and x=94.4%, Sd=5.6, n=3) for Caretta caretta and Chelonia mydas respectively.

The main causes of nest losses were sea storms flooding the nests, and predation of eggs and emerging hatchlings by the crab Ocypode cursor. Predation by man and domestic animals were also recorded.

Preliminary results of artificial incubation and raising experiments show that the best conservation strategy for nests of both sea turtle species on Israel's Mediterranean shore is incubation in their natural beach setting under weekly surveillance. Artificial incubation is considered only where nests are in immediate danger of flooding or predation by animals or by man.

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V

V-III7

The endangered loggerhead of Zakynthos relative to the Mediterranean Sea Turtle conservation problem

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THE ENDANGERED LOGGERHEAD OF ZAKYNTHOS RELATIVE TO THE MEDITERRANEAN SEA TURTLE CONSERVATION PROBLEM

A Recommendation at the Council of Europe's most important meeting on wildlife conservation on the 11th December 1987, was unanimously accepted by the Greek Government. This Recommendation concerned itself in great detail with the essential measures to protect, on the island of Zakynthos (Laganas Bay), the largest known concentration of nesting Loggerhead sea turtles in the Mediterranean. Additionally, a co-ordinated three Ministerial Decision was signed in Greece in December 1987, to control traffic in the Bay.

In the summer of 1987, research by the Sea Turtle Protection Society (STPS) revealed that fewer sea turtles nested, compared with any previously recorded year. Furthermore, half of the nesting turtles were injured, some very seriously, presumably by motorboats which constantly criss-cross the entire Bay.

Human related disturbance presents the greatest hazard to successful nesting... night-time beach use; beach obstruction by boats and sunbeds; the digging of pits and building of sand-castles; compaction of the sand from constant use by humans and vehicles; excessive dynamite fishing; machine cleaning of the beaches; accumulated litter; the planting of Tamarisk trees altering the sand temperature and ground humidity; the fatal attraction to hatchlings of unshielded lights inland; low frequency sound of the discos heard all over the Bay; sand removal for the recent building boom; horse riding along the beaches; destruction of nests by beach umbrellas stuck in the sand; man-made walls on certain beaches preventing sea turtles from nesting; and the most serious disturbance, touristic development.

The Kalamaki area aims at 30,000 beds and at a distance of only 150-200 metres from the water edge of the nesting beaches. If one also adds the 300,000 tourists who, according to the Prefect's official statement in the Greek press in November 1987, will be visiting the island in 1988, I ask you: how will it be possible for nesting areas to be protected in the face of this invasion? For anyone to believe that guards will be able to control such a vast number of people is quite unrealistic!

I quote: "Greece has agreed (Recommendation No. 12. Council of Europe 11.12.1987) that Laganas Bay should qualify for a stricter protection category, such as marine park, natural monument or other appropriate legal status." How could such a protected area survive the impact of mass tourism?
I am greatly concerned at the lack of available information on comparative studies, data, etc. collected in Zakynthos and the Peloponese over the last four years. I am also worried that research and conservation efforts are concentrated mostly on the two small nesting beaches of Sekania and Daphni, which appear to sustain the largest number of female sea turtles (approximately 63% of the whole of the Bay), although these beaches are actually losing many of their nests due to this unprecedented overcrowding. Almost no effort is being made to conserve the equally important and as yet undeveloped beaches at East Laganas and Kalamaki! This is due, of course, to the vocal opposition of a minority which puts at risk the very survival of the Zakynthos Loggerhead.

By concentrating all short-term efforts on the small and grossly overcrowded beaches, one is surely guaranteeting that the Zakynthos turtle population will continue to decline, perhaps even to the point of extinction. There must be an urgent redirection of research and monitoring to the other beaches. It is of vital importance, therefore, that over the next few years a comparative applied research programme and study be carried out, in order to establish the rate at which the species is threatened with extinction.

In addition to the above problems, there is an even more serious national legal issue which does not appear to have been understood by organizations outside Greece: the Ministerial Decision of 29th January 1987, Controlling Residential Development, Restricting Building and Defining Zones for the protection of sea turtles is valid for three years only! In January 1990 Laganas Bay will remain without any legal protection!

In April 1988 the appeal launched by about nine out of the twenty landowners of Laganas denouncing the Ministerial Decision as illegal, is to be tried by the highest Greek court. It is very possible that the landowners could win their case

The long promised Presidential Decree, if signed and published before April 1988, alone could prevent the above-mentioned disasters, but the problems of the Zakynthos Loggerhead will never be solved until and unless the laws are scrupulously enforced.

I cannot stress sufficiently that this is not a local issue but a national and international Mediterranean one.

There is now a serious danger that the Mediterranean Loggerhead turtle will not survive. New problems emerge daily and conservation measures are few. Some scientists consider that sea turtles could already be extinct as a breeding species in the Mediterranean.

I believe that one responsible body should co-ordinate Mediterranean sea turtle conservation projects, research, funding and lobbying, e.g. The Mediterranean Association to Save the Sea Turtles (MEDASSET) in which all European countries, international organizations and individuals could work together to ensure the future survival of the highly endangered Mediterranean sea turtle.

V-III8

Turtle conservation in Cyprus

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Of the marine turtle two, the Green Turtle (Chelonia mydas) and the Loggerhead Turtle (Caretta caretta) have been found to breed regularly on the island's beaches. Both have evidently been more abundent in past. In Cyprus turtles and their eggs have been protected by law (Regulations made under the Fisheries Law, Cap.135) since 1971.

In 1976 and 1977 a thorough survey of the turtle breeding beaches was undertaken. It showed that the Green Turtle breeds almost exclusively in the desolate beaches on the west coast of the island north of Paphos, mainly in the Lara area. Loggerhead turtles breed on most beaches that provide some "privacy" after midnight.

In 1978, after the diagnosis was made that the turtle populations of Cyprus are declining and are in danger, a conservation project was launched, by the Fisheries Department and a hatchery was set up to increase hatching success and survival. It is the first and only hatchery in the Mediterranean and in Europe. The project was mainly aimed at protecting the Green Turtle which was more in danger that the Loggerhead Turtle. The main dangers to the turtles are destruction of their breeding habitats and predation by foxes on eggs and hatchlings. Resent estimates of their populations put them at about 100. The Loggerhead turtle population is also at the same time being looked into and aided, though there is evidence that this is larger.

The project is administered directly by the Department of Fisheries of the Ministry of Agriculture and Natural Resources and is financed by Government funds. For three years (1980-1983) it has received ubstantial help from the World Wildlife Fund as a IUCN/WWF project.

The study of populations is being carried out through tagging and surveys and the restocking of the sea by hatchery work and by "head starting". Hatchery work includes collection of the eggs and hatching with various methods, primarily by reburying the eggs in the sandy beach of the station, but also by laboratory hatching. The project also includes collection of data on environment and hatchery conditions. Hatchling and young turtle nutrition are being studied in a special laboratory set up in Nicosia. Rearing to various ages is being undertaken and will continue primarily with a view to investigeting the possibility (and success) of releasing ongrown turtles as well as hatchlings.

The methods that have been used in the project have been the protection of "natural" nests in situ and the removal and hatching of nests that could not be adequately protected in situ, in the turtle hatchery at Lara.

Each year since 1978 about 3000-4000 hatchlings are released to the sea. Hatching rate has been in the region of 60%-75% which though a little lower than that of "wild" nests it is multiple of the number of hatchlings that would have reached the sea from these nests should they have been unprotected.

The Lara beaches are leased by the Department of Fisheries and are managed as a nature reserve. The intent is of course to have the main breeding beaches permanently protected in such a way during nesting and during hatching.

V-III9

Loggerhead (Caretta caretta) in Italian waters (Reptilia, Cheloniidae)

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Loggerheads are relatively frequent in Italian waters. They are accidentally captured in remarkable number, mainly by drifting longlines, in a smaller amount by trawling and gillnets.

More loggerhead (64%) than swordfish were exceptionally fished in August 1982 using drifting longlines in the Gulf of Taranto (Miccoli,1985); obviously it is an unusual case: the normal number of turtles captured in the same month and in the same area with this kind of fishing is in average the 3% compared with captured swordfish.

From 1985 to 1987, thanks to the co-operation of fishermen in Salento (mainly S. Maria di Leuca, Otranto, Tricase), Molise (Termoli) and other parts of Italy, it has been possible to rescue, to tag and to release 537 specimen.

The 87% of those were captured using drifting longlines, 6% by trawling, 2% by gillnets and the remaining 5% using different manual methods.

We had tag returns: turtles were collected in Sardegna, Tunisia, Albania and along the Italian shores both Adriatic and Tirrenian. A loggerhead relesead in the Gulf of Mexico on June 2, 1982, was recaptured by us in S.Maria di Leuca on August 19, 1986.

Furthermore a remarkable number of specimen were rescued by distraint, strandings, occasional captures, and so only a small number of those could be tagged. Totally we rescued and released more than 800 turtles.

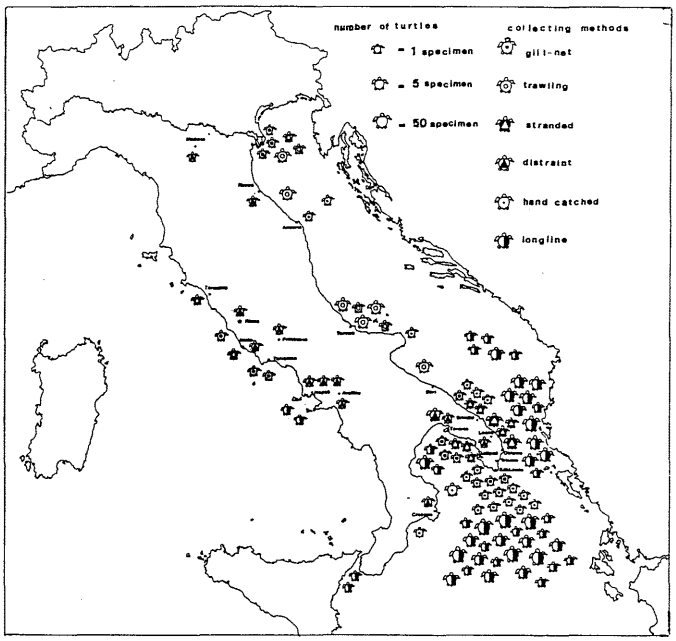
The rescue and the releases of adult specimen request an organisation of stalling centers for animals in sickness or in bad conditions.

We consider this as a fondamental operation both on the educational and conservational purpose: we work to make it more efficent, but we need suitable means. that needs to be ampliate, when possible.

So it will be possible to control fishing damages, to educate people to a better use of the natural resources and to restore natural populations with specimen in a reproductive age.

Reguarding to the breeding areas, single nests were located along the Sicilian coasts from Marsala to Mazara del Vallo, Gela, Capo Passero, over Pelagian Islands (Lampedusa and Linosa).

As well as a continuous control in the depositional sites, a mapping of the beaches of Southern Sicily was done, describing all the trouble data, with the aim to report further exploitations and to reduct the present ones.



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V-IV1

Sur la répartition de Globicephala melaena (Traill, 1809) dans les eaux méditerranéennes Espagnoles

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INTRODUCTION

Une étude sur la distribution de *Globicephala melaena* du XIXème siècle jusqu'à nos jours montre que l'espèce est distribuée irrégulièrement dans les eaux espagnoles de la Méditerranée. Depuis 1918, il est à remarquer que les observations du Globicéphale noir sont peu nombreuses près des côtes de Catalogne et dans les eaux voisines, alors qu'elles sont plus fréquentes autour des Baléares, près de Valence, et plus spécialement dans la mer d'Alboran.

En Méditerranée occidentale, une répartition irrégulière a également été observée près des côtes françaises : la fréquence plus élevée de *G. melaena* dans les eaux voisines de la Mer ligurienne contraste avec l'absence presque totale à l'ouest de l'embouchure du Rhône (Di Natale et Mangano, 1981 ; Duguy, 1983 ; 1984 ; 1985 ; 1986 ; 1987).

RESULTATS

Un total de 49 échouages et observations en mer de *G. melaena* près des côtes espagnoles de la Méditerranée a été enregistré de 1860 jusqu'à nos jours. Parmi ceux-ci, 5 se trouvent dans les eaux de la Catalogne, dont 4 se sont produits dans la période 1894-1918, 4 près des Baléares, 19 dans le secteur de Valence, et 21 en mer d'Alboran.

L'étude d'un contenu stomacal d'un spécimen de *G. melaena* échoué sur les côtes valenciennes a montré les restes de céphalopodes appartenant aux genres *Histioteuthis* (4 proies) et *Rossia* (1 individu), de même qu'à la famille *Octopoteuthidae* (2 exemplaires). Il a également été trouvé des otolithes appartenant à des poissons de la famille des *Gadidae* (6 individus).

DISCUSSION

On peut supposer qu'il y a plusieurs facteurs qui conditionnent la distribution de cet odontocète : nourriture, caractéristiques des eaux, courants de même que d'autres difficiles de préciser (contamination, activités humaines, etc...).

En ce qui concerne la nourriture de *G. melaena* en Méditerranée, les seules données existantes ont été fournies par Desportes (1985) pour les côtes françaises, signalant l'apparition exclusive de céphalopodes dans son régime alimentaire, et notamment les espèces *Teuthowenia megalops*, *Histioteuthis* sp., *Chiroteuthis* sp. et *Toradotes* sp. Néanmoins, dans le seul contenu stomacal examiné jusqu'à présent pour les côtes espagnoles, à part des restes de céphalopodes, il a été trouvé des otolithes de poissons.

Les groupes de céphalopodes qui font partie du régime alimentaire du Globicéphale noir échoué sur les côtes valenciennes ne sont pas exclusives de ces eaux. Pour cette raison, la nourriture, en dépit de son importance, ne semble pas être un facteur limitant de sa répartition.

Les variations le long des côtes méditerranéennes d'Espagne des conditions des eaux qui peuvent influencer directement la répartition des cétacés, telle la température, paraissent être peu importantes. En raison de cela, on peut penser que ce facteur peut difficilement jouer un rôle primordial dans la discontinuité de *G. melaena* sur nos côtes.

D'après Smith *et al.* (1986), il paraît y avoir une corrélation entre la répartition des cétacés et les concentrations superficielles de chlorophylles, ce qui peut être un autre facteur à prendre en compte dans la répartition du Globicéphale noir dans le bassin occidental de la Méditerranée, notamment dans les eaux espagnoles. En fait, Estrada *et al.* (1985) signalent une haute productivité primaire le long des côtes de Valence et, en général, dans tout le sud-ouest méditerranéen.

En ce qui concerne les courants, d'après les données publiées par Font (1987) sur les eaux superficielles de la mer Catalanne, il paraît exister, dans les zones de Valence et des Baléares, une série de courants de nette influence atlantique. En ce qui concerne les eaux de Catalogne, on a observé, néanmoins, une influence des eaux du Rhône et du courant Liguro-Provençal.

D'après Giordano (1982), la turbidité des eaux peut influencer la distribution de quelques espèces de cétacés, comme *Stenella coeruleoalba*. A ce propos, il est intéressant de signaler que, dans la Méditerranée occidentale, les zones avec la fréquence la plus faible du Globicéphale noir correspond avec l'aire délimitée par l'embouchure des fleuves Rhône et Ebro. L'influence de ces fleuves comme facteur limitant possible de la distribution du Globicéphale noir dans ces zones est donc à prendre en compte.

V

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V-IV2

Hivernage et mise-bas du Cachalot en Corse

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Les Mers Ligure et Tyrrhénienne ont toujours été considérées par les anciens cétologues comme favorables aux cachalots, la première comme aire de nutrition parce que riche en céphalopodes, la seconde comme aire d'hivernage et de mise bas.

Cependant les observations en mer sont peu nombreuses comparées à celles des autres espèces (VIALE, 1985); aussi les preuves de mises bas sont-elles interessantes. Le 31 janvier 1988 un cachalot de 6,70 m s'échoue sur la plage de Chiuni, près de Cargese, ouest-Corse; son âge peut être évalué à 0,1 à 0,5 an; il était allaité totalement.

A part une large fente ventrale béante, l'état du tégument sans cicatrice ni parasites externes et l'epaisseur importante du lard, bien blanc et rigide sont des indications de bon état général. Le foie est apparu à l'autopsie ferme, bien conservé, sans aspects anormaux ni dans le volume, la forme ni la texture.

En revanche, les intestins présentent extérieurement au niveau du mésentère des cristaux indentés l'un dans l'autre, formant des adhérences d'une anse intestinale à l'autre; à l'ouverture de la cavité abdominale les anses intestinales ne se sont pas étalées librement comme c'est le cas normalement; elles ne glissent pas les unes sur les autres car elles sont rendues solidaires par des accrochages lithiques réalisés par des concrétions et des cristaux.

De telles formations lithiasiques ont été déja décrites chez certains spécimens de cétacés (VIALE 1979, 1981). Dans tous ces cas observés les animaux présentent des teneurs non négligeables de cadmium, de plomb et de mercure susceptibles d'interférer dans le metabolisme du calcium.

Des prélèvements de tissus de ce cachalot ont été faits en vue d'une recherche de polluants métalliques.

Ce nouveau-né est-il mort d'un accident, de maladie, ou de faim parce que sa mère est morte? Cette dernière supposition vient du fait que dès le 22 janvier 1988, un cétacé de 15 à 20 mètres est annoncé flottant mort à 8 milles de la côte orientale de la Corse, par 42°20'N. Alertés, nous avons attendu l'échouage en surveillant les variations météorologiques : les vents du Nord-est drossant l'animal vers la côte se sont inversés dès le 23 en vent de sud-ouest. Entre le 23 et le 31 janvier les vents ont soufflé dans les directions de 130° à 220° avec des vitesses variant de 61 à 118 $km.h^{-1}$. Il s'ensuit que le bébé cachalot qui flottait le long de la côte SW de Corse a été drossé à la côte alors que le cétacé adulte ne s'est pas échoué sur les côtes de Tyrrhénienne. De fait, le courant superficiel dans le Canal de Corse présente en janvier une soudaine accélération et dépasse $50cm.sec^{-1}$ (ASTRALDI et al., 1987; HEBURN, 1987). Ce dernier auteur y modélise les vecteurs vitesse du courant superficiel dû au vent en janvier et, d'après ses figures, tout cadavre flottant vers 42°N et ayant une prise au vent doit être entraîné rapidement et peut se retrouver sur la côte depuis Nice jusqu'au delà de Marseille .

Effectivement un cadavre de cétacé de 16 m femelle est venue s'échouer près de Cassis le 5 fevrier 1988, mais c'est un Rorqual (Balaenoptera physalus.).

Discussion::

La mort du jeune cachalot ne peut donc être supposée liée à celle de sa mère; elle est probablement d'origine traumatique ou traumatico-pathologique liée à un dysfonctionnement calcique d'envergure apte à engendrer des problèmes psycho-moteurs. Les anomalies sous forme de calculs mis en évidence dans les intestins impliquent une altération du métabolisme calcique .

La mort de ce cachalot nouveau-né allaité atteste la présence de l'espèce en hiver en Méditerranée occidentale : il serait intéressant de localiser de façon plus précise la zone d'hivernage et de mise bas, qui révèlerait ainsi ses potentialités trophiques hivernales. Il est possible que ce soit la Tyrrhénienne.

En effet, les travaux recents sur la dynamique de la Méditerranée montrent l'importance des échanges de cette dernière avec la Mer Ligure par le canal de Corse et les bouches de Bonifaccio ; par suite, de nombreux échouages attribués à des populations liguro-provençales sont probablement d'origine tyrrhénienne .

Des missions seraient necessaires dans cette zone en hiver. Au cours de 13 missions océanographiques traversant la Méditerranée dans tous les sens entre 1978 et 87 (valorisations de transits CNRS-CIRNED ou IFREMER) (VIALE et al., *op.cit.*) on observe trois fois plus de baleinoptères que de cachalots.

Parmi ces missions, 4 ont eu lieu en Tyrrhénienne en printemps-été et n'ont fourni aucune observation de cachalot.

Des missions en Tyrrhénienne en hiver seraient donc utiles pour chercher une cohérence entre les observations, les échouages et la dynamique de cette zone.

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V-IV3

Cétacés en Méditerranée orientale : campagnes CETORIENT sur N/O Le Suroit IFREMER, 1986

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Deux valorisations de transit du navire océanographique "Le Suroit" allant en Mer Rouge (mission MINOS de l'IFREMER) nous ont permis de traverser la Méditerranée Orientale deux fois (Toulon - Port-Said - Toulon) en étudiant la macrofaune de surface et les biomasses sous-jacentes, du 11 au 16 mars et du 14 au 19 avril 1986.

MATERIEL et METHODES.

Détection visuelle des cétacés, oiseaux, thons etc. et acoustique des biomasses profondes (sondeur de 15KH avec enregistrement sur papier). Mesure en continu de la température de l'eau superficielle et de l'air par une sonde thermique avec affichage electronique à la passerelle; un relevé manuel est fait toutes les 30 minutes, avec l'aide des officiers de quart; la vitesse du navire varie de 9 à 11 noeuds, ce qui représente une maille pour l'observation de la température variant de 4,5 à 5,5 milles, équivalente à celle de la télédetection infra-rouge fournie dans les documents du Centre Météorologique de Lannion que nous utilisons pour caler nos mesures et nos observations.

La vigie est maintenue en continu de jour, interrompue au crépuscule. La largeur de la zone inspectée le long du trajet varie avec les conditions météorologiques et l'heure de la journée : elle a été de 1,5 à 2 milles de part et d'autre du navire entre 11h et 14h (TU +2), 1 mille par soleil voilé, et 0,5 mille à partir de 17 h.

RESULTATS

A l'aller, huit observations de cétacés, soit 35 individus, sur un trajet de 3000 km comportant 60 heures de vigie :

1 *Balaenoptera physalus* en Mer Ligure
1 *Physeter macrocephalus* en Mer Ligure
5 *Stenella coeruleoalba* en Mer Ligure
2 *Balaenoptera physalus* en Tyrrhenienne.
3 *Grampus griseus* en Mer Ionienne.
1 groupe de *Tursiops truncatus* au large du Stromboli.
1 groupe de *Tursiops truncatus* dans le detroit de Messine.
1 groupe de *Delphinus delphis* à 100 milles de Port-Said.

Au retour, deux observations, soit 27 individus pour le même nombre d'heures de vigie.

La mission retour, par un hasard de circonstances, a reproduit les mêmes conditions de vigie dans les zones traversées à l'aller : d'où l'observation des troupeaux de *Tursiops* dans le détroit de Messine et au large du Stromboli, comme à l'aller.

Des discontinuités thermiques apparaissent en Tyrrhénienne et en mer Ionienne alors qu'elles n'apparaissent pas sur les cartes du Centre Météorologique National de Lannion. La plus forte discontinuité thermique est observée à 100 milles de la côte d'Egypte.

Parallèlement, la bande enregistrée au sondeur ne montre des échos de bancs de biomasse que dans le détroit de Messine et en mer Tyrrhénienne à la hauteur des Bouches de Bonifaccio

DISCUSSION.

Au total, si on écarte les *Stenella* et le cachalot observés en quittant Toulon et les *Balaenoptera physalus* observés en Tyrhénienne, trois espèces seulement ont été observées dans le Bassin Oriental : *Tursiops, Grampus, Delphinus.*

Les résultats sont très décevants : indice moyen d'abondance de 0,062 individu par mille. Dans des conditions d'étude rigoureusement semblables en Méditerranée Occidentale, six espèces sont observées avec un indice moyen d'abondance de 0,52 individu par mille de vigie, et de 1 en Mer d'Alboran et dans le Détroit de Gibraltar.

Le sondeur semble indiquer peu de biomasses le long de notre trajet; de fait, nous pensons que le réglage aurait dû être mieux adapté à ces faibles biomasses, ce que nous avons réalisé dans nos autres missions (LEGALL, 1986 ; VIALE, sous presse).

Un résultat probant est néanmoins la concordance des observations de cétacés soit dans les détroits où justement l'échosondeur a révélé la présence de biomasses, soit près des discontinuités thermiques. Nous avons déja obtenu des résultats semblables au cours des missions en Méditerranée Occidentale (VIALE, *op.cit.* ; VIALE et PISTEK, 1988); l'investigation doit être poursuivie pour comprendre le déterminisme des discontinuités thermiques rencontrées et semblant productives d'après la répartition des cétacés observés.

CONCLUSION.

La répartition des cétacés, composants essentiels de la macrofaune de surface, est très hétérogène en Méditerranée Orientale et semble, au terme de cette première enquête, liée aux zones de front ,comme nous l'avons trouvé dans le Bassin Occidental.

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X-I1

Table Ronde "Ecosystèmes des marges continentales"

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La Commission Internationale pour l'Exploration Scientifique de la mer Méditerranée, dans le cadre de son Projet d'étude de la marge continentale, a intégré les résultats des actions actuellement menées à travers les Programmes ECOMARGE et EURECOMARGE.

Cette Table Ronde a été organisée pour établir un bilan des travaux pluridisciplinaires qui se déroulent sur les marges continentales ; il est donc largement ouvert et dépasse le cadre strict du Programme français.

Des présentations synthétiques, si possible pluridisciplinaires, ont été demandées pour ouvrir une discussion prospective.

En effet, l'action de stimulation C.E.E., EURECOMARGE, a permis de réelles collaborations (échanges, missions communes, utilisations collectives d'instruments et de moyens lourds) entre les équipes espagnoles, françaises, grecques, italiennes et suisses, qui ont amené à une focalisation des thèmes et à des réflexions constructives. L'Algérie participe à ce Programme dans le cadre de coopération bi-latérale.

On trouvera, dans les condensés ci-après, un aperçu des travaux actuels menés par les différentes équipes sur plusieurs ateliers en Méditerranée, mais également en Atlantique. On constatera, ainsi, l'identité des approches qui doit conduire à une vue globale des processus se déroulant dans un domaine clé du système océanique et, à terme, à une modélisation.

Dans les dernières réunions de concertation (Workshop d'Océanologie à Naples, en novembre 1987, Réunion à Monte-Carlo, en avril 1988), il a été décidé de concentrer les efforts sur un nombre restreint de zones ateliers, de mettre en commun les moyens logistiques et de développer les techniques marines. Le manque d'instrumentation in situ constitue actuellement un réel handicap, les équipes ne possédant que des moyens classiques d'investigation exigeant des missions répétitives.

Il devrait être possible de bénéficier, en 1989, d'une prospection, par sonar latéral (SAR) et par submersible CYANA, sur les cibles définies en Méditerranée occidentale, en collaboration avec l'Institut Français de Recherche pour l'Exploitation de la Mer.

Dans les différentes phases de développement du Programme, la C.I.E.S.M. est devenue partenaire de certaines actions internationales. Elle a également procédé à l'édition des actes du Colloque International d'Océanologie (Perpignan, juin 1987). Cette publication rapide, largement diffusée, a permis une information sur les travaux des différentes équipes autour d'une thématique dont l'intérêt est désormais internationalement reconnu.

La Table Ronde a pour finalité la définition d'objectifs précis au vu des connaissances et de l'expérience déjà acquises ainsi qu'une extension de collaborations à tous les Pays méditerranéens ou européens qui en ont, d'ores et déjà, manifesté le désir.

X-I2

Transferts particulaires et réponses de l'interface sédimentaire

GROUPE ECOMARGE *

Les résultats obtenus dans le cadre du programme ECOMARGE, dans la zone atelier du Golfe du Lion, permettent à présent de caractériser et de quantifier les processus contrôlant les transferts particulaires sur cette marge. Le système est alimenté, à l'entrée, par les apports continentaux directs ou indirects et par le courant liguro-provençal, qui en constitue également le moteur principal. Le mouvement advectif des particules est modulé par les phénomènes d'agrégation organo-minérale (neige marine) et biologique (pelotes fécales) responsables de la sédimentation pélagique (MONACO et al., 1987 ; HEUSSNER et al., 1987a ; HEUSSNER et FOWLER, 1987). Ces phénomènes d'agrégation sont particulièrement importants en période d'homogénéisation des eaux et en période de production.

La répartition de la matière en suspension montre que le transfert plateau-pente est fortement contrôlé par le système hydrologique. Il s'effectue selon plusieurs couches superficielle, intermédiaires et profonde, identifiées au cours de 5 campagnes saisonnières (NYFFELER et GODET, 1987). Ces néphéloïdes, où domine de fait le matériel terrigène, se forment et se détachent, au niveau des discontinuités morphologiques (rupture de pente, parois des canyons), dans les zones les plus énergétiques et se maintiennent au niveau des ergoclines. Ce système est très semblable à celui décrit sur la marge de Thermaikos-Sporades (DURRIEU de MADRON et al., ce volume).

Les expériences menées par pièges à particules séquentiels, à la sortie du système Golfe du Lion (Canyon Lacaze-Duthiers), confirment et quantifient ces processus. Le matériel particulaire récolté révèle une double origine : authigène et terrigène (MONACO et al., 1987 ; HEUSSNER et al., 1987b ; MICHAELIS et al., 1987 ; etc...), la seconde résultant principalement d'apports advectifs par le fond. L'importance relative de ces deux composantes dépend de la saison et de l'état hydrologique. Ainsi, le signal terrigène est prédominant en hiver, les flux mesurés près du fond (600 m) ayant atteint 20 $g.m^{-2}.j^{-1}$.

Compte tenu cependant du caractère frais du matériel advecté-attesté par la présence de matière organique labile, l'état des pigments chlorophylliens, les acides aminés (GUIDI, 1987 ; BUSCAIL et al., 1987) - ces flux sont très énergétiques. Les zones où se manifestent saisonnièrement ces phénomènes impulsionnels coïncident avec la structure morphologique et bathymétrique. On note ainsi la plus forte activité biogéochimique et biologique à l'interface sédimentaire dans la zone axiale du canyon (BUSCAIL, 1987). Ces phénomènes expliquent également les cycles annuels du méiobenthos profond (copépodes et nématodes), l'activité plus importante dans les canyons et l'existence de gradient de densité de population que l'on observe de la côte vers le large d'une part et d'Est en Ouest d'autre part, dans le sens du circuit liguro-provençal (SOYER et al., 1987 ; DE BOVEE, 1987).

Le rôle déterminant des canyons dans le fonctionnement de l'écosystème des marges méditerranéennes apparaît ainsi de plus en plus nettement. Les premiers résultats obtenus dans la zone ligure confirment ce fait (CORRADI et al., ce volume).

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X-I3

Bilan des transferts de matière organique à l'interface eau-sédiment sur la marge de Méditerranée Occidentale

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Une des composantes du programme Ecomarge est de préciser quelles peuvent être l'origine et les caractéristiques (physico-chimiques) des flux de matière organique sur la marge du Golfe du Lion. Zones intermédiaires entre les domaines épicontinental et les bassins profonds, les marges ne représentent que 14 % de la surface océanique mais constituent une zone clé pour la dynamique des transferts. On constate que les zones à concentrations élevées en matière organique coïncident à peu près exactement avec les marges continentales. De plus, la distinction qualitative des composés organiques, labiles ou réfractaires, présente un grand intérêt pour le fonctionnement de l'écosystème benthique de la marge.

1 - ORIGINE DES FLUX DE MATIERE ORGANIQUE

Sur la marge du Golfe du Lion les composantes principales de l'origine du matériel organique en suspension dans les masses d'eaux sont :

L'origine continentale : l'apport par les fleuves principalement lors de leurs crues printanières et automnales en régime de type méditerranéen.

L'origine épicontinentale :Les apports connaissent une période de pré-dépôt dans les zones prodeltaïques au droit des embouchures puis remis en suspension sous l'effet des houles et des courants littoraux, ils sont exportés vers le rebord du plateau.

L'origine marine autochtone : La production biologique, importante dans la couche euphotique mais aussi pélagique par la production de pelotes fécales qui contribue au flux de matière organique vers l'interface sédimentaire (4).

2 - DYNAMIQUE DU TRANSPORT DE LA MATIERE ORGANIQUE

Sur les marges les modes de transport sont de deux types :

Convectif : en raison de la dynamique des masses d'eau un flux à composante de déplacement plutôt oblique que vraiment verticale est issu de la production biologique et subit une intense dégradation biochimique dans la masse d'eau d'où le terme résiduel pour le flux mesuré à proximité du fond.

Advectif : Un système multi-couches turbides emprunte la tête des canyons ; plus en aval le néphéloïde benthique est susceptible d'alimenter l'interface sédimentaire de la marge (6). Les apports alimentent préférentiellement le chenal axial des canyons où sont observées les plus fortes teneurs en C.org et la plus forte proportion de matière organique hydrolysale, ainsi que des composés ligneux d'origine continentale (7).

Le piègeage des particules en suspension dans le canyon Lacaze-Duthiers a révélé, en été, des flux en C.org. et en azote forts en surface et faibles au fond selon un facteur 100 à 1. Par contre, en hiver et au printemps apparaît un néphéloïde benthique très énergétique avec 200 mg C.org/m^2/J et 16 mg N/m^2/J, soit 40 fois plus de C.org. et 20 fois plus d'azote qu'en été à la même profondeur.

3 - MATIERE ORGANIQUE DANS LA BENTHIC BOUNDARY LAYER

3-1 Caractéristiques biochimiques des flux à proximité du fond

Les caractéristiques biochimiques des flux à 600 m montrent l'importance de leurs variations saisonnières. En été la proportion de sucre et d'acides aminés est inférieure à 25 % du flux de carbone organique total qui lui-même est faible ; en automne on observe la prédominence des sucres sur les acides aminés indice d'une matière organique plus dégradée, moins assimilable par les organismes benthiques. Par contre, en hiver et au printemps, la proportion de C Org hydrolysable principalement constitué d'acides aminés devient prédominante. La présence notable de glycine, marqueur de la préservation des membranes cellulaires de Diatomées, est un indice du transfert rapide vers l'interface sédimentaire d'un matériel organique "frais" à haute valeur calorique.

3-2 Matière organique à l'interface sédimentaire

En moyenne les taux de C. Org. sont faibles à l'interface (0,5 à 0,8 %) mais la proportion d'éléments labiles est forte par comparaison avec les données du programme similaire SEEP sur la marge de New-England (8). L'observation simultanée de l'interface sédimentaire montre que pour une augmentation d'un facteur 10 du flux de C. org, 1mg de C.org. est stocké en plus dans 1g. de sédiment superficiel. Pour la même période le caractère labile donc plus facilement assimilable de cette matière organique se traduit par un taux de C Org hydrolysable 2 fois plus élevé (35 à 70 % du COT), bien que l'augmentation de la biomasse benthique observée en réponse à cet apport favorise une consommation plus importante (3).

Les apports de composés organiques à l'interface eau-sédiment se font donc par impulsions d'amplitudes variables avec les saisons, sous l'effet de l'hydrodynamisme général du courant Liguro-Provencal qui circule d'Est en Ouest dans le Golfe du Lion, ou fonction du régime des fleuves côtiers très bas à l'étiage, en crue lors des pluies diluviennes de l'automne et du printemps.

3-3 Processus

L'étude des flux de matière organique à proximité du fond permet de préciser la diminution notable de C.org au passage suspensions du fond - interface sédimentaire. Les processus à l'origine d'une telle discontinuité sont de deux types : biologiques et géochimiques. Leur importance relative varie en fonction de la nature du matériel organique qui alimente l'interface, labile ou réfractaire à la dégradation par les organismes benthiques, sensible aux processus d'oxydations chimiques. On notera que nature de la fraction organique et composition minéralogique du sédiment ne sont pas indépendantes et que l'étude de la diagenèse précoce de la matière organique doit être incluse dans une sédimentologie bien comprise définissant précisément les caractéristiques physico-chimiques des milieux de dépôt (1,2).

L'interface eau-sédiment est le siège d'échanges de matière organique dont le bilan a été tenté. Un flux moyen annuel de 33 g/m^2/an de C.org. a été mesuré à 650 m de profondeur sur la marge. La confrontation entre flux de masse totale et vitesse de sédimentation conduit à affirmer que seulement 3 % du flux C.org. contribuent au dépôt, le reste étant exporté plus en aval dans le canyon. Le bilan aboutit à ce que 30 % du flux de C.Org. s'accumulent et 70 % soient relargués dans la masse d'eau, reparticipant ainsi au cycle du carbone en milieu océanique. Pour quelques sites de la marge la vitesse d'accumulation du C.org. à l'interface a été corrélée avec le nombre d'individus de la méiofaune. La relation obtenue est de type exponentiel. Une valeur minimale limite du nombre d'individus semble stabilisée entre 200 et 100 individus /10 cm^2 pour une vitesse d'accumulation de 220 mg C. org/m^2/an qui peut toutefois encore augmenter (440 mg/m^2/an).

Par comparaison, en domaine abyssal il semble plutôt que le taux d'accumulation de C.org soit croissant avec le nombre d'individus total de la méiofaune. Une plus grande importance du métabolisme en domaine profond contre une minéralisation très marquée en domaine bathyal due à des apports trophiques très énergétiques par rapport aux apports en domaine abyssal peut être la cause. Les flux de C.org sont multipliés par 10 dans le canyon (90 mg/m^2/J) par rapport au domaine abyssal atlantique (10 mg/m^2/j) et leur qualité c'est-à-dire leur potentialité d'assimilation est également plus forte. Le sédiment de surface contient 55 % de composés néobiogéniques (fraction humine) non assimilables dans les grands fonds (5) et seulement 30 % dans le chenal axial du canyon, sur la marge de Méditerranée occidentale.

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X-I4

Importance des canyons sous-marins dans la dynamique sédimentaire de la mer Ligure

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Les canyons sous-marins sont, en Mer Ligure, nombreux et typiques, surtout dans les marges alpine et corse. A l'aide de la sismique réflexion on peut aisément distinguer entre:

1) canyons d'érosion sous-marine. C'est notamment le cas des deux vallées de Gênes, creusées dans une série plioquaternaire horizontale;

2) canyons d'origine tectonique. Il s'agit de grabens ou demi-grabens d'allure généralement normale à la côte, dont on a plusieurs exemples entre Savone et Marseille. Ils se forment à la suite des phases principales de la tectonique distensive mio-plio-quaternaire;

3) canyons d'origine mixte. Ils sont engendrés par l'activité d'une faille et ensuite creusés par érosion.

Même les canyons d'origine tectonique pure ont connu, pendant le Plio-Quaternaire, plusieurs épisodes de comblement. Ils ont été réactivés grâce à l'activité des failles, qui a permis aux agents de l'érosion sous-marine de recreuser en correspondance avec la dépression structurale. Parmi ces agents, on reconnaît:

- les courants de turbidité, actifs surtout pendant le Pliocène inférieur et au cours de phases de régression glacioeustatique du Quaternaire;
- les courants de densité se déplaçant sur le fond, actifs à la suite de situations climatiques particulières (actuellement en hiver).

La répartition des sédiments en Mer Ligure, à l'echelle géologique du temps, dépend en grande partie de ces phénomènes, mais les canyons ont une fonction importante même dans la dynamique actuelle, hydrologique et sédimentaire, de ce Bassin.

Des études récentes sur les suspensions minérales dans les eaux de surface et de profondeur dans les canyons de Gênes ont montré qu'en hiver, des masses importantes d'eau, chargée de matériel, descendent lentement de la surface jusqu'à la profondeur de 500m le long de l'axe de ces canyons. L'axe de la vallée est toujours en érosion grâce à des courants trés actifs qu'on a mis en évidence en étudiant les mouvements des sédiments qui s'y trouvent, tandis que la vallée ouest connaît actuellement une phase de déposition. En été, on observe une remontée d'eau riche en particules le long de la vallée est.

L'élaboration d'images CZCS chez le CCR d'Ispra (Italie) sur 20 passages du satellite, montre des situations intéressantes qui concernent même les matériaux organiques. Les répartition et concentrations des materiaux en suspension dans les eaux de surface du Golfe de Gênes, bien que déterminées en grande partie par les activités de la ville, semblent influencées par des phénomènes d'upwelling prés de la tête des canyons.

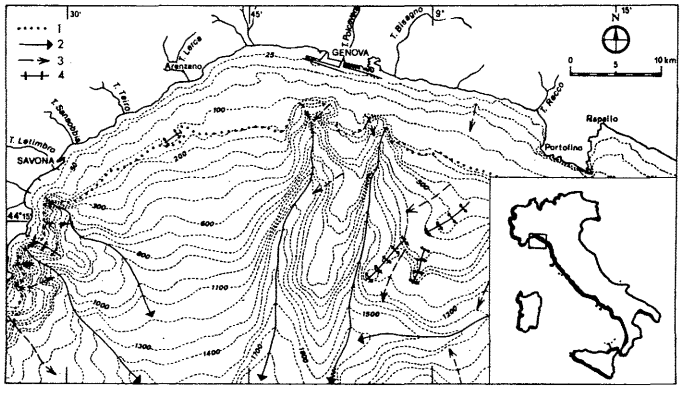

Fig. 1 - Morphologie du Golfe de Gênes. - (1) Rebord; (2) Axes de canyons; (3) Dépressions érosives; (4) Reliefs.

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X-I5

Advection of resuspended material along the slope of the Thermaikos Margin

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Hydrodynamical and sedimentological characteristics of the Thermaikos margin and of the Sporades basin have been described by BALOPOULOS et al. (1987) and LYKOUSIS et al. (1981). More recently, an extensive coverage of this area by hydrological and nephelometric casts provided an improved picture of the general circulation and of the distribution of the suspended matter (CHRONIS et al., 1987).
The geostrophic flow calculated at the eastern limit of the Sporades basin indicates an anti-cyclonic flow above the no-motion depth and a cyclonic flow in the deep water (fig.1). This circulation is in agreement with the isopycnal and isothermal structures in the Sporades basin. The depth of reference has been determined using the inverse method based on the conservation of the fluxes (VERONIS, 1987).
The dynamical method cannot be applied to the shallow water of the shelf. However, the nepheloid structures illustrate the combined effect of these two circulations on the transport of suspended matter in the transitional area of the continental slope. An axial section across the shallow basin (fig.2) shows a detached shelf-BNL extending above the slope at depth of the shelf break and an INL between 400 and 500 meters (fig. 3 a). From the transect along slope (fig. 2), this INL is interpreted as a consequence of the erosion of the slope (fig. 3 b), as confirmed by the high turbidity spot between the two canyons. The absence of intensive BNL in the canyons indicates that erosion and subsequent advective transport compete with the predominant down-canyon transfer from the shelf observed on other continental margins (MONACO et al., 1987). The horizontal processes are therefore believed to play a major role in the distribution of suspended matter on the Thermaikos margin and in the Sporades basin.

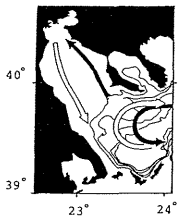

Figure 1 . Schematic flow pattern as deduced from the survey (spring, no significant wind conditions) :
The white arrows represent the surface water flow on the shelf and geostrophic flow above the depth of no motion (ca. 400 m) in the Sporades basin. The black arrows represent the bottom water flow on the shelf and geostrophic flow below the depth of no motion in the Sporades basin.

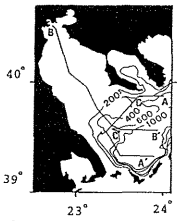

Figure 2 . Bathymetry and sections across the Thermaikos shelf and the Sporades basin :
(A-A'): along margin section
(B-B'): longitudinal section
(C) and (C'): canyons

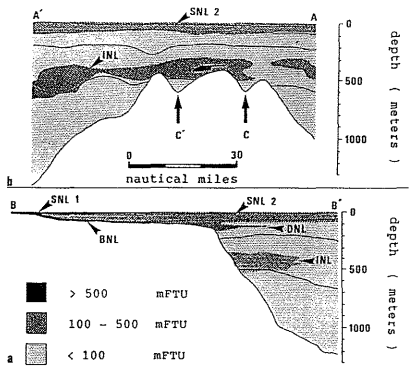

Figure 3. Turbidity and density structures. (a): cross-section of the Thermaikos shelf and the Sporades basin. (b): section along the margin. Turbidity is expressed as FTU (Formazine Turbidity Unit).
The vertical distribution of suspended matter follows the isopycnals surfaces and is subdivided roughly in four nepheloid layers :
- The Surface Nepheloid Layer has a predominant terrigeneous origin near-shore (SNL 1) and is more biogenic off-shore (SNL 2).
- The Detached Nepheloid Layer (DNL) at shelf-break depth originates mainly from the Bottom Nepheloid Layer (BNL) observed on the shelf.
- By contrast, the Intermediate Nepheloid Layer (INL) at depth between 400-500 m is attributed to resuspension processes and transport by the general circulation along the slope as suggested by an absence of a BNL in the canyons C and C'.

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X-I6

Hydrological conditions and material transfer mechanisms in the Northwestern Aegean Sea (Thermaikos Plateau and Sporadhes Basin) : research activity within the framework of the EURECOMARGE Project

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INTRODUCTION

The northwestern Aegean region of the Eastern Mediterranean Sea invites the attention of marine scientists because alterations are occurring in its waters, as a consequence of urban waste disposal and industrial effluent inputs. Of particular scientific interest are the alterations occurring in the marine environment from the outflows of large river systems (Axios River, Loudhias River, Aliakmon River, Pinios River), which discharge along the northern and western coastlines. The rivers supply large quantities of freshwater (total annual discharge of some 10.2×10^6 m^3 of water) and associated fine-grained terrigeneous material (of the order of $3-4 \times 10^6$ tonnes/year), influencing greatly the ecosystem and in particular the hydrodynamical and sedimentological conditions in the area (Balopoulos et al., 1987; Chronis et al., 1987; Chronis et al., 1988).

In the framework of the EURECOMARGE Project, the northwestern Aegean Sea (Thermaikos Plateau and Sporadhes Basin) was surveyed by the R/V AEGAIO during the ECOAEGAIO-I-87 Cruise (1-6 June 1987).

METHODS

Hydrographic casts were made at 85 stations using a Neel Brown CTD profiler, coupled with a transmissometer (for the measurement of the concentration of the suspended material, expressed in units of turbidity Formazine FTU). In addition, two current meter moorings, consisting of three self-recording current meters (Aanderaa RCM5) each, were maintained on the shelf break (water depth 200-210m), during the same time period, to study near-surface, mid-depth and near-bed currents.

RESULTS

Surface waters were generally characterized by higher temperatures and lower salinities, than the underlying waters. This lowered the water density of the upper layers and resulted in strong stratification. In Thermaikos Gulf surface temperatures and salinities ranged between 19.0-20.0 °C and 36.0-37.7‰, respectively. The thermocline and halocline extended down to around 30m. Below this depth temperature decreased gradually with increasing depth and salinity increased only slightly. In Sporadhes Basin surface temperatures and salinities varied between 17.0-19.0 °C and 36.0-38.5‰, respectively. Here, the stratification extended down to a depth of around 50m, below which was present an almost homogeneous water mass of low temperature 12.5-13.5 °C and hihg salinity 38.7-38.8‰.

To the north, surface waters of low salinity (34.0-36.5‰), high temperature (20.0-21.0 °C) and high turbidity (1400-2000 mFTU), related to the discharges of the Rivers Axios and Aliakmon, were flowing towards the Aegean Sea along the western coastline (Fig. 1). The outflow from the Pinios River was present as a tongue of surface water of low salinity (35.8-37.0‰) and high turbidity (1400-2400 mFTU), extending towards the northeast. Further south (Station 1) water flow was towards the southwest at speeds of less than 13 cm/s (Table 1) Relatively data records collected in the west (Stations A and B) were all unimodally distributed, showing high concentrations northwards.

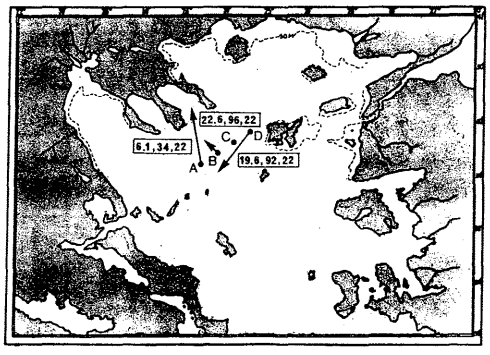

Fig. 1. Summary of near-surface residuals in North Aegean Sea. [Arrows indicate direction. Lengths are proportional to the magnitude of the vector means. Each set of the three values represent: residual flow in cm/s; the steadiness factor "B", as a percentage (Balopoulos et al., 1986b); and, the length of the record in days (in that order)].

In the west (Station A), residual currents (Table 1) exhibited quite important speeds (22.6 cm/s at the near-surface layers, 13.8 cm/s at mid-depth and 11.2 in the near-bed layer). Here, residual flow was, in all cases, northwards (e.g., see Fig. 1). At the adjacent Station B, the residual current was in the same direction but much lower in magnitude (6.11 cm/s at the near surface layers, 3.8 cm/s at mid-depth and 1.8 cm/s in the near-bed layer). In the east (Stations C and D), the magnitude of the residual current, in the near-bed layer, was around 8.5 cm/s. The residual flow was towards the southwest at Station C and towards the northwest at Station D. At the latter station the residual flow at the near-surface and mid-depth layers was towards the southwest at around 19.6 cm/s and 7.1 cm/s, respectively.

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Current meter measurements in the North Aegean, Eastern Mediterranean Sea (late Winter, 1988)

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INTRODUCTION

Several physical oceanographic studies have been carried out within the last fifteen years to study hydrological conditions and water circulation patterns over the continental shelf of Thermaikos Gulf, in the Northwestern Aegean Sea (Balopoulos and James, 1984; Balopoulos et al., 1986a; Balopoulos et al., 1986b; Balopoulos et al., 1987). The investigations were recently extended (in the framework of the EURECOMARGE Project) over the Sporadhes Basin. However, the study of circulation patterns in the North Aegean Sea and particularly in the straits connecting the northern sea area (Sporadhes and Athos Basins) with the southern region (Chios Basin) requires further investigation. In this contribution, water flow characteristics from long-term current measurements between the Islands Psathoura and Limnos are presented and the variability in direction and speed of the measured residual currents are investigated.

METHODS

Four current meter moorings were maintained in the above mentioned area (Fig. 1) from February 28 to March 22, 1988. Self-recording current meters (Aanderaa RCM5) were used in all cases; these were deployed using a vertical mooring array with subsurface buoyancy.

RESULTS

Mean current speeds at the various stations decreased with increasing depth. They ranged from 21.6-23.4 cm/s in the near-surface layer, 11.1-14.8 cm/s at mid-depth and 7.1-11.8 cm/s in the near-bed layer. Maximum current speeds were in all cases seen in the upper layers. They ranged from 42.1 cm/s (Station B) to 50.2 cm/s (Station D). The numerical estimates for the standard deviation suggest that the current meter data recorded in the upper layers, were, at all stations, the most widely dispersed. The direction frequency distributions for the higher current speeds (up to 33 cm/s) were measured at Station 2. Here, there was indication of a three-layered water circulation. That is, in the near-surface layer the steady water flow was towards the northwest, at mid-depth the residual current was towards the northeast, whilst in the near-bed layer dominated water flows towards the southeast. Analysis of the data further revealed, that oscillating flows with periods near the inertial frequency band seem to be a quite important feature of the mid-depth and deep water motion, in the area.

TABLE 1. SUMMARY OF MEASURED RESIDUAL CURRENTS IN THE NORTH AEGEAN SEA AND THEIR VARIABILITY IN DIRECTION AND SPEED (USING DOODSON'S Xo FILTER).

Stn Ref	z	Scalar Mean (cm/s)	Vector Mean Ampl. (cm/s)	Vector Mean Dir. (o)	Residual Current Steadiness Factor "B" (%)	σ⟨v⟩ (cm/s)	σ⟨u⟩ (cm/s)	Length of Record (days)	Data Cycles
A	365	23.59	22.58	340	96	1.56	1.50	22	3311
	165	14.35	13.82	004	96	1.00	0.83	22	3311
	043	11.59	11.21	017	97	1.17	0.76	22	3311
B	345	17.86	6.11	312	34	3.33	2.13	22	3297
	180	8.95	3.81	317	43	1.70	1.08	22	3297
	030	4.75	1.76	033	37	0.87	0.66	22	3297
C	030	10.72	8.45	226	79	1.33	1.20	22	3283
D	203	21.29	19.58	239	92	1.87	1.68	22	3263
	108	10.91	7.09	268	65	1.59	1.56	22	3263
	033	9.66	8.49	352	88	1.00	0.97	22	3263

KEY: z is the elevation above sea-bed, in metres
σ⟨v⟩ is the standard error of N-S component of residual flow
σ⟨u⟩ is the standard error of E-W component of residual flow

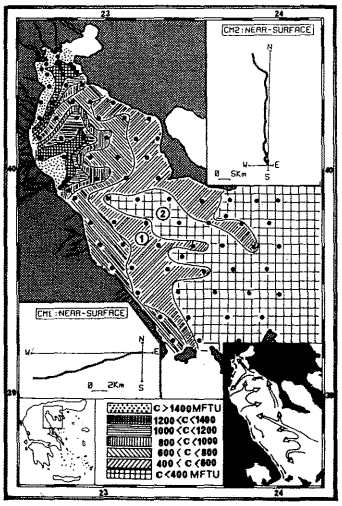

Fig. 1. Distribution of suspended material (mFTU) in the surface layer (<5m) of the northwestern Aegean Sea.

TABLE 1. CURRENT STATISTICS IN THE NORTHWESTERN AEGEAN SEA

Stn.	z	P	Mean	σ	Max.	Min.
CM1	195	V	4.3	2.4	10.5	0.1
		u	-4.1	2.3	-0.1	-9.9
		v	-1.0	1.1	3.1	-3.9
CM1	120	V	2.5	3.1	9.9	0.1
		u	-1.5	2.6	2.3	-8.9
		v	-1.0	2.3	3.5	-7.5
CM1	007	V	4.0	4.5	13.3	0.1
		u	-2.3	2.8	0.1	-9.2
		v	-3.2	3.6	0.2	-10.9
CM2	187	V	16.5	6.7	32.6	2.3
		u	-2.2	6.1	12.6	-18.9
		v	14.6	7.9	32.6	-8.2
CM2	120	V	6.2	3.8	13.8	0.1
		u	3.7	3.9	12.9	-3.8
		v	3.7	3.3	11.6	-2.6
CM2	007	V	2.0	2.5	8.3	0.1
		u	0.8	2.2	7.9	-5.1
		v	-0.7	2.1	5.4	-6.6

z is the elevation above the sea-bed in metres.
P is the parameter.
σ is the standard deviation.
V is the current speed
u is the E-W current component
v is the N-S current component

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Conditions hydrosédimentaires en Méditerranée nord-orientale. Application aux plateformes deltaïques N.O. Mer Egée (plateau de Thermaikos-bassin des Sporades) : Projet EURECOMARGE

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Sur la base de relevés sismiques, morphologiques, mesures in situ (néphélométrie, courantométrie, hydrologie) et de méthodes spécifiques à l'étude des sédiments, une reconstitution des mécanismes hydrosédimentaires actuels et des mécanismes sédimentaires récents (dernière transgression Holocène) est effectuée.

Dans le système deltaïque (Fig. 1) de la plateforme de Thermaikos on reconnaît actuellement :

- Le domaine de stockage sur le plateau interne avec constitution d'un prisme sédimentaire épicontinental (PSE) et progradation forte au niveau des embouchures de trois principaux émissaires (r. Axios, r. Aliakom, r. Pinios). Le taux de sédimentation varie de 2,5 m à 0,05 m par millénaire en allant de la côte Ouest vers la côte Est de ce compartiment. Les phénomènes cycloniques, (BALOPOULOS et al., 1988), liés aux conditions météorologiques et les phénomènes de floculation conduisent à l'envasement précoce. La perte de charge de la couche néphéloïde superficielle est de l'ordre de 50 % à 5 milles de l'embouchure d'Axios. Cette observation est comparable à celle du Rhône. La géométrie du BNL prend une forme prismatique (CHRONIS G. et al., 1988) comparable au prisme sédimentaire holocène.

- Le plateau externe, limité entre les isobathes de 50 et 200 m, est caractérisé par l'amincissement du PSE. Vers le bord du plateau apparaissent les sables reliques wurmiens (LYKOUSSIS et al., 1987). Le taux de sédimentation holocène varie entre 1,5-2,0 m par millénaire. L'évolution du BNL subit une diminution vers le large et vers l'Est. Dans la zone de transition cette couche tend à se détacher du fond indiquant l'influence d'un transport advectif.

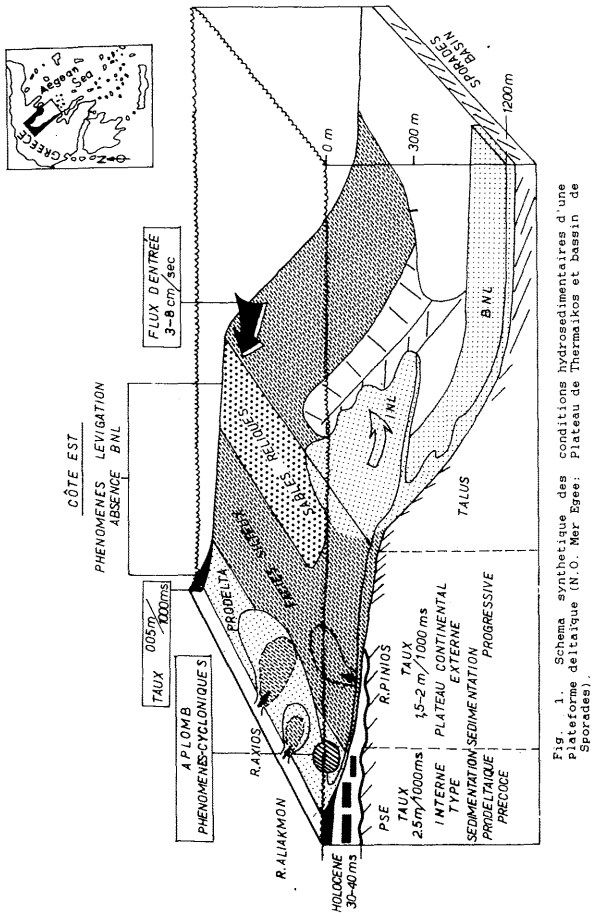

Fig. 1. Schema synthetique des conditions hydrosedimentaires d'une plateforme deltaïque (N.O. Mer Egee: Plateau de Thermaikos et bassin de Sporades).

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X-I9

Project EURECOMARGE
Eutrophication and phytoplankton ecology in the Thermaikos Gulf

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SUMMARY

The abundance and taxonomic diversities of phytoplankton has been studied in relation to sewage and rivers pollution in the Thermaikos Gulf, Greece. Surface water samples were collected from a series of stations in December 1984 and in May and September 1985. Water samples from the vicinity of sewer outfalls and rivers showed very high concentrations of nutrients, a greater abundance of phytoplankton, and a lower taxonomic diversity than samples remote from sewage outfalls and rivers. Thus, increase in abundance is highly correlated with PO_4^{-3} and NO_2^- concentrations and the decrease of salinity is highly correlated with the same parameter. A considerable variation in the occurrence of species and dominance occurred along the pollution gradient. Diatoms dominated in all the area and in the three seasons. Nitzschia closterium, Cerataulina bergonii, Leptocylindrus minimus, Chaetoceros socialis and Thalassiosira sp. were the most dominant species. Thus, the natural coastal phytoplankton community appears disturbed by the increased level of nutrients from sewage effluents and rivers.

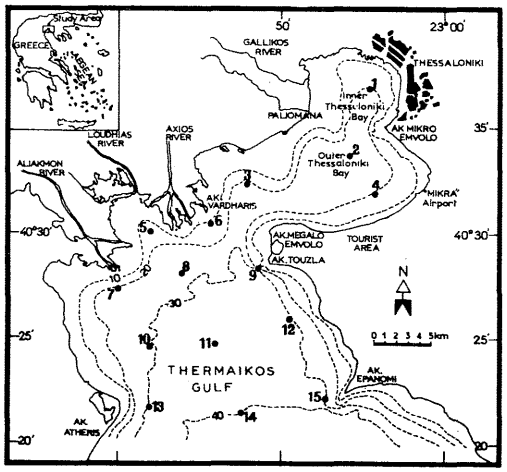

Fig 1. Location of the stations in the Thermaikos Gulf.

X-I10

Project EURECOMARGE
Research on the Adriatic and Tyrrhenian continental shelves

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The first big impact of land derived materials, both from natural processes and human activity occurs in the continental shelf. This environment normally receives a continuous supply of suspended solids and associated pollutants whose fate and influence on the marine ecosystem are very difficult to assess. In this context, an interdisciplinary approach to the environmental research becomes necessary, and the EUROECOMARGE stimulation program has been a notable attempt to focus the experiences of different scientists (geologists, oceanographers, chemists and biologists) to study selected environments of the Mediterranean margins, in preparation of a bigger effort in marine ecosystem studies supported by the EEC.

Our Institute took part to this stimulation program, because of its interest in geological, sedimentological and environmental marine researches. Our general aim is to study the sedimentary processes in terms of events, mechanisms and reactions which involve particulate materials. Even if some researches were performed in other areas to test methods and compare results, the main interdisciplinary effort was devoted to the Adriatic Sea.

Obviously the processes we study in the water column and in the sediment occur on different time scales ranging from present back to several thousand years.

In order to obtain quantitative basic information it is necessary to go through the following steps: 1) identify different sources of inputs (rivers, runoff, atmosphere); 2) follow sorting and dynamics of suspended solids in the marine environment and localize the sites of accumulation of fine materials; 3) estimate the nature and rate of solid-solution interactions in the water column; 4) estimate deposition fluxes to the bottom and influence of resuspension and mixing processes; 5) estimate benthic exchanges of ionic species at the sediment-water interface and their prevailing directions. Important sedimentological information can be obtained from the upper portion of the sedimentary column: 1) areal distribution of sediment characteristics; 2) downward distribution of geochemical and sedimentological parameters; 3) preservation or loss of distinct sedimentary structure.

High resolution seismic and side scan sonar data contribute to the reconstruction of specific sedimentary environments pointing out the sedimentary processes active during sediment deposition and layer formation. This is of great importance for a better understanding of the sedimentary dynamic processes both at large and fine scale. These techniques provide a framework for the environmental researches and can also be used to collect detailed information in order to position sampling stations and to locate the best zones for in situ experiments.

In this field the main research interest was focused on the last-glacial sealevel fluctuation in the shelf of the Eastern Tyrrhenian. Erosional and depositional features suggest sealevel drop during the last-glacial maximum to the present-day -110/-120 m bathymetry /1-2/. In these conditions the deeper parts of the shelf remained entirely submerged during the glacial hemicycle. These outer-shelf areas provide the excellent opportunity of studying the erosional and depositional features that originated during the sealevel lowstand, since no younger sediment supply reached the area during and after the ensuing sealevel rise.

The interaction between sediment supply and shelf-depth currents along the shelf was also pointed out /3/. Evidences of currents capable to winnow the sediments, at depths of as much as -110 m during highstand conditions, came from direct core sampling on top of morphologic reliefs /4/. A comparison between the Tyrrhenian and the Adriatic shelf is at this point expected to be constructive, for the two data-bases have improved greatly during the last few years and some interdisciplinary work is in progress.

Geological and sedimentological studies of the Adriatic shelf were described by many authors /5-6/. However, for a long time, these studies have been limited by the lack of information about recent sedimentation rates.

Radiochemical measurements of Cs-137 (from fallout) and Pb-210 are used to evaluate rates of sediment accumulation on the Adriatic Sea shelf. The activity-depth profiles provide a maximum apparent accumulation rate of the order of 2 g cm^{-2} yr^{-1} /7/ near the Po River delta. The Chernobyl signal (Cs-137 and Cs-134) /8/ and the radionuclide inventories show that the radiocesium supply from the drainage basins of major rivers significantly overcomes the input from direct fallout all over the shelf. On the contrary, fallout of Pb-210 seems to be more significant with increasing distance from the river mouths.

The radionuclide distributions in the sedimentary column can be due to sediment accumulation and mixing and the ratio of mixing to accumulation is important to understand the stratigraphic record. The incidence of mixing phenomena (bioturbation, resuspension) on the profile is now being evaluated to obtain the net accumulation rates. Moreover some assumptions in the application of the model calculations have to be verified.

Researches on sediment pollution for heavy metals, chlorinated hydrocarbons and nutrients were carried out on the continental shelves of the Italian seas, particularly in the NW Adriatic. Some of them were mainly concerned with areal distribution of pollutants /9/, some related sediment features with suspended particle fluxes and composition /10/. The results for the Northern Adriatic Sea have been reviewed by Frascari et al. /11/.

Much effort was afterwards devoted to benthic flux measurements /12-13/ and interstitial water analyses of nutrients and related ionic species /12-14/. These data were interpreted in order to estimate exchange reaction rates between water and sediment and assess the factors controlling sediment contribution to the mass balance of these substances. These measurements are still in progress with technological improvements.

In order to improve our knowledge about the processes occurring in the marine ecosystems and their influence on the environmental quality, we are prepared to insert our experience in the broad multidisciplinary perspective now available.

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The Pollensa Bay carbonate factory (Balearic Is., NW Mediterranean Sea)

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The Balearic Islands continental shelf, mainly comprised in the photic zone, is a preferential site study area for the interelationships between benthic carbonate-producing communities and carbonate sedimentation. In this sense, Pollensa Bay, a roughly rectangular, well-protected bay, in the NE part of the Mallorca Island, covering an approximate area of 600 Ha, meets special requirements concerning the establishment of those interelationships. The outer limit of the Bay is marked by the isobath of 50 m.

From shallower to deeper waters, the carbonate-producing benthic communities -in parentheses, production range and mean ponderated annual production in gr $CaCO_3/m^2$/year- in Pollensa Bay are : **1) Photophylic algae** of hard substrate (40-350, 200); **2) Caulerpa prolifera** with the seagrass Cymodocea nodosa (<5, 5); **3) Posidonia oceanica** (around 100,100); **4) Sand communities with Spatangus** (<5, 5); **5) Sand communities with concretions and Vidalia volubilis** (50-130, 90) and **6) Coralligenous** (100-150, 125). After integration of the areas covered by each community, a total annual carbonate production of 4000 metric tones results, the 60% to 70% coming from the P. oceanica community.

Obviously, the carbonate production in the Pollensa Bay is used to form several types of surficial biogenic sediments which, by means of a multivariate statistical analysis, have been classified as following : **a) Bioclastic gravels and sands (BGS)**, in the inner and medium bay, to 25-27 m deep; **b) Pelecypoda-dominated muddy sands (PMS)**, in the central outer part of the bay and off of its mouth; **c) Pelecypoda and echinoid-dominated muddy sands (PEMS)**, covering a small area at the north of the bay, near its mouth; and **d) Algal sands (AS)**, locally **algal crusts (AC)**, from the outer limit of the bay towards the open shelf. With few exceptions, **terrigenous sands and gravels (TSG)**, dominated by mudstone debris, are present only in some coastal areas. **Transitional sediments** (like the coastal fringe grading from TSG to BGS, and the **mixed transitional muddy sands (TMS)** which mark the passage from BGS and PMS to the outer bay AS and AC) and sediment patches of different sizes are also a very common feature.

Difficulties to establish the direct relationships between benthic communities and sediment types arise from two main facts : a) the natural variability of the living communities (both in time and space), and b) from physical and biological processes breaking and transporting the particles. Also incipient solution and diagenetic changes during first burial stages may add difficulties to the problem. However, in the Pollensa Bay some correspondencies seem to exist between the benthic communities and the sediment types. For example, the inner-medium bay BGS recovers well the area occupied by the community of P. oceanica. Also, the fact that the coralligenous community patches are surrounded by algal sands and crusts suggests a genetical relationship. The low productive passage zone (sand communities with Spatangus) from the highly productive P. oceanica community to the deeper and also highly productive coralligenous community seems to be marked by more muddy sediment types (MSP, TMS); patches of algal sands and crusts in these muddy sediments would be related with the high productive sand communities with concretions and V. volubilis. Also, by the area they occupy and by their composition, the pelecypoda and echinoid-dominated sediments (PEMS) suggest a genetic relation with the sand communities with Spatangus.

Although precautions must be taken when considering raw data and final gross values, carbonate losses or gains at a given point can be showed by comparison between **theoretical sedimentation rate (St)** resulting from **carbonate production (P)** and **"accumulated time-averaged carbonate production" (Pt)** obtained from known ^{14}C derived **mean sedimentation rates (S)**.

As an example, for a core taken at 87 m deep, off the Pollensa Bay, a Pt of 175 to 238 gr/m^2/year has been obtained. In this case, the mean Pt, 206 gr/m^2/year, is 1.6 times greater than the coralligenous community mean ponderated production and, at least, 41 times greater than the sand communities with Spatangus mean ponderated production. Such a Pt cannot be explained only as local derived and a supplementary input from sorroundig areas is required, even considering time variations in P related to the last eustatic rise and its associated modifications in the emplacement of the high productive benthic communities. Finally, we want to point out that figures such as those just mentioned must be considered more as magnitude indicators than as absolute values.

Also other strong supporting evidencies of carbonate particle transfers from the shallow productive zones to greater depths are : erosive channels, undercuting of slopes, slide scars and tilted blocks in the P. oceanica prairies; presence of allochtonous particles from shallower depths in almost all the sediment types; spillover deposits in sediment cores; thick prograding sedimentary sequences in the upper continental slope; filling of old shelf seavalleys going from the Pollensa and Alcudia Bays towards the shelfbreak; large and intermediate transport bedforms as sand waves in the Menorca Channel.

We can conclude that the Pollensa Bay, probably like other bays and shallow areas in the Balearic Islands shelf, is a true factory of carbonate sediments which are partly spitted to the open shelf and deeper areas. In such a factory, one single "specialised worker", the P. oceanica community, is responsible for more than 60% of the total annual production of carbonates.

La marge continentale Sud-Gascogne (Atlantique N.E.) Enseignements dans le cadre du Programme ECOMARGE

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Au titre du Programme ECOMARGE les flux de matière et d'énergie au système océanique profond sont étudiés de manière complémentaire sur deux façades océaniques :
- la marge méditerranéenne, système à régime microtidal et à transfert rapide des matières d'origine continentale vers le bassin profond.
- la marge Sud-Gascogne (Atlantique N.E.), système à régime macrotidal et à temps de résidence élevé des particules sur le plateau.

La présente communication est consacrée (fig. 1) à la partie interne de la plateforme Sud-Gascogne, marge très étendue (160 km au maximum) présentant une morphologie uniforme. La couverture sédimentaire est principalement constituée de sables fins et de graviers mis en place durant les régressions quaternaires et profondément remaniés jusqu'à l'Actuel. Au large de l'embouchure de la Gironde, entre 30 et 65 m de profondeur, des sédiments fins ("vasière Ouest-Gironde") sont plaqués sur le substrat sablo-graveleux. Sur cette marge, la marée (type semi-diurne ; amplitude moyenne 2,3 m) contrôle la quantité, la qualité et le devenir des flux issus des sources continentales. La principale source , l'estuaire de la Gironde, fournit 70 % des apports. Selon les années, les flux varient de 0,5 à $1,5.10^6$ T/an pour les matières solides (M.E.S.) et de 2 à 5.10^6 T/an pour les matières dissoutes. Les flux de carbone organique particulaire (COP) représentent en moyenne $1,4.10^4$ T/an et ceux de carbone dissous $13,5.10^4$ T/an [4].

Caractéristiques des estuaires macrotidaux, les expulsions[2] ne se produisent que quelques dizaines de jours par an (15 à 50) lorsque se trouvent réunies les conditions suivantes : marées basses de vives-eaux, localisation du bouchon vaseux à l'aval de l'estuaire, crues des fleuves. Sur le plateau, la configuration du panache turbide dépend de la marée, de la houle et des conditions météorologiques. La figure 2 montre l'expulsion en surface des eaux estuariennes chargées en particules et l'alimentation de la vasière par le fond. Au large, les masses d'eau à caractère typiquement océanique (salinité, T) créent une barrière hydrologique (fig. 3) contrôlant directement la géométrie du panache turbide et la sédimentation. La distribution du COP et du ^{13}C associé [3] montre que, en relation avec les caractéristiques hydrologiques [1], les masses d'eau dessalées s'étendent vers le Nord et l'Ouest jusqu'à l'isobathe 40 m puis sont rabattues vers le Sud alimentant une sédimentation sur la "mud-line", dans les vasières littorales et la vasière "Ouest-Gironde". Un important développement phytoplanctonique a été observé dans les masses d'eau soumises à l'influence de la Gironde ; il est lié au flux estuarien de substances nutritives dissoutes : COD, nutrients [3].

La vasière W-Gironde, qui constitue le principal réceptacle des flux particulaires estuariens présente, sur les 20 premiers centimètres, une zonation dynamique qui est mise en évidence[5] par l'agencement des séquences lithologiques, l'activité biologique, les datations isotopiques (^{210}Pb, ^{7}Be, ^{137}Cs) et polliniques .

Dans la zone interne de la vasière, entre 25 et 40 m de profondeur, des dépôts résiduels fossiles constitués de vases argileuses mises en place, il y a environ 3 000 ans dans un environnement côtier, sont soumis à l'érosion : seuls les sédiments sableux amenés par les tempêtes persistent. Dans ce secteur la sédimentation fine actuelle est uniquement saisonnière et fugace.

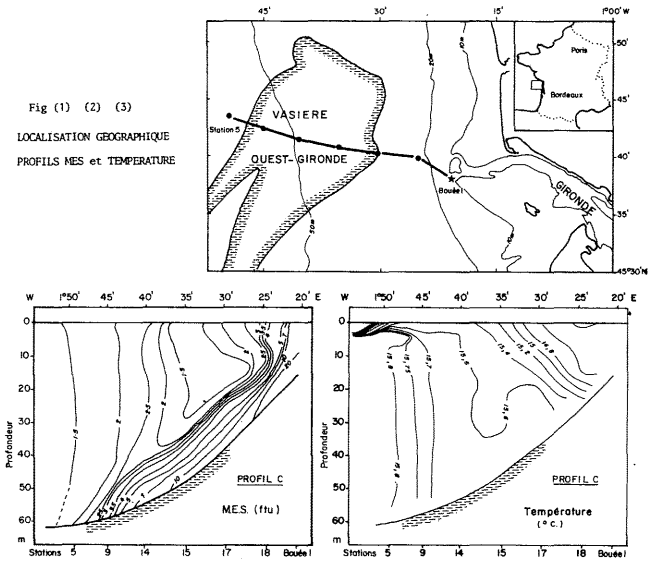

Fig (1) (2) (3)
LOCALISATION GEOGRAPHIQUE
PROFILS MES et TEMPERATURE

Dans la zone médiane et externe de la vasière (entre 40 et 70 m de profondeur) la preuve d'une sédimentation actuelle, principalement issue de la Gironde, a pu être établie. Les vingt premiers centimètres de sédiments ont moins de 30 ans, le 1er cm étant contemporain (présence de ^{7}Be). Dans ce secteur où la sédimentation est plus intense que l'érosion, la structure des dépôts témoigne d'une succession de phases dynamiques et de périodes calmes pendant lesquelles l'activité biologique peut se manifester d'une façon importante.

Les résultats montrent donc la complexité de la sédimentation et des transits sédimentaires sur une marge de régime macrotidal. Si les flux d'origine continentale sont principalement contrôlés par la marée, les processus sédimentaires et les transits sur la marge paraissent en revanche directement soumis à la limite d'action efficace de la houle et de l'hydrologie générale sur le plateau, en particulier de la position du front océanique.

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Continental shelf Research (sous presse).

X-II1

Les Méduses de la Méditerranée orientale

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Samples from the coasts of Liban contain 50 species of Medusae. Actually, 64 species are known from the eastern Mediterranean Basin, 10 with indo-pacific repartition (thick written in the list).

Depuis longtemps, on constate un déséquilibre dans la connaissance faunistique des deux bassins de la Méditerranée. La localisation des missions océanographiques et la position des laboratoires de recherches expliquent l'abondance des observations dans la partie occidentale. Aussi, toutes les données, même ponctuelles, sur la partie orientale deviennent très précieuses car elles comblent une lacune et sont susceptibles d'orienter des travaux dans ce secteur.

L'exemple est fourni par l'étude des méduses. Cinq publications, en vingt ans, apportent enfin quelques précisions sur le peuplement du bassin oriental. Dowidar et El Maghraby (1970, 1983) citent 17 espèces au large d'Alexandrie; Lakkis et Zeidane (1971, 1985) en citent 23 au nord de Beyrouth et Schmidt (1973) 15 dans une zone s'étendant à l'est du 26° E. Dans les échantillons pêchés en un an sur les côtes du Liban, 50 espèces ont été répertoriées dont 23 nouvelles dans ce secteur. Ces analyses font ressortir la richesse du Bassin Oriental avec 64 espèces connues. L'ensemble de ces travaux s'accorde sur les 2 périodes d'abondance: avril-mai et fin septembre, et fait ressortir le caractère tempéré et chaud de la majorité des espèces dont certaines ont une affinité avec la faune de l'Océan Indien (en gras dans la liste).

Liste des espèces	Dowidar	Schmidt	Lakkis *et al.*	Liban
Dipurena ophiogaster			x	x
Sarsia eximia				x
Sarsia gemmifera				x
Ectopleura dumortieri	x			x
Euphysa aurata	x			x
Euphysora bigelowi		x		
Plotocnide borealis				x
Zanclea sessilis			x	
Zanclea costata				x
Cytaeis tetrastyla				x
Paracytaeis octona			x	x
Oceania armata	x		x	x
Turritopsis nutricula	x	x		x
Podocoryne carnea			x	x
Podocoryne minuta				x
Bougainvillia ramosa	x			x
Bougainvillia platygaster				x
Thamnostoma sp.				x
Amphinema dinema				x
Halitiara formosa				x
Merga tergestina				x
Niobia dendrotentaculata			x	x
Pandea conica	x	x		
Kantiella enigmatica				x
Laodicea fijiana		x		
Laodicea undulata v. ocellata			x	x
Obelia spp	x	x	x	x
Phialidium hemisphaericum	x		x	x
Pseudoclytia pentata				x
Cirrholovenia tetranema			x	x
Eucheilota paradoxica				x
Eucheilota ventriculatis			x	
Lovenella cirrata	x			
Phialella quadrata		x		x
Eirene viridula		x	x	x
Helgicirrha schulzei		x		x
Eutima mira	x	x		x
Eutima gracilis				x
Aequorea aequorea	x			x
Aequorea conica				x
Moerisia carine			x	
Gossea corynetes	x			
Pochella oligonema				x
Proboscidactyla ornata				x
Geryonia proboscidalis		x	x	x
Liriope tetraphylla	x	x	x	x
Halitrephes juvenile				x
Aglaura hemistoma		x	x	x
Pantachogon haeckeli	x			
Persa incolorata				x
Rhopalonema funerarium	x			
Rhopalonema velatum		x	x	x
Sminthea eurygaster				x
Tetrorchis erythrogaster			x	
Solmundella bitentaculata		x	x	x
Cunina octonaria		x		
Cunina sp.			x	x
Solmissus albescens			x	x
Nausithoe punctata	x			x
Pelagia noctiluca	x			
Aurelia aurita	x			
Cotylorhiza tuberculata			x	
Rhizostoma pulmo			x	x
Cassiopea andromeda				x
TOTAL	17	15	23	48 dont 21 nouvelles

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X-II2

Vingt ans d'observations sur le plancton des eaux Libanaises : comparaison avec le plancton de la mer Rouge

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Les données sur le plancton du secteur libanais sont relativement récentes.Avant 1968,elles étaient presque inexistantes(Lakkis,1971). Depuis cette date des prélèvements quasi mensuels sont effectués au moyen de filets planctoniques standards de différentes mailles(50, 200,300 et 500 microns) en plusieurs stations côtières et au large de la côte libanaise ayant pour but d'étudier la composition et les cycles annuels ainsi que les variations d'abondance saisonnières des différents groupes du Phytoplancton et du Zooplancton.Les résultats ont été rapportés par étapes suivant l'avancement des recherches(Lakkis,1973,1976,1980,1983,1984;Lakkis et Novel-Lakkis,1981,1985).Dans cette note, nous présentons une synthèse de la composition et de la répartition du plancton libanais avec une comparaison générale avec le plancton de la mer Rouge,fondée sur les espèces indo-pacifiques et érythréennes migratrices formant des éléments importants du plancton levantin.

Le secteur libanais est caractérisé par un plateau continental étroit une eau à salinité élevée(moyenne S=39,20‰)et une température variant en surface entre 16°C en février et 30°C en août. La circulation générale comprend un courant de surface sud-nord parallèle à la côte,duquel se détachent des courants cycloniques locaux,suivant la configuration topographique de celle-ci.Le plancton des eaux libanaises est de type méditerranéen tempéré avec une certaine affinité subtropicale due aux conditions hydrologiques locales,notamment T°C,S‰ ainsi qu'aux apports d'espèces indo-pacifiques et érythréennes devenues au cours des années des formes endémiques du Bassin levantin.En effet, l'influence du canal de Suez sur la faune et la flore planctoniques est prépondérante,car l'émigration vers la Méditerranée orientale est quasi continue.Par ailleurs,la régularisation des eaux du Nil depuis 1965 par le Haut Barrage d'Assouan semble avoir des répercussions sur l'écologie entière du Bassin levantin

Au tableau I,nous présentons les données relatives à la composition et à l'abondance saisonnière des différents groupes planctoniques ainsi que le nombre d'espèces présentes en comparaison avec le plancton de la mer Rouge et du canal de Suez. Les espèces indo-pacifiques et érythréennes présentes dans les eaux libanaises suscitent un intérêt écologique particulier . On distingue les espèces qui forment des populations,surtout entre août et novembre;citons parmi elles Hyas coarctatus,Ceratium egyptiacum,Rhabdonella valdestriata,Tintinnopsis spp., Labidocera pavo,Corycaeus minimus indicus,Tetrorchis erythrogaster, Leucifer hanseni,Albunea carabus,Cassiopea polypoides.Un autre groupe d'espèces indo-pacifiques est formé d'espèces présentes dans nos eaux levantines en petit nombre, mais d'une façon régulière et toujours durant la meme période août-novembre.Parmi celles-ci,signalons Proplectella perpusilla,Protorhabdonella simplex,Labidocera pectinata group,Labidocera madurae,Calanopia elliptica,C.media,Acartia fossae, Palaemonidae spp.,Processa spp.,Stenopus hispidus.Les espèces phytoplanctoniques d'origine éryhréenne présentes dans les eaux levantines montrent leur poussée saisonnière en août contrairement aux espèces méditerranéennes dont le pic printannier en avril-mai est réguier. Les tintinnides et les espèces zooplanctoniques d'origine éryhréenne et indo-pacifique ont toujours leur pic saisonnier entre octobre et novembre lorsque les conditions hydrologiques locales coïncident avec celles de la mer Rouge:température 26°C,salinité 39,30‰ . Par ailleurs,la majorité des espèces migratrices présentes dans les eaux levantines sont plus fréquentes dans les eaux du large ainsi que dans es prélèvements verticaux; seule la grande schyphoméduse Cassiopea polypoides se rencontre dans les eaux côtières et portuaires entre août et septembre.

En conclusion,on peut dire qu'environ 50% des espèces microplanctoniques et 37% des espèces zooplanctoniques sont communes aux deux milieux marins,Bassin levantin et mer Rouge(Halim,1969;Lakkis,1980;Dowidar,1985).Il est évident que ces formes indo-pacifiques et érythréennes,qui ont pu migrer à travers le canal de Suez,sont devenues pour la plupart des espèces endémiques étant donné les conditions hydrologiques favorables dans le Bassin levantin.

Tableau I. Données comparatives entre le plancton des eaux libanaises (Bassin levantin) et celui de la mer Rouge(moyennes génér.).

GROUPES	Nomb. d'esp.	Espèces communes	Hiver	Print.	Eté	Aut.	% relat.
Diatomées(cel/l-1)...	107	31	60000	250000	35000	75000	70%
Dinoflagellés/l-1...	157	63	10000	35000	20000	23000	30%
Foraminifères(N/m3).	5	?	20	45	75	68	-
Acanthaires(N/m3)...	4	?	10	20	30	32	-
Radiolaires(N/m3)...	3	?	1500	2400	1800	2000	-
Tintinnides(N/m3)...	76	31	6000	15000	11000	16000	-
Copépodes(N/m3).....	57	51	1600	6000	2000	1500	61%
Larves Décapodes....106		?	10	35	1100	50	0%
Ichtyoplancton	50		8	22	18	13	3%
Méduses.....	37	10	11	20	13	18	2%
Siphonophores.....	26	14	10	27	9	383	2%
Amphipodes.....	20	?	2	1	2	2	-
Appendiculaires.....	13	8	91	394	230	85	5%
Chaetognathes	10	5	46	175	107	174	4%
Ptéropodes	8	5	18	108	20	6	1%
Cladocères.....	6	2	1	178	765	185	4%
Ostracodes.....	4	0	5	3	1	2	-
Salpes	3	1	2	23	3	3	1%
Dolioles.....	3	2	1	1	1	1	-
Cténophores.....	3	?	3	2	1	3	-
Nauplii de Cirripèdes	?	?	156	58	48	18	3%
Larves diverses.....	?	?	10	570	250	15	6%

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Les Thécosomes de la mer Rouge

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Nous avons successivement exploré la mer Rouge septentrionale (Casanova et al, 1973), la mer Rouge méridionale (Rampal, 1985) et, récemment, le golfe d'Aqaba (27 prélèvements de surface près des côtes jordaniennes en février 1980; 10 prélèvements entre 1200 et 0 m dans la partie méridionale en 1976-1977).

Vingt espèces ont été recencées en mer Rouge (tableau 1). Si l'on excepte le cas des ubiquistes, prédominants sur l'ensemble du bassin, les Thécosomes ont une répartition hétérogène qualitativement et quantitativement : gradient décroissant de la variété spécifique et de la production du sud vers le nord du bassin.

* **En mer Rouge méridionale,** le peuplement, très varié (17 espèces) (tableau 1) comprend des autochotones et des transfuges. Le recrutement de ces derniers traduit l'influence du courant indien qui est très important notamment pendant la mousson hivernale : *Creseis chierchiae* et *Limacina bulimoides*, hôtes fréquents du golfe d'Aden sont rares en mer Rouge et limités au voisinage du détroit de Bab el Mandeb. L'influence du courant se traduit aussi par un phénomène d'eutrophisation qui favorise l'augmentation de la biomasse des autochtones. Ainsi *Creseis acicula*, *Limacina inflata* et *L. trochiformis* qui peuplent tout le secteur sud et représentent près de 90% du peuplement, montrent des pics d'abondance dans la zone du vestibule érythréen (Rampal 1985). Un 4è Thécosome ubiquiste, *Clio convexa* , est assez bien représenté mais il semble éviter la partie la plus méridionale et surtout la zone néritique du détroit. *Creseis virgula* a sensiblement la même répartition que ce dernier. *Cymbulia sibogae*, *Desmopterus papilio* et *Hyalocylis striata* sont des hôtes fréquents de la mer Rouge méridionale mais ils sont moins abondants que les précédents et plutôt localisés au sud de 17° N. Les autres Thécosomes recencés sont parfois fréquents mais généralement peu abondants.

* **En mer Rouge septentrionale** on ne dénombre que 9 espèces de Thécosomes (tableau 1). 4 espèces sont majoritaires : *Limacina inflata*, *Diacria quadridentata*, *Creseis acicula* et *C. virgula* (Casanova et al., 1973); elles représentent plus de 90% des effectifs. *Clio convexa* et surtout *Limacina trochiformis* sont beaucoup plus rares qu'en mer Rouge méridionale. L'espèce caractéristique, *Diacria quadridentata*, se rencontre sur toute la mer Rouge mais ses plus forts pourcentages se situent au nord de 19° N.

* **Dans le golfe d'Aqaba** on a dénombré 10 espèces (tableau. 1). Les Thécosomes dominants sont *Limacina inflata*, *L. trochiformis*, *Creseis acicula* et *Diacria quadridentata*. *Clio convexa* est assez fréquent; dans nos prélèvements il est représenté par de nombreux jeunes. Ce golfe relativement profond, semble favorable au développement de cette espèce à tendance bathypélagique. Par la fréquence de *Diacria quadridentata* , le golfe d'Aqaba montre des affinités pour la mer Rouge septentrionale. Il en diffère cependant par l'abondance de *Limacina trochiformis*, espèce très abondante aussi en mer Rouge méridionale. Par ailleurs, ce golfe semble abriter des *Diacria quadridentata* phénotypiquement différents des représentants de la mer Rouge méridionale (ces derniers sont identiques à ceux du golfe d'Aden) et un éventuel isolat géographique de *Cavolinia gibbosa gibbosa* (Rampal, 1975). Le golfe d'Aqaba représente donc une entité dans l'environnement érythréen et pourrait favoriser les isolats géographiques.

* **Dans le golfe de Suez** ont été recencées 4 espèces : *Limacina inflata*, *Creseis conica*, *Diacria quadridentata* et *Cavolina longirostris* alors que nous n'avons pas récolté de Thécosomes dans le canal de Suez.

On peut donc distinguer plusieurs types de répartitions :
- des espèces ubiquistes très abondantes sur l'ensemble de la mer Rouge : *Limacina inflata* et *Creseis acicula*.
- des espèces à large répartition hétérogène : *Clio convexa* et *Creseis virgula*; elles évitent les zones les plus méridionales et se raréfient vers le nord.
- une espèce à répartition septentrionale préférentielle : *Diacria quadridentata*.
- des espèces à répartition méridionale préférentielle : *Cymbulia sibogae*, *Desmopterus papilio*, *hyalocylis striata* et *Limacina trochiformis*. Mais cette dernière est aussi très fréquente dans le golfe d'Aqaba.

Les autres Thécosomes sont peu abondants ou peu fréquents et souvent localisés dans la partie la plus méridionale de la mer Rouge. Certains, fréquents dans le golfe d'Aden, sont limités au voisinage du détroit de Bab el Mandeb : nous citerons notamment *Creseis chierchiae* et *Limacina bulimoides* qui ont valeur de transfuges et témoignent des échanges permanents entre ces 2 aires marines.

La faune érythréenne des Thécosomes est typiquement tropicale. Les espèces polytypiques y sont représentées par les formes indiennes mais elles peuvent acquérir certaines caractéristiques phénotypiques propres à la mer Rouge. Cette mer est un appendice indien faunistiquement appauvri puisqu'un tiers environ des Thécosomes de l'océan ne figurent pas dans les inventaires de cette mer. Parmi les manquants on note un certain pourcentage d'espèces bathypélagiques.

Nous dirons enfin que cette faune est différente de celle de la Méditerranée, tant au point de vue des inventaires que des phénotypes et qu'aucun transfuge n'a encore été observé dans le canal de Suez (Rampal 1975).

ESPECES /SECTEURS	golfe de Suez	golfe D'Aqaba	mer Rouge septent.	mer Rouge mérid.
Limacina inflata	x	x	x	x
trochiformis		x	x	x
bulimoides				x
Creseis conica (1)	x		x	x
virgula (2)		x	x	x
acicula		x	x	x
chierchiae				x
Styliola subula			x	
Hyalocylis striata				x
Clio convexa (3)		x	x	x
Diacria trispinosa				●
quadridentata	●	x	x	x
Cavolina gibbosa		x		
globulosa			x	x
longirostris	●	●		x
uncinata		x		x
Peradis bispinosa				x
reticulata		●		
Cymbulia sibogae				x
Desmopterus papilio				x

(1) = C. virgula conica; (2) = C.v.virgula; (3) = Clio pyramidata convexa.

Tableau 1.- Présence des Thécosomes dans les différents secteurs de la mer Rouge. Mentions personnelles (**x**), mentions des auteurs (●).

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Seasonal patterns of Mesopelagic Calanoid Copepods in the Central Red Sea

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ABSTRACT

Under the unusual environmental conditions of the Red Sea various zooplankton species show strong affinities for different vertically segregated habitat zones. Most mesopelagic calanoid copepod species (Pleuromamma indica, Temoropia mayumbaensis, Lucicutia paraclausi, Haloptilus acutifrons, H. longicornis, H. ornatus) inhabit specific depth strata throughout the year, since the physical environment in the deep water remains relatively constant. In contrast, a distinct seasonal pattern in depth distribution can be observed among members of the family Eucalanidae. From spring through autumn, Eucalanus elongatus occupies depths between 50 and 600 m, while Rhincalanus nasutus is found from 200 to 900 m. During the winter, both species are also caught in the upper 50 m of the water column. The Red Sea populations of these species, unlike those of the other copepods mentioned, are obviously "reinforced" by the surface import of specimens from the Gulf of Aden during the winter monsoon.

X

X-II5

Vertical migration of Calanoid Copepods in the Gulf of Aqaba (Eilat)*

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The diel vertical migration of a whole species spectrum of calanoid copepods in the Gulf of Aqaba (Eilat) was studied, by taking stratified samples with a closing net of the Villefranche type , in the upper 300 m of the water column. The samples were taken in the Northern Gulf, at a single station and once every three hours during 24 hours, on 8/9 March 1983.
A total of 29 species were found at the collecting site, the majority of them small herbivores, a few omnivores and only one scarcely represented carnivorous species, **Paracandacia truncata**.
It resulted that there are different patterns of vertical migration in the species studied and that there are also indications for a permanent vertical space-partitioning among congeneric species.

The small herbivores live mainly in the upper 200 m. There are indications for an upward migration at sunset and sunrise in **Ctenocalanus tageae** and **Calocalanus pavoninus**. **Paracalanus indicus** seems to migrate to the surface layer (50 to 0 m.) during daylight. **Calanus minor.Acrocalanus gracilis** and **Calocalanus styliremis** do not appear to migrate at all. **Ctenocalanus campaneri** lives at lower levels (100 to 50 m.)than its congeneric **C.tageae** and most of the other herbivores; moreover this species does not make a significant appearance in the surface layer at any time. Similar vertical niche-partitioning is found among the three species of **Calocalanus**.

Among the omnivorous species the vertical migration patterns are more conspicuous. **Euchaeta concinna**,**Pleuromamma indica** and **Lucicutia flavicornis** perform upward migration of larger amplitude than the herbivorous species. Only **Acartia negligens** exhibits an inverse migration : it sunk below 100 m. at midnight and migrated to the surface during daylight.

The species which live in deepwater layers, exhibit a third pattern of vertical migration : they migrate upward during the hours of total darkness. **Scolecithricella auripecten** and **Macandrewella chelipes** appeared in the lower part of the sampled column only after sunset and before sunrise. **M. chelipes** is reported here for the first time from the Gulf of Aqaba (Campaner, in preparation).

The distribution patterns of 15 species of Calanoida were analysed. The rest of the species sampled, occurred only in very low numbers, quite characteristically for the extremely low biomasses of the Northern Red Sea. Moreover, their appearance was a scattered one and therefore one could not reach a clear picture of their depth distribution and vertical migration.

There are previous data about the diel migration of the total copepod biomass in the Gulf of Aqaba(Schmidt,1973). Almeida Prado-Por (1983) presented the first indications for a differential migration pattern in calanoids of the Gulf.There are as yet unpublished data by Zalkina-Finkelstein about differential and small-scale migrations in the cyclopoids.

From the open Red Sea,which unlike the Gulf of Aqaba, has a marked oxygen minimum layer at medium depths, Weikert(1982) described the vertical migration pattern of **Pleuromamma indica** and Bottger(1987) studied the vertical distribution of the small cyclopoids as a whole.

Though presented here only in a succint way and without the numerical data and the graphical illustrations, the present paper is the first attempt to compare between the diverse migrating behaviour of a large number of Calanoida of the Gulf of Aqaba. To the best of our knowledge similar comparative studies have not been carried out yet in the Red Sea and neither in the Levantine Basin of the Mediterranean. When one compares the calanoid populations of the two adjacent seas and discusses possible contact through the Suez Canal, presence or absence of migrating behavior and the patterns of the vertical migration of each particular species have to be studied.

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Les Euphausiacés du golfe d'Aqaba et leur biogéographie en mer Rouge

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L'examen de vingt cinq prélèvements superficiels recueillis en février 1980 le long de la côte jordanienne[*1], a montré la présence d'Euphausiacés dans treize d'entre eux, à savoir, par ordre d'abondance décroissant : *Euphausia diomedeae, Pseudeuphausia latifrons, Stylocheiron abbreviatum et Stylocheiron affine*. La présence d'adultes mûrs et de nombreuses larves indique qu'il s'agit d'espèces capables d'effectuer leur cycle biologique dans le golfe.

Dans la partie nord du golfe [*2], neuf pêches nocturnes de surface, effectuées en novembre-décembre 1987 ont ramené uniquement *Euphausia diomedeae*, mais trois pêches diurnes plus profondes (100-0 m et 600-0 m), faites en novembre 1985 et mars 1986, contenaient également *Stylocheiron abbreviatum* et *S. affine*.Enfin, dans sept pêches profondes par paliers entre 1200 m et 0 m, effectuées dans le cadre du D.C.P.E sur quatre stations dans la moitié méridionale du golfe [*3], figurent les espèces précédentes ainsi qu'*Euphausia sanzoï* (St. G, entrée du golfe).

Malgré la diversité d'origine du matériel,seules cinq espèces sont recencées dans le golfe d'Aqaba. Mais, par comparaison avec un travail antérieur de Weigmann (1974), *Pseudeuphausia latifrons* est nouvelle pour ce secteur. Connue en mer Rouge jusqu'à 21° Nord (5,6,2), cette forme constitue, comme l'indique la présence de séries larvaires, des populations pérennes jusque dans les zones côtières les plus septentrionales de la mer Rouge. Le caractère essentiellement néritique de cette forme se trouve confirmé par son absence dans toutes les pêches effectuées au large. Elle peut donc être qualifiée d'ubiquiste néritique, comme le sont *Stylocheiron abbreviatum, S. affine* et *Euphausia sanzoï* dans le domaine pélagique. *Euphausia diomedae* apparaît majoritaire dans le golfe d'Aqaba, comme elle l'est déjà dans le nord de la mer Rouge (3,7), confirmant ainsi sa répartition septentrionale, alors que dans le sud cette place revient à une autre *Euphausia, E.sibogae* à répartition dite méridionale (2). Ces six espèces effectuant leur cycle vital en mer Rouge, y constituent donc un peuplement autochtone.

L'examen de quelque 20.000 spécimens de ces Crustacés sur l'ensemble de cette mer nous amène à faire deux remarques sur leur adaptation morphologique au milieu érythréen.

La première est un nanisme relatif qui affecte, d'une part chacune des espèces autochtones (cas, par exemple, de *Stylocheiron abbreviatum*, dont les tailles des larves et des adultes, sont inférieures à celles des spécimens, en Méditerranée notamment) et, d'autre part, l'ensemble du peuplement qui n'est constitué que de petites espèces, la plus grande (*Euphausia sanzoï*) n'atteignant que 15 mm tandis que dans le golfe d'Aden voisin, dans des récoltes comparables, sont présentes des espèces de *Thysanopoda, Nematobrachion* et *Stylocheiron* dont certaines dépassent 30 mm. Il serait intéressant de voir si ce nanisme déjà signalé chez les Thaliacés (4) affecte également d'autres planctontes.

La deuxième consiste en un développement exceptionnel des branchies, en particulier celles issues des derniers thoracopodes. Dans le tableau suivant ont été portées des mesures comparatives des filaments branchiaux de deux espèces vivant à la fois en mer Rouge et en Méditerranée, deux mers semi-fermées. L'augmentation de la surface branchiale semble bien être une réponse adaptative à la raréfaction du taux d'oxygène dans la première (1).

Ces deux particularités morphologiques, nanisme des espèces d'une part et grand développement de leurs branchies, d'autre part, montrent l'impact sélectif important des conditions du milieu régnant en mer Rouge sur les populations des Euphausiacés qu'elle abrite.

	L.7			L.8		
	Méditerranée	mer Rouge		Méditerranée	mer Rouge	
Stylocheiron longicorne	f.courte	f.longue	f.n.ind.	f.courte	f.longue	f.n.ind.
LT = 6,6-7,7 mm	0,20-0,25	0,25-0,32	0,50-0,87	0,37-0,42	0,37-0,50	0,75-1,00
7,8-10,4		0,30-0,37	0,75-1,17		0,42-0,55	0,87-1,12
Stylocheiron abbreviatum	Méditerranée		mer Rouge	Méditerranée		mer Rouge
LT = 8-10 mm	0,25-0,32		0,66-0,71	0,45-0,71		1,10-1,32
10-12	0,38-0,50		0,71-0,82	0,71-0,87		1,21-1,40
> 12	0,40-0,60		0,77-1,04	0,87-0,99		1,43-1,65

Tabl.1.- Longueur des filaments branchiaux des 7ème (**L.7**) et 8ème thoracopodes (**L.8**) chez *Stylocheiron longicorne* et *S.abbreviatum* en fonction de la taille (LT mesurée de la pointe du rostre à l'extrémité du telson) en Méditerranée et en mer Rouge.

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"Y" Crustacean larvae (order Facetotecta) in the plankton of the Gulf of Aqaba (Eilat), Red Sea

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For a century now, there were scattered reports of Hansen's " Y nauplii " in literature. They have been reported under the name **Protolepas hanseni** from Trieste by Steuer(1911) and from many parts of the world ocean. Bresciani(1965) and Schram (1970) identified convincingly the corresponding " Y cypris " Recently Grygier (1985) established for them the new order Facetotecta, and placed it among the Maxillopoda. Finally, Ito described many types of Y nauplii and Y cypris, denominating them **Hansenocaris**(1984;1985;1986).

In the Gulf of Elat, we observed for many years certain types of peculiar nauplii which we are describing in a forthcoming publication under the preliminary name **"Ufocaris"**. Since we suspected the proximity of these types of nauplii to the classical "Y nauplii" of the literature, recently we focused our attention on such organisms.

Presently we can report the presence of at least two types of **Hansenocaris** nauplii and one type of **Hansenocaris** cypris in the Gulf of Aqaba(Fig.1).

These Facetotecta are present in the Gulf in variable amounts and several developmental stages have been found. We believe that the **Hansenocaris** cypris is either an adult animal, or is the young stage of a parasite on a planktonic host: this is the only way in which their permanent presence in the plankton can be explained. The problem of the " **Ufocaris**" larvae is even more complicated: we did not find them in stadia more advanced than that corresponding to a metanauplius. Three types of the **"Ufocaris"** larvae are extremely frequent in all stations and seasons and appear as large-sized (0.80 mm) well-adapted pelagic organisms. It seems to us fairly evident that they represent a different order of Maxillopoda or at least a second major taxon within the Facetotecta.

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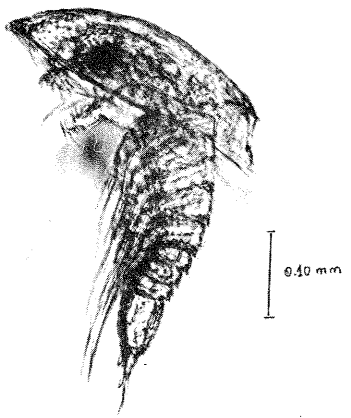

Fig.1 **Hansenocaris**sp. cypris from the Gulf of Aqaba(Eilat)

Description de quelques stades larvaires de Stenopus spinosus Risso 1826. Remarques sur le genre Stenopus Latreille 1819 et position systématique de ce groupe

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Des larves de Stenopus spinosus Risso prises dans le plancton des côtes Algériennes sont décrites. Elles présentent des différences de détail plus ou moins importantes. Ces variations seraient individuelles mais elles pourraient également être intra-spécifiques. Cependant, de SAINT-LAURENT et CLEVA (1981) dans une étude sur les Sténopodidea des Philippines ont montré que dans un même genre existent des formes voisines ainsi que de nombreuses variations de structures chez presque toutes les espèces. Ils observent également, chez les femelles d'une même espèce, une variation très importante dans la dimension des oeufs. Ceci semble davantage lié au stade de développement de l'oeuf, c'est-à-dire de l'embryon qu'à des variations intra-spécifiques, individuelles ou à la taille des femelles.

Le genre Stenopus Latreille a une répartition circumtropicale et Stenopus spinosus (espèce atlanto-méditerranéenne) et Stenopus hispidus (espèce Indo-Pacifique) sont des espèces dites "Vicariantes", relictes de l'ancienne mer Tethys (PERES, 1985).

Du point de vue systématique les Stenopodidea constituent un groupe à affinités incertaines. De SAINT-LAURENT (1979) adopte les vues de BURKENROAD (1963) mais inclue les Stenopodidea dans les Reptantia. Dans sa récente révision des Crustacés Décapodes basée presque entièrement sur les caractères adultes, BURKENROAD (1981) les subdivise en 4 sous-ordres : Dendrobranchiata, Euzygida (Stenopodidea), Eukyphyda (Caridea) et Reptantia : le premier et le dernier sous-ordre ont une origine indépendante tandis que les 2 autres ont une origine commune. FELGENHAUER et ABELE (1983) dans leur étude de morphologie comparée sur les Crevettes Péneides, Stenopodides, Carides et Procaridides concluent que chaque groupe et, en ce qui nous concerne, les Stenopodidea, représente des lignées évolutives indépendantes. Du point de vue larvaire, WILLIAMSON (1965, 1976, 1982) attache beaucoup d'importance à l'armature du telson et en particulier à la 2e épine réduite à un poil. Cette 2e fine soie ne se rencontre que chez Stenopodidea, Thalassinidea et les Anomura ainsi que chez les Dromiacea. Pour WILLIAMSON et RICE (1980) cette 2e fine soie est un caractère apomorphe. Pour BURKENROAD (1981) cette 2e fine soie semble "... more likely to be a relic from the stem-form of the three incubatory suborder...". Mais les Stenopodidea ne possèdent aucun ancêtre adulte fossile (GLAESSNER, 1969) encore moins au niveau larvaire pour des raisons évidentes. Comme l'indique WILLIAMSON (1982) les larves comme les adultes ne sont, ni plus ni moins difficiles à séparer et la sélection qui influe les adultes pourquoi n'agirait-elle pas sur le développement ontogénique, de l'oeuf à l'adulte. Comme cette 2e fine soie n'existe ni chez les Dendrobranchiata, ni chez les Caridea, ni chez les Astacidea, ni chez les Palinura, ni chez les Brachyura, elle aurait un caractère plus apomorphe que simplement relique. Ainsi, les Stenopodidea constituent un groupe distinct qui diverge de la lignée qui donna naissance aux Thalassinidea et aux Anomura, et il nous semble, comme le pensent FELGENHAUER et ABELE (1983), que l'origine et les affinités des Stenopodidea"... are to be found among those groups traditionaly considered reptants".

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Notes on larvae of two Red Sea Trapezid Crabs and their bearing on classification within the Xanthoidea (Crustacea : Brachyura)

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A new classification of adult Brachyura, based primarily on the position of the female and male genital openings was proposed by Guinot (1978). Eight families were recognised within the superfamily Xanthoidea, which members are prominent among Red Sea Brachyura. Guinot supported Ortmann (1897) in giving the rank of family to the Trapeziinae as defined by Miers (1886). But for a few minor changes, Guinot indicated that the family contained all the genera listed by Balss (1957) in his subfamily Trapeziinae. Guinot did not use any larval characters to corroborate her classification.

The first stage zoea of Tetralia glaberrima (Herbst, 1790) (now T. cavimana Heller, 1861, see synonomy of Galil, 1988) and Trapezia cymodoce (Herbst, 1799) of Gurney (1938), collected in the Red Sea, are redescribed and compared both with the original description and with the description of Tetralia glaberrima by Al-Kholy (1963). This information is utilized to re-examine the classification of the xanthoids. Larval characters that appear to support the separation of the families Platyxanthidae and Trapeziidae, as proposed in a classification of adult xanthoids by Guinot (1977 and 1978), are identified.

Employing larval descriptions Rice (1980) divided the Xanthidae into four groups which he thought lent support to the divisions proposed by Guinot (1978). Martin (1984) using larval characters, too, identified six groups within the Xanthidae. Rice (1980) and Martin (1984) agree on the suite of characters that defines their Xanthoid group III, but the genera they assigned to their respective groups III differ. Eriphia, Homalaspis, and Tetralia form group III according to Rice; Martin adds to this group Baptozius, Carpilius, Epixanthus, Paramedaeus, Platyxanthus and Trapezia. The present redescription of Trapezia cymodoce and Tetralia cavimana larvae indicates that group III of both workers can be divided into two. Group A comprises of Tetralia cavimana and Trapezia cydomoce larvae and corresponds to the Trapeziidae of Guinot (1978). Group B contains larvae of Homalaspis plana (A. Milne Edwards), Platyxanthus crenulatus (A. Milne Edwards) and P. patagonicus (A. Milne Edwards) and corresponds to Guinot's Platyxanthidae. Other larvae that fit in this group are Baptozius vinosus (H. Milne Edwards), Epixanthus dentatus (White), Eriphia laevimana smithii Macleay, E. spinifrons (Herbst), E. verrucosa (Forskal), Ozius rugulosus Stimpson, O. truncatus H. Milne Edwards and Pilumnoides perlatus (Poeppig). None of these are listed in Guinot's classification, but on the basis of larval characters these genera appear to have affinities with Platyxanthidae. The xanthids Monodaeus couchii and Paramedaeus noelensis (Ward) are grouped here too with the Platyxanthidae though Guinot placed them in the Euxanthinae. Apart from this incongruity, the larval evidence appears to correspond to the classification of adult Platyxanthidae and Trapeziidae. The classification proposed by Guinot (1978) might be further substantiated by careful examination of the Xanthoidean larval descriptions.

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X-II10

Les Chaetognathes du golfe d'Aqaba

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Les Chaetognathes du golfe d'Aqaba n'étaient connus que par le travail de Furnestin (1958) portant sur 25 récoltes côtières effectuées entre Eylath et la pointe sud du Sinaï, jusqu'à 100 m de profondeur au maximum, et dans lesquelles figuraient cinq espèces.

Le matériel étudié ici a deux origines (fig. 1) :
- d'une part, 27 pêches superficielles provenant du nord du golfe, en face des côtes jordaniennes * ;
- d'autre part, 10 prélèvements à différents niveaux (entre 1.200 et 0 m) sur 4 stations de pêches par paliers (3 dans la moitié méridionale du golfe et 1 au sud du détroit de Tiran) ** .

Près de 14.000 spécimens ont été dénombrés, appartenant à dix espèces au sein desquelles on peut reconnaître trois groupes, selon leur répartition dans le golfe :
- ubiquistes de surface et subsurface : *Sagitta enflata, S. pacifica, S regularis, S. hexaptera* et *Krohnitta pacifica;*
- ubiquiste profonde : *S. decipiens* qui, strictement mésoplanctonique (profondeur ⩾ 200 m), n'a été trouvée qu'exceptionnellement en surface (2 spécimens immatures dans le matériel jordanien); son comportement dans le golfe est identique à celui qu'elle affecte en mer Rouge (Casanova, 1985);
- espèces rares : *S. ferox, S. galerita, S. tropica* et *S.erythraea.*

S'il y a peu à dire sur les espèces des 1er et 2ème groupes, sinon que les quatre premières, les plus abondantes, avaient déjà été signalées dans le golfe avec *Krohnitta subtilis*, celles du groupe 3 suscitent quelques remarques d'ordre morphologique et/ou écologique.

Sagitta ferox est représentée par 9 jeunes spécimens en face d'Aqaba. Or, toutes les mentions antérieures de l'espèce en mer Rouge indiquent qu'elle y a une répartition méridionale; il faut donc admettre, soit l'existence d'une petite population pérenne dans le golfe d'Aqaba, soit un transport exceptionnel par le courant superficiel d'eau en provenance de la mer Rouge.

Sagitta galerita, bien que peu abondante (31 spécimens), ne semble pas accidentelle dans les eaux néritiques jordaniennes, puisque présente sur 9 stations; elle y atteint même ses plus grandes dimensions, 12,5 mm contre 10 mm seulement dans les eaux malgaches où elle a été décrite (Dallot, 1971), ce qui signifie qu'elle y trouve des conditions de milieu plus favorables.

Sagitta tropica est, semble-t-il, une espèce polymorphe. J'avais déjà noté des différences entre les spécimens du golfe de Suez (Ducret, 1973) et ceux du sud de la mer Rouge, dans le nombre de dents postérieures notamment: respectivement 10 à 18 (LT = 3-7,8 mm) et 15 à 24 (LT= 4,5-7 mm). Or, ceux du golfe d'Aqaba (7 spécimens entre 200 et 0 m, st. E, et 1 spécimen entre 200 et 0 m, st. D) sont encore différents puisqu'ils n'en ont que 7 à 12 (LT = 4-5,1 mm). L'étude de cette espèce est donc à revoir sur toute l'étendue de son aire de distribution.

Sagitta erythraea est présente à raison d'un seul exemplaire immature (LT= 4,8 mm) au milieu du golfe (st.D, 200-0 m). Il s'agit d'une espèce rare, que j'avais décrite du sud de la mer Rouge à partir d'un exemplaire adulte. Plusieurs caractéristiques du spécimen du golfe permettent de l'identifier sans grand doute : aspect étoilé de la tache pigmentée de l'oeil, 7 crochets, 7 dents antérieures alignées selon un axe transversal, 12-13 dents postérieures et ébauches des vésicules séminales éloignées de la nageoire caudale.

Tous les Chaetognathes présents dans le nord de la mer Rouge vivent donc dans le golfe d'Aqaba. Cela n'est pas étonnant lorsqu'on sait que celui-ci réunit les conditions requises pour abriter à la fois des espèces néritiques et océaniques. En effet, d'une part, il est très profond (plus de 1800 m), permettant aux espèces subsuperficielles et mésoplanctonique d'y vivre; d'autre part, il est séparé de la mer Rouge par le seuil de Tiran, dont la profondeur (250 m) favorise des échanges hydrologiques importants avec la mer Rouge. C'est là d'ailleurs que réside la différence principale avec le golfe de Suez voisin, dont la faible profondeur (60 m) n'autorise que l'installation d'espèces néritiques, ce qui a déjà été noté pour d'autres planctontes, Thaliacés (Godeaux, 1974) et Copépodes Calanoida (Almeida Prado-Por, 1983), par exemple.

Ainsi, sur les 17 espèces qui vivent avec certitude en mer Rouge, 11 sont signalées du golfe d'Aqaba. Il y manque, à une exception près (*Sagitta ferox*), toutes celles dont la répartition en mer Rouge est dite "méridionale" (Casanova 1985), c'est-à-dire qui sont transportées par le courant issu du golfe d'Aden, dont les caractéristiques hydrologiques s'altèrent au fur et à mesure qu'il progresse vers le nord, et qui sont donc rarement mentionnées au-delà de la partie centrale de la mer Rouge.

Enfin, il est intéressant de rappeler que si les modalités de répartition des espèces sont les mêmes dans les deux mers semi-fermées que sont la mer Rouge et la Méditerranée (Casanova,1985 et 1986), leur peuplement a une origine différente, indo-pacifique pour l'une et atlantique pour l'autre; en effet, seules quatre espèces ubiquistes sont communes aux deux mers et l'on n'a encore jamais observé en Méditerranée orientale *Sagitta pacifica, S. regularis, S tropica* ou *S. galerita*, pourtant abondantes dans le golfe de Suez.

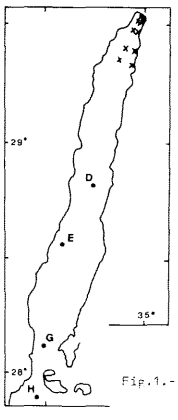

Fig.1.- Position des stations de pêches planctoniques superficielles (croix) et verticales par paliers (cercles).

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Thaliacés de la Méditerranée Levantine et du nord de la mer Rouge

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La Méditerranée est en relation avec l'océan Atlantique par le détroit de Gibraltar situé par 36°N alors que la mer Rouge communique avec l'océan Indien par le détroit de Bab-el-Mandab par 13°N. Les extrémités des deux mers sont reliées par un canal de 162 km, large de 125 m et profond de 15 m au maximum.

Les conditions écologiques (température, salinité) sont très semblables dans les deux régions qui sont des bassins d'évaporation. Côté Méditerranée, la salinité est supérieure à 39‰ et la température de surface oscille entre 15°C en hiver et 30°C en été. Côté mer Rouge, la salinité dépasse 42‰ dans le golfe de Suez et la température oscille entre 20 et 30°C. Toutefois le canal de Suez traverse les Lacs Amers où, en dépit du drainage, la salinité des eaux reste très élevée (salinité > 45‰ = conditions métahalines).

La faune des Thaliacés de la Méditerranée levantine provient de la zone tempérée chaude. S'y observent Doliolina sp.(mueller i ?), Doliolina intermedium (nourrices seules), Doliolum denticulatum, D.nationalis, Dolioletta sp.(gegenbauri ?), Cyclosalpa pinnata, C.polae, Thalia democratica, Thalia orientalis, Salpa fusiformis, Ihlea punctata, Pegea confoederata. Plus à l'ouest se rencontrent Pyrosoma atlanticum et Salpa maxima. Ce sont des espèces eurythermes et euryhalines. Cyclosalpa polae et Thalia orientalis sont les espèces les plus strictes au point de vue température.

Les Thaliacés les plus fréquemment rencontrés le long des côtes égyptiennes et levantines, proches du débouché du canal de Suez sont Doliolum denticulatum, Salpa fusiformis, Thalia democratica, Thalia orientalis et Doliolum nationalis.

En mer Rouge, à côté de formes ubiquistes telles que Doliolum nationalis (très abondant dans le golfe de Suez) et Doliolum denticulatum, la faune comprend Doliolina indicum, Salpa cylindrica, Thalia cicar, Thalia rhomboides, Ritteriella amboinensis, Iasis zonaria, Pegea confoederata, outre les rares Cyclosalpa bakeri et C.floridana. Aucun Pyrosome n'a jamais été capturé. D'autre part, aucune information n'est disponible sur le canal de Suez.

Alors que plusieurs espèces d'Ascidies sont connues pour avoir franchi le canal depuis des décennies (transport passif d'animaux adultes fixés à la coque des bateaux et émission de larves du côté méditerranéen), aucune espèce de Thaliacé ne paraît l'avoir fait.

Les espèces indicatrices d'un passage dans le sens mer Rouge-Méditerranée grâce au courant S-N qui parcourt le canal seront : Doliolina indicum (phoro = et gonozoïdes), Salpa cylindrica, Thalia cicar, Thalia rhomboïdes (forme indo-pacifique), Ritteriella amboinensis. Dans le sens opposé, les espèces indicatrices seraient Salpa fusiformis et Thalia democratica. Les autres espèces coexistant dans les deux mers, ne sont pas utilisables.

Les espèces de la mer Rouge ont subi une sélection sévère liée aux conditions régnant surtout dans la partie nord. Elles sont certainement aptes à s'acclimater dans le secteur levantin et à concurrencer les espèces autochtones. La possibilité d'un franchissement du canal reste néanmoins douteuse, puisque les espèces indicatrices sont toutes des espèces océaniques et que les Lacs Amers constituent toujours une barrière difficile à franchir.

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The seasonal surface zooplankton dynamics near Eilat, Gulf of Aqaba, Red Sea

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Summary: 100 surface zooplankton collections, near Eilat in the northern Gulf of Aqaba , during November 1985 - October 1987 demonstrated specific trends in population dynamics and community structure. Samples taken day and night along both the coral reef and 2 km offshore contained more than 200 animal taxa. Taxa not previously studied include Ostracoda, composed of 6 genera and dominated by the genus Cypridina; Mysidacea, composed of 6 species and dominated by Anisomysis maris rubri; Cumacea, composed of 4 species and dominated by Cumella limicoloides; Isopoda, composed of 5 species and dominated by Eurydice inermis; pelagic Gammaridea, composed of 13 species and dominated by Gnyopia variabilis; Hyperidea, composed of 27 species and dominated by Hyperoides sibaginis; and Euphausiacea, composed of 3 species and dominated by Euphausia diomedeae. In some taxa previously studied, additional species and genera observed are Sagitta decipiens, S. galerita (Chaetognatha); Pegea confoederata (Thaliacea); Thenus sp., Panulirus spp., and Scyllarus spp. (Decapoda).

A percent dissimilarity index ($DKL = \sum | P_iK - P_iL | \cdot 50$; where P_i is the percent of species i, in sample K and L) was employed to compare the offshore and reef communities. Nightly percent dissimilarity values were generally greater, where daytime values varied from 28 to 64 %, while nightly values varied from 42 to 98 %. Values greater than 90 % coincided with maximum concentrations of the near - reef fauna. Approximately half of these high dissimilarity values are explained by the reproductive behavior of some Peracarida taxa. As for example, the gammarid amphipod and cumacean taxa were almost completely composed of male individuals.

Near - reef zooplankton biomass measurements were approximately 5 to 15 times greater than those observed 2 km offshore. Winter and summer maxima were observed at both sites. The summer maxima were smaller in magnitude and more characterized by larval forms. Near the reef a maximum of 155 animals or 12.2 g wet biomass m^{-3} was observed in March 1988, while 103 animals or 8.5 g wet biomass m^{-3} was observed in July. 2 km offshore a maximum of 53 animals or 2.5 g wet biomass m^{-3} was observed in February 1988, while a maximum of 33 animals or 0.5 g wet biomass m^{-3} was observed in July. The dominant winter forms near the reef were gammarid amphipods, yielding approximately 100 individuals m^{-3}. The offshore fauna, although gammarid amphipods were still numerous, was more characterized by copepods and appendicularians, each at a maximum concentrations of approximately 13 individuals m^{-3}. The summer maximum near the reef was composed of 24 fish eggs, 30 gammarid amphipods, and 34 mysids m^{-3}, while the offshore maximum was dominated by brachyuran zoeas, yielding 31 animals m^{-3}.

Table 1 Winter zooplankton biomass in the upper 100 m, size spectrum > 330 um. (* after Weikert, 1987)

	Gulf of Aqaba 29°N	Red Sea* Northern to 24°N	Red Sea* Central to 18°N	Red Sea* Southern
mg m^{-3}	0.02	48	81	105
individuals m^{-3}	42	1520	1750	4750

A clear reduction in both number and biomass is evident in The Red Sea with increasing latitude (Table 1). Although average Gulf of Aqaba Values appear consistent with this trend, within the Gulf of Aqaba the central region appears to be greater in biomass (Reiss et. al., 1977). There is evidence, that near Eilat, wind strength has an effect on zooplankton communities. However, we will not fully understand the forces effecting zooplankton dynamics until meterological and oceanographic studies are considered to be an integral part of planktonology.

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X-II13

New information on the productivity of the deep Eastern Mediterranean and Red Seas

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Introduction and methods: Primary production and plankton biomass were investigated aboard the R.V. Meteor in the winter and summer of 1987. Preliminary results are presented together with much previously unpublished data from earlier cruises into the Red Sea (Table 1).

Chlorophyll a (chl a) in hydrocast samples and primary production by the C 14 method were determined in-situ in the Red Sea but in-situ simulated using Mediterranean water. Zooplankton was collected by stratified sampling using opening-closing nets with mesh sizes of 300 µm (modified Bé net) in the Red Sea and 333 µm (Mocness) in the Mediterranean Sea.

Results, Red Sea: The results, which support earlier findings for November (Khmeleva 1970), show that in February and July, the amount of primary production in the euphotic zone of the southern Red Sea is considerably greater than that in the central part. In March this regional difference is still apparent, but the values for production at all stations were relatively low. The distribution of the phytoplankton biomass, calculated as chl a, generally showed the same pattern. In March, however, there was a greater biomass in the central Red Sea than in the southern part.

A gradual decrease in the average chl a content from 21.8 mg/m^2 in the north to 15.8 mg/m^2 in the south was observed during July in the Sudanese section of the central Red Sea. In contrast, the production values followed the trend for the entire sea and increased to the south from 62 to 83 mgC/m^2.d.

The largest set of data was obtained from the region of the Atlantis II Deep area (A II Deep), which is located in the middle of the open sea section of the Sudan. In March and July, the production remained below 100 mgC/m^2.d, while in June and October, it was obviously greater. The low average for October in Table 1 was computed without including high production figures from two stations, for which there were no data on the Secchi depth. The highest average production, 440.9 mgC/m^2.d, was observed in February 1981, and similarly high values in February 1987 were recorded by Moigis (pers. comm.).

In contrast to the phytoplankton biomass, which showed seasonal variations in the A II Deep area, the biomass of the zooplankton displayed an obvious decrease during the course of the year. Its average value in the upper 1050 m of the water column, in g wet weight per m^2, amounted to 15.6 in February (1981), 10.7 in March, 9.0 in June, about 8 in July, and 5.1 in November (1977). The differences between neighbouring sites were minor. Considering the larger areas of the sea, the zooplankton biomass stocks in the central Red Sea were only half as large as those in the southern Red Sea in March and July.

Eastern Mediterranean Sea: A coursory study of the Levantine basin off the southern coasts of Crete and Cyprus in January 1987 revealed low primary production in the euphotic zone. It ranged between 17.4 and 79.5 mgC/m^2.d. Unlike in the Red Sea, chl a concentrations remained below 0.1 mg/m^3 and were rather uniform throughout the upper 100 m. The zooplankton stock in the upper 1050 m reached about 6 g wet weight per m^2, about 90 % of the stock in the entire 4000 m water column.

Conclusions: The production and biomass data obtained during February and July 1987 fit into the general pattern of biological production in the Red Sea previously proposed by the author (Weikert 1987). Mixing processes promote a high phytoplankton production and support large plankton stocks in the northernmost and southern parts of the sea, at least throughout most of the year. The sharpest gradients of these parameters in the general decrease to the north are apparently located between 17°N and 18°N. Farther to the north, in the central Red Sea, the seasonal destabilization of the water column seems to promote the development of mesotrophic conditions in winter, except perhaps in the Egyptian waters. According to production figures of Khmeleva (1970), these conditions may already develop in November.

Determinations in the Sudanese section of the sea during February 1987 revealed relatively high phytoplankton production and biomass values in the region of the A II Deep (Lenz et al. 1987, Moigis pers. comm). This local increase, which was not observed in July, may have been promoted by a seasonal discontinuity zone in the area.

The annual cycle in the central Red Sea, characterized by production and biomass peaks in winter, resembles that in the Gulf of Aqaba. In contrast, oligotrophic conditions were encountered in the eastern Mediterranean Sea during the winter. However, there are some similarities between these regions, such as the high proportion of picoplankton (≤ 2 µm) in the phytoplankton stock. Similarly, more than 85 % of the zooplankton stock was encountered in the upper 1050 m of the water column in both regions. These proportions indicate an effective utilization of energy in the upper water column and only minor losses due to sinking into greater depths.

Approx. Lat.	Northernmost 27°N		Central 25°N		Central 21°N		Southern 15°N–17°N		Depth
	PP	Chl a	PP	Chl a	PP	Chl a	PP	Chl a	(m)
Feb. 1981	-	-	-	-	440.9	23.2	-	-	140
Feb. 1984***	621.3*	73.3*	77.3*	24.3*	132.3*	38.3*	750.9	59.2	160
Mar. 1979	-	-	-	-	47.0	22.4	90.0*	16.8*	150
Jun. 1979	-	-	77.0	27.2	134.0	35.0	-	-	150
Jul. 1987	-	-	-	-	80	17.0	330	21.9	140
Oct. 1980	-	-	85.6	9.4	108.0 195.0**	16.0	-	-	140

Table 1: Regional and seasonal changes in phytoplankton production (PP, mgC/m^2.d) in the euphotic zone and chlorophyll a (Chl a, mg/m^2) at given depths along the central trough of the Red Sea. * Single sample, ** Calculation for the upper 140 m including high production values from two stations. *** From Petzold (1986)

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X-II14

Microplankton of the Red Sea, the Suez Canal and the Levantine Basin. Some characteristic features and aspects of distribution

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The taxonomic categories considered in this contribution include the whole spectrum of phytoplankton size groups and the major groups of planktonic protozoa as they have been studied over the years in the three environments.

The data analysed are based on the results of past and recent investigations carried out within the framework of national and internationally sponsored research programs. Notably among the latter are the migration of biota through the Suez Canal and the impact of the Aswan High Dam on the Levant Basin of the Mediterranean.

A common feature of the microplankton in the three environments is the presence of a large number of species, particularly among the diatoms and dinoflagellates of the larger phytoplankton, and among the tintinnids of the ciliate protozoans. This seems to fit a basic characteristic of oligotrophic seas, particularly in regard to the areas of the open ocean in the tropics which show a relatively low productivity (Russell-Hunter 1970). In fact, low levels, particularly phosphates and nitrates, chlorophyll a and productivity values as recorded in recent years in the Gulf of Aqaba and in both the inshore and the offshore waters of the Levantine Basin, point to these areas as among the least productive in the world (Levanon-Spanier et al. 1979; Berman et al. 1984; Azov 1986).

The microflora and microfauna of the Suez Canal consists, as expected, of numerous species common both to the Red Sea and the Mediterranean which are able to subsist in a shallow and hyperhaline environments. Our knowledge of the Suez Canal microbiota is limited to diatoms, dinoflagellates and tintinnids.

A number of autochtonous species in the plankton of the Red Sea are not found, so far, in the Levantine Basin, particularly among the dinoflagellates, and phaeodarian radiolarians (Halim 1969). At the same time a number of species of indopacific origin such as the well known commensalic association of Chaetoceros coarctatus with Vorticella microstoma and Ceratium egyptiacum, among others, have made their appearance in the plankton of the Levantine Basin during the past few decades and established stable populations.

Symbiontic and commensalic associations involving diatoms with cyanobacteria, diatoms with ciliates, foraminiferids, radiolarians and acantharians with algal symbionts are a common occurrence in the plankton of both seas. In some cases they may constitute important contributors to the primary productivity of these areas as was the case with Sphaerozoum punctatum which dominated the surface plankton of the Levantine Basin in April 1981. The presence of one or more deep chlorophyll layers has been recorded both in the Red Sea and in the Levantine Basin. These layers are characterised by a high phytoplankton standing crop associated largely with pico and nanoplankton organisms which together constitute over 90% of the total phytoplankton (Kimor et al. 1987).

The shade flare consisting of oligophotic organisms at the base of the photic zone is well represented in the microplankton of both environments but it is not to be confused with the phenomenon of summer submergence of winter epipelagic species which is common to several groups of the marine microbiota, particularly dinoflagellates and tintinnids.

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Resource partitioning of two Red Sea colonizers and two indigenous Mullids in the Eastern Mediterranean

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Resource partitioning in most co-evolved fish assemblages occurs along one or more axes (Werner, 1979). The colonization of the eastern Mediterranean Sea by Red Sea fishes provides an unique opportunity to investigate interaction between co-occuring closely related species that did not coevolve (Por, 1978).

The family of Mullidae, which is of considerable commercial importance, constituting more than a third of all Israeli trawl catch (Golani, 1981-85), is represented in the Levant coast by two indigenous species, Mullus barbatus and M. surmuletus, as well as the two Red Sea colonizers, Upeneus moluccensis and U. asymmetricus. In the present work, the feeding habits, habitat selection and spawning seasons of these species were studied for the purpose of assessing the nature and extent of resource partitioning.

Habitat selection was determined by the frequency which each species occupied selected depths (20, 40, 55, 70 and 90 m) as sampled by commercial trawlers. Feeding habits of each mullid were determined by calculating the index of relative importance (IRI) of each prey category. Trophic separation was determined by calculating the feeding habits overlap for each pair of species, using IRI.

In addition the predator size--prey size relationship was determined. Spawning seasons were calculated by the gonado-somatic index.

Of the three axes of resource partitioning investigated concerning the eastern Mediterranean mullids, the most important axis is habitat separation. Both colonizers are found in a shallow habitat, U. asymmetricus being dominant in the primarily sandy-bottom at 20-30 m and U. molluccensis at 40-55 m, at which depth the sea bottom becomes increasingly silty. The indigenous M. barbatus is dominant in water deeper than 55 m although it can be found in large quantities from 40 m. M. surmuletus appears in small numbers in all depths.

Segregation according to food type or size is much less apparent. The primary prey of all four species is mainly macrurid crustaceans, which constitute 51.4-61.2 % of IRI. The secondary prey is polychaets, constituting 4.3-26.0 % of IRI. The values of diet overlap are rather high (T = 0.666-0.928) when including samples from all depths and decrease considerably (T = 0.527-0.846) in samples from the area where species are most sympatric (40-55m), suggesting that trophic separation may also be a means of resource partitioning.

Prey size is also not an efficient means of segregation. Young individuals (SL < 115 mm) of all four species feed upon prey of similar size (60-120 mg). Among larger specimens (SL ≥ 115 mm), three species continue to feed mainly upon the same size prey, with occasional larger organisms, while one species, U. moluccensis, feeds upon considerably larger prey (600-2200 mg), of which 38.2% of the gravimetrical index are benthic fish.

The separation between spawning seasons of local versus colonizing species may also contribute to reduce competition. The local species spawns in March-June while one of the Red Sea species, U. moluccensis, spawns in July-October and the other, U. asymmetricus, spawns from March to October.

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A prudent assessment of the role of the Suez Canal in plankton interchange between the Mediterranean and the Red Sea

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Despite the scepticism expressed by some authors (Godeaux, 1974; Por, 1978) about the magnitude and the future of the Lessepsian migration of holoplanktonic organisms , the subject is still attracting much attention and the expectations are high.

New reports of putative migrant Indopacific species are often being quoted in literature. Among the calanoid copepods, the reports of **Arietellus pavoninus** from the Aegean Sea and of **Euchaeta concinna** from the Lybian Coast deal probably with preexistent circumtropical species. The calanoids reported by Lakkis (1976) from Lebanon need to be confirmed as real Lessepsian migrants. Only species which are sufficiently euryhaline and/or reported also from the Suez Canal waters, such as **Calanopia elliptica, C. media, Acartia centrura** and **A. fossae** are probable migrants. The siphonophore **Sulculeolaria chuni** (Alvarino, 1974) cannot be considered a migrant. The phtoplanktonic species and the tintinnids reported by the Egyptian colleagues have been all found near the Suez Canal outlet in the Mediterranean. The two hydromedusae reported by Schmidt (1972) are not holoplanktonic and may have been introduced in their polyp instar.

Although very prudent in her conclusions, Furnestin (1979), who quotes several of the above examples, expects that planktonic immigration will increase in the future even to an extent to allow for such organisms like **Euphausia diomede** to cross over into the Mediterranean. This would be the outcome of the cessation of the Nile flow and especially of the gradual decrease of the salinities in the Suez Canal.

That the situation is not such, has been shown recently by Egyptian scholars and especially by El Sharkawy and Sharaf El-Din (1983). The salinities in the Bitter Lakes maintain a level above 46 ppt and in the summer reach more than 49 ppt. Moreover, saline stratification in the Bitter Lakes persists and during 1973-1974 there were even hypersaline values near the bottom.

The Canal waters have a residence time of about 6 months in the Bitter Lakes and salinity increases there during this time much more because of the high evaporation rate than because of the dissolution of the residual fossil salt bed on the bottom. It is therefore unrealistic to expect future and further improvement in the salinity regime of the Suez Canal: Every organism entering the Bitter Lakes from the Red Sea is submitted at least for the duration of the average residence time of the Red Sea water, to the metahaline salinities of the system.

It results that only organisms able to withstand the extreme neritic and even lagunary conditions of the Bitter Lakes with high salinities, low winter temperatures and which furthermore are able to reproduce in these waters are prone to turn into Lessepsian migrants . The methodological caveat proposed by Por (1978) retains full viability: migrant species should be looked for first of all in the Suez Canal waters.

Planktonic congeners found on both sides of the Suez Canal are probably different at a species level. They probably behave like **Calanus helgolandicus** s.l. which according to Fleminger and Hulsemann (1987) split into sibbling species separated by the Bosphorus. If the gene flow between the Aegean and the Black Sea populations in this genus is so reduced, what can one expect of the saline trickle of the Suez Canal ?

In conclusion: Indopacific influx of holoplanktonic species from the Red Sea to the Eastern Mediterranean , if possible at all, is restricted to very few special cases.

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X-III1

Artificial gamma emitters in Black Sea bottom water and sediment off the Danube Mouths in 1986-1987

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Abstract

Data are presented regarding the variation of Cs-137 and Cs-134 levels in sea water and sediment sampled on the 10 m and 20 m isobaths off-shore from the Danube mouths in 1986 - 1987. Sediment/water concentration factors for Cs-137 and activity ratios for Chernobyl derived radionuclides in sediment are also given.

Résumé

On présente des données sur la variation des concentrations en Cs-137 et Cs-134 dans l'eau et les sédiments marins prélevés en points situés sur les isobathes de 10 m et 20 m devant les embouchures de Danube au cours des années 1986-1987. Les facteurs de concentration sédiment/eau pour Cs-137 et les rapports des activités pour radionucleides en provenance de Tchernobyl, en sédiment, sont également exposés en ce travail.

In view of assessing the impact of the Tchernobyl accident on the Romanian coastal benthic region, in 1986 radioactivity measurements were initiated on marine water and sediment sampled at locations situated on the 10 metres(m) and 20 m constant depth lines. In 1987 measurements were repeated for the profiles defined by the mouths of the two southern branches of the Danube (points 1 - 4 in Fig. 1).

Evaporation residue resulted from unfiltered water sampled at 1 m above the sea floor, and sediment, dried to constant weight at 110°C, were analysed by gamma spectrometry using Ge(Li) detectors.

The variation of Cs-134 and Cs-137 concentrations in water and sediment offshore from the Danube mouths in 1986-1987 is illustrated in Fig. 1. At lesser depths the two radioisotopes show an important depletion in 1987 as compared to 1986, in both water and sediment. At greater depths radiocaesium levels increase in sediment and decrease slightly in water.

Values of the sediment/water concentration factor (equal to the ratio between radionuclide concentrations in sediment and water) for Cs-137, presented also in Fig.1, vary in the accepted range [1,2], depending mainly on the dimension and composition of sediment particles [1,3].

Activity ratios for some fission and activation products in sediment sampled in September 1986 (extreme values are given in Table 1) compare well with those in Chernobyl derived atmospheric deposition. Values are presented in Table 1 for deposition collected at a station on land, located approximately 4 km northwest of sampling point 3 (see Fig. 1), between April 30 and May 12, 1986 [4], decay - corrected to sediment sampling time.

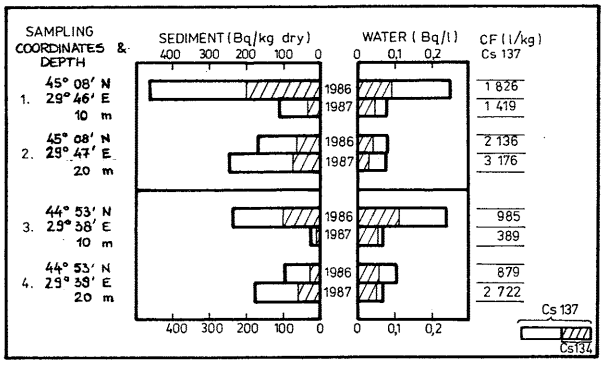

FIG.1 Cs-137 and Cs-134 levels in sea water and sediment in 1986-1987. Sediment/water concentration factors (CF) for Cs-137. Concentration values are decay-corrected to sampling time : 1986.09.15, 1987.07.31.

TABLE 1

Sample	Activity ratio Cs-137 / Cs-134	Cs-137 / Zr-95	Ru-106 / Ru-103	Ru-106 / Cs-137	Cs-137 / Sb-125	Ce-144 / Cs-137
Sediment	2.3-3.6	0.33-1.9	1.8-2.1	1.4-2.6	11-16	0.18-0.63
Deposition	2.5	0.36	1.7	2.2	14	0.18

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X-III2

Natural and artificial gamma radioactivity off the Romanian Black Sea Coast during 1986-1987

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ABSTRACT

Concentrations of gamma emitting radionuclides in Black Sea sediment, water, macrophyta, mollusca and fish samples have been measured during 1986-1987.

RESUME

On a determiné les concentrations des radionucléides gamma emmeteures dans échantillons de sédiment, d'eau de mer et de certaines macrophytes, mollusques et poissons de la mer Noire, pour les années 1986-1987

The survey and monitoring (IAEA,1965) of natural and artificial radioactivity in the marine environment along the Romanian Black Sea coast, initiated since 1980 (BOLOGA et al.,1985; DOVLETE and BOLOGA,1986), was continued in 1986-1987.

MATERIALS AND METHOD

Environmental and biota samples were collected nearshore between Mamaia (44°15' N) and Vama Veche (43°45' N). Sea water samples were also collected up to 30 nautical miles (water depth 50 m) offshore from the Danube Delta (Sulina, Mila 9 and Sf. Gheorghe) and on the east-Constantza transection. For comparative purposes fish samples from the east-central and south-eastern Atlantic Ocean have also been collected.

A total of 114 samples of sediment (dry), sea water (salt), macrophyta, mollusca (shell and soft part) and fish (ash) were analyzed gamma spectrometrically using a CANBERRA computer-based multichannel analysis system consisting of Ge(Li) detectors, associated modular electronics and 8100 MCA. Counting times ranged between 20,000 and 300,000 seconds/sample. Spectra were analyzed with a PDP-11/04 computer, using improved SPECTRAN III codes.

RESULTS AND CONCLUSIONS

Among natural radionuclides the most common is K-40, with concentrations up to 396 Bq/kg in sediment, 8 Bq/l in water, 159 Bq/kg fresh weight in macrophyta (Cladophora sericea), 107 Bq/kg f.w. mollusca (Mya arenaria, soft part) and 293 Bq/kg f.w. in fish (Engraulis enchrassicolus ponticus). Ac-228 reached concentrations of 6.3 Bq/kg in sediment, 156 Bq/kg f.w. in Bryopsis plumosa and 3.3 Bq/kg f.w. in Trachurus mediterraneus ponticus, and Ra-226 of 59 Bq/kg in sediment and 381 Bq/kg f.w. in Bryopsis plumosa.

The previously notified marked trend towards lower fission product levels along the Romanian Black Sea coast between 1981 and 1985 was interrupted by the nuclear accident in Ukraine on April 26, 1986. Thus, during May 1986 Chernobyl-derived radionuclides (e.g. Izrael et al.,1987) were identified in the atmosphere, some of them, namely Mn-54, Co-60, Zr-95, Nb-95, Ru-103, Ru-106, Ag-110m, Sb-125, I-131, Cs-134, Cs-137, Ba-140, La-140, Ce-141, Ce-144, being also detected in marine

Table 1. Highest annual concentrations for some of the artificial gamma emitters identified in Black Sea sediment (Bq/kg), water (Bq/l) and biota (Bq/kg f.w.) samples.

SAMPLE	Co-60	Ru-106	Ag-110m	Cs-134	Cs-137	Ce-144
Sediment 1986	<MDA	22±15	<MDA	14±2	30±4	470±11
1987	<MDA	<MDA	<MDA	7±1	19±2	7± 4
Sea water 1986	<MDA	0.3±0.1	<MDA	0.23±0.02	0.9±0.4	0.4±0.3
1987	<MDA	<MDA	<MDA	0.07±0.02	0.13±0.01	<MDA
Macrophyta 1986	NO DATA	N.D.	N.D.	N.D.	N.D.	N.D.
1987	144±30	<MDA	<MDA	56±15	170±15	<MDA
Mollusca 1986	<MDA	22± 7	7± 3	2.3±0.4	4 ± 2	<MDA
1987	0.4±0.3	7± 2	2.2±0.4	2.2±1.0	3.3±0.7	<MDA
Fish 1986	22± 1	126± 7	<MDA	13± 1	29.6±0.7	226± 7
1987	3.7±0.7	<MDA	18.5±0.4	3.7±0.7	11± 1	<MDA

It follows that both the environmental radioactivity significantly decreased in all components in 1987 as compared to 1986, and the highest Cs-134 and Cs-137 concentrations are in all edible biota below 'action levels' for food (FAO, 1986).

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On the radioactivity of the Romanian littoral zone after Chernobyl accident during 1986

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ABSTRACT. Artificial and natural radionuclides were determined in the algae Enteromorpha linza, Ceramium rubrum and the snail Rapana venosa Vall., as well as in sands from various sites of the Rumanian Black Sea shore. Gamma spectrometry with a high resolution Ge(Li) detector was applied for determining the radionuclides: Ce-144-Pr-144, Ru-106-Rh-106, Cs-134, Cs-137, Co-60, Th-232 and U-238. The neutron activated Ag-110m was found only in the algae samples.

INTRODUCTION. After Chernobyl accident, from August until the end of 1986, the artificial radioactivity due to the accident has been decreased rapidly. The species E. linza and C. rubrum were chosen for estimating the radioactive pollution level of the Rumanian coast, since these species are able to accumulate radionuclides in a high degree, (1).

EXPERIMENTAL. The spawning of R. venosa, the shells of Mytilus galloprovincialis, sampled in 20 August 1986, as well the algae E. linza and C. rubrum and the sands collected in October 1986, were treated as follows: Samples of R. venosa and Mytilus sp. were rinsed with water dried and ashed. The shells were dried and grounded to a fine powder. The sand samples were dried at 105 Celcius. Radioactivity counting was performed by gamma spectrometry using a multichannel analyser coupled with a Ge(Li) detector. The counting time varied from 16 to 20 hours.

RESULTS AND DISCUSSION. The following artificial radionuclides were determined: Ce-144-Pr-144, Ru-106-Rh-106, Cs-134, Cs-137, Ag-110m and Co-60. The radioisotopes RaC', Bi-214 and Pb-214, belonging to the natural family U-Ra, as well Pb-212 and Ac-228, from the Th-232 family were found. The radionuclide activity in the algae sampled in October 1986, is given in TABLE 1.

According to the data presented in Table 1, we can say that in C. rubrum sampled from North Eforie higher activity levels for Ce-144-Pr-144 and Cs-137 were found, than in samples collected from Mangalia. Co-60 was detected only in C. rubrum sampled from the North Eforie area. The highest level of Ru-106 - Rh-106, was found in C. rubrum from Mangalia. In R. venosa sampled from Mangalia the following activity values (Bq/kg dry matter) were found: Ru-106-Rh-106 (2700); Ce-144-Pr-144 (250); Cs-134 (55); Cs-137 (96); U-238 (<130); Th-232 (81). Low activity was detected in the shells. In the sands sampled from Mamaia to Mangalia-South only Cs-134, Cs-137, Th-232 and U-238 were found.

TABLE 1. Radioactivity of two Macrophytes sampled in October 1986 (Bq/kg in ashed material, error in parenthesis)

Radionuclide	Enteromorpha linza		Ceramium rubrum	
	North Eforie	Mangalia	North Eforie	Mangalia
Ce-144-Pr-144	43 (25)	73 (32)	600 (50)	105 (325)
Ru-106-Rh-106	210 (60)	390 (67)	616 (75)	660 (50)
Cs-134	40 (6)	60 (6)	64) (7)	70 (7)
Cs-137	109 (9)	114 (10)	167 (10)	160 (10)
Co-60	*	*	48 (13)	*
Th-232	15 (6)	25 (7)	25 (8)	11 (5)
U-238	21 (14)	13 (9)	<12	<12
Ag-110m	22 (12)	20 (10)	14 (7)	14 (8)

* : NOT DETECTED

Cs-137 values were very low (3.2 to 9.3). The Cs ratio (134/137) values in Rapana Enteromorpha and Ceramium species measured in samples from North Eforie and Mangalia sampling areas were as follow respectively: 0.57 and 0.70; 0.40 and 0.40; 0.52 and 0.44. This ratio value reported (2) in terrestrial plants from the region Monaco-Menton is 0.49. The neutron activation product Ag-110m was also identified in Mediterranean algae (2).

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Sur la radioactivité de Mytilus galloprovincialis récoltée du nord au sud du littoral Roumain et de quelques plantes de la flore spontanée d'août à octobre 1987

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Summary. The mussels *Mytilus G.*sampled at different depths at Sulina, Portitza and Mangalia, algae *Enteromorpha.l.*, the plants *Hybiscus sp.* and *Calamagrostis sp.*for man made and natural radionuclides were analyzed by the nondestructive gamma-spectrometric method. ^{134}Cs and ^{137}Cs are predominant in all the samples as well as ^{232}Th and ^{238}U. The ratio $^{134}Cs/^{137}Cs$ for the most samples, lies between 0.47±0.51. The ^{106}Ru - ^{106}Rh is concentrated only in the soft tissues of the mussels and in *Enteromorpha l.*

INTRODUCTION

La Moule Mytilus galloprovincialis est reconnue pour sa capacité d'accumulation des radionucléides artificiels et naturels, leur degré de contamination étant un indice d'évaluation de la pollutions radioactive du milieu ambiant.* Les retombées atmosphériques ont été évaluées en analysant la radioactivité de plantes pérennes.

MATERIEL ET METHODES

Les Moules, dès le prélèvement, ont été rincées à l'eau distillée et après élimination des coquilles, on a procédé à la séparation du byssus et de la pulpe. Tous les composants ont été séchés à 105°C, puis réduits en poudre dans un mortier d'agathe, enfermés dans des containers en plastique et analysés par spectrométrie gamma à l'aide d'un cristal Ge(Li) à haute résolution, 2 keV pour les rayons gamma du ^{60}Co, couplé à un analyseur multicanaux. Les plantes et l'Algue ont été incinérées. L'eau marine de surface a été étudiée en appliquant la méthode du MnO_2 pour l'extraction des radionucléides de grands volumes d'eau marine. Pour le Radiocésium, l'extraction a été effectuée à l'aide d'AMP.

RESULTATS ET DISCUSSIONS

Le ^{106}Ru-^{106}Rh a été identifié dans l'Algue Enteromorpha l. échantillonnée, en août 1987, à Eforie Nord et dans la pulpe de Mytilus g. et tous les échantillons entre (14±6) ÷ (24±6) $Bq.kg^{-1}$ de matière sèche ; dans le byssus et les coquilles, il est absent. Les ^{134}Cs et ^{137}Cs se rencontrent dans tous les prélèvements : eaux marine, Mytilus g., pulpe, byssus et coquille, l'Algue Enteromorpha l., les plantes Hybiscus sp., et Calamagrostis sp. Il faut souligner que la plus grande activité du ^{137}Cs (280±70)$Bq.kg^{-1}$ cendres, se trouve dans les feuilles d'Hybiscus (Tableau 1).

TABLEAU 1. Radioactivité de la flore spontanée, près du lac Tabacaria-Constantza, 9/8/1987 ($Bq.kg^{-1}$ cendres).

Echantillon	*Hybiscus sp.*			*Calamagrostis sp.*			
				1		2	
Radionucléide	Fleurs	Feuilles	Tiges	Epis	Tiges	Epis	Tiges
^{134}Cs	66±41	76±49	85±58	58±22	27±22	94±38	65±55
^{137}Cs	130±70	280±70	195±85	70±55	49±30	132±56	80±65
^{232}Th	<190	173±98	160±118	90±53	80±55	< 140	<140
^{238}U	140±100	230±110	285±120	107±56	98±58	170±78	<150

Les radionucléides naturels ^{232}Th et ^{238}U sont également présents dans tous les prélèvements. Dans le byssus de la Moule, l'Uranium-238 varie entre (28±13) et (45±28)$Bq.kg^{-1}$ de matière sèche. Les rapports $^{134}Cs/^{137}Cs$ ont varié entre 0,47 ÷ 0,51, pour la plupart des échantillons, avec quelques exceptions, mais en tenant compte des erreurs pour les valeurs des Radiocésium on obtient le même rapport.

Les épis de Calamagrostis sp. sont plus contaminés que les tiges. L'eau marine de surface présente une faible activité en ^{134}Cs et ^{137}Cs : (<3 ÷ <5)$Bq.m^{-3}$ pour le ^{134}Cs et (<8 ÷ <10)$Bq.m^{-3}$ pour le ^{137}Cs.

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X-III5

Radioactive contamination of the Bulgarian Black Sea Coast due to Chernobyl accident

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INTRODUCTION The Chernobyl nuclear power plant accident released large quantities of vaporized radionuclides, and, to a lesser extent mechanically released small aerosol particles. Fallout radioactivity was likely to have been deposited to the Black Sea during the later stages of the accident (1-6 May)[1]. In order to obtain information on the degree of radioactive contamination of the bulgarian Black Sea coast, sampling and measurements of marine organisms, beach sands and sediments have been carried out. This work was performed under Contract 696/Bulgarian Ministery of Culture, Science and Education.

MATERIALS AND METHODS From the first days of May 1986 our Laboratory of Dosimetry and Radiation Protection was engaged in a routine control of food production. Field measurements and collection of marine samples started two months after the accident. All samples were treated by a dry ashing procedure at 110°C, mechanically homogenized and analyzed with low-background gamma-spectrometer.

RESULTS AND CONCLUSIONS From the results, shown in table 1, some preliminary conclusions could be drawn: 1) As a whole, the bulgarian Black Sea coast is contaminated to a lesser extent, compared with other regions of Bulgaria[2]. Only ^{106}Ru levels in plancton and microphytobentos are similar to observed in most plants from the land; 2) The absence of ^{144}Ce in plancton collected in June-July 1986 is likely to be due to the relatively higher rate of remouval from the surface water column of this more particle reactive radionuclide.

TABLE 1
CONCENTRATIONS OF FISSION RADIONUCLIDES AND ^{40}K IN SELECTED SAMPLES FROM BULGARIAN BLACK SEA COAST / Bq/kg / dry

SAMPLES	^{141}Ce	^{144}Ce	^{103}Ru	^{106}Ru	^{134}Cs	^{137}Cs	^{95}Nb	^{40}K
PHYTOPLANCTON			380	1400	160	260	340	14500
ZOOPLANCTON				1950	290	480		450
MICROPHYTOBENTOS	880	190-4700	20-760	480-1230	5-310	75-380	72-2500	4300-7100
CHLOROPHYTA	10	200	24-160	66-295	5-60	32-135	10-40	830-3800
PHAEOPHYTA	10-84	45-400	87-220	120-390	13-39	49-107	79-115	2300-2700
RHODOPHYTA	30-32	20-265	28-140	170-490	10-49	30-200	30-64	1000-2900
SEA GRASS *			80	285	37	54	35	2500
MOLLUSCA *			9-11	8-29	2-4	5-7		70-175
FISH *		LD		30	7	14		280
LICHENES		4000	80	1330	880	1950		570
BEACH SANDS	14-43	10-84	45-220	17-75	8-63	13-115	45-130	
SEDIMENTS		10-250		10-150	5-19	5-92	300	90-650

* Bq/kg wet weight

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X-III6

The contribution of Fish consumption to the dose received by the Greek population due to the Chernobyl accident

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ABSTRACT The concentrations of artificial radionuclides in lake and marine fish samples have been determined after the Chernobyl accident. The related average and critical group doses have been evaluated.

INTRODUCTION The Chernobyl accident resulted in a considerable contamination of the Greek environment with fission and activation products. The major part of the radioactivity arrived in Greece early in the morning of May 2, 1986. Due to the strong differences in the precipitation conditions, the activity deposition vary by 1 to 2 orders of magnitude in different regions of the Country, with maxima clearly correlated with heavy local rainfalls. The average deposition of the radioactive cesium is estimated to be 9± 3 kBq/m2 and regional averages up to 40 kBq/m2 have been measured in certain parts of Central Greece (1,2). By use of the data from the island and coastal regions we estimate the average deposition of total cesium to be of the order of 4 kBq/m2 for the Aegean sea (including the Cretian sea) and 2 kBq/m2 for the coastal region of the Ionian sea.

EXPERIMENTAL Immediately after the accident and its early impact on Greece a sampling program was established in order to collect specific information concerning the contamination of the marine environment. The program included also sediments as well as different species of marine biota. The main sampling period was May 5 to July 25, 1986 while some additional samples were collected on October 1986. The sampling has been implemented by use of the oceanographic ship "Aegaio" as well as of a 400 HP fishing motorboat, while some samples have been provided by the Piraeus fish landing. The samples have been measured in the wet state with the addition of formaldehyde for preservation, due to the special circumstanses (large number of samples, urgent demand for early information). The analysis has been done by use of two high-resolution gamma spectrometry systems (HpGe detectors of 20% and 23% relative efficiency and 2.0 keV FWHM at 1.33 MeV, 4096 chan. analyzers and gamma spectrum analysis software support). Cylindrical and Marinelli geometries of 0.4 l and 0.9 l respectively have been used.

RESULTS and DISCUSSION The concentrations of Cs-137 in marine fish after the Chernobyl accident are of the order of 10 Bq/kg wet mass (mean value), higher typically one order of magnitude than those observed before May 1986 (3,4).
- The concentrations of Cs134+Cs137 in lake fish are typically one to two orders of magnitude higher than those in marine fish. Nevertheless, the 600 Bq/kg limit of the C.E.C is found to be exceeded in one sample only.
- The relatively high values of Ru103 (160 and 1050 Bq/kg w.m.) Zr/Nb95 (120 Bq/kg w.m.) and Ce141 (120 Bq/kg w.m.) observed in fish flesh from two sampling stations probably could be due to the ingestion of hot particle(s), which are characterized by enrichement in non-volatile elements (5). It must be noted that the ingestion is not considered as a critical pathway for exposure to hot particles.
- The fluctuations of the observed values in fish concentrations are supposed to be due mainly to different bioaccumulation of the various species as well as to the different ecological parameters of each region. The data available do not allow a sufficiently valuable correlation with the local activity deposition.
- The estimated doses due to fish consumption are given in Tab.1:

TABLE 1. ESTIMATIONS OF THE EFFECTIVE DOSE EQUIVALENTS COMMITTED DUE TO THE CONSUMPTION OF FISH DURING 1986.

Population group	Fish consumption (kg)	Total activity intake, Bq	Comm. eff. dose, μSv
Average adult	8.3	92 (total Cs)	1.2
Average child 10 yr	5.6	62 ..	0.8
Critical adult	17	3500 ..	47
Critical child 10 yr	11	2250 ..	30

The recently published IAEA conversion factors have been used in the above estimations. The members of the critical groups are supposed to consume purely lake fish with a rate 2 times higher than the average. Concerning the other radionuclides detected in the fish samples, we estimate that their contribution to the total dose is less than 30%. The values in Tab.1 should be considered as overestimations as long as they have been derived under the assumption that the measured concentrations during June 1986 were not changed till the end of this year. These values represent less than 1% and 2.5% of the total doses received by the average and the critical groups respectively. Therefore, we can conclude that the fish consumption has a minor contribution to the first year dose in a region located more than 1000 km away from an accidental radioactivity release to the atmosphere.

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Distribution spatio-temporelle des radioéléments issus des retombées de l'accident nucléaire de Tchernobyl au sein des différents compartiments du Bassin Méditerranéen nord-occidental

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Résumé

A la suite de l'accident nucléaire du réacteur n°4 de Tchernobyl le 26 avril 1986 un programme d'études du devenir des radioéléments associées aux retombées atmosphèriques de l'accident a été mis en place sur l'ensemble du domaine marin français. Ainsi des échantillons d'eaux de mer, de matières en suspension, de sédiments et de bioindicateurs marins (algues, phanérogames, mollusques, poissons) ont fait l'objet de collecte sur plus de 30 sites du littoral continental et insulaire méditerranéen du bassin nord-occidental français afin de mesurer les différents émetteurs gamma anthropogénes. Ces mesures (3000) sont venues compléter une base de données, dénommée **RADMED** pour **RAD**ioactivité de la mer **MED**iterranée, créée en 1981 et renfermant des résultats acquis depuis 1975. L'exploitation de cette base de données permet aujourd'hui d'évaluer l'impact des retombées atmosphériques suite à l'accident de Tchernobyl en comparaison avec les niveaux radiologiques associés aux rejets liquides faiblement radioactifs industriels chroniques et aux retombées atmosphèriques dues aux essais d'armes nucléaires d'armes dans l'atmosphère de l'hémisphère nord dont le dernier date de 1979.

L'analyse de l'ensemble des données au cours du temps montre que la totalité des indicateurs prélevés: eaux de mer, sédiments et bioindicateurs ont réagit très rapidement à l'introduction des radioéléments issus de l'accident de Tchernobyl par l'apparition brutale principalement de 144Ce, 141Ce, 137Cs, 134Cs, 125Sb, 110mAg, 106Ru, 103Ru. Cependant au cours des 30 premiers jours les niveaux de ces radioéléments ont décrut de près de 60 à 90%. Dans le cas des éléments à vie courte comme le 131I, ces derniers ont disparus totalement en quelques semaines. En 1987, 18 mois après l'accident, seuls 137Cs, 110mAg et 106Ru sont encore détectés régulièrement dans les différentes composantes de l'environnement marin méditerranéen. Dans l'espace, la région française la plus touchée se limitait à la portion est du littoral méditerranéen de Toulon à Monaco y compris le littoral corse.

Dans les zones exemptes de tous rejets industriels faiblement radioactifs la modélisation des phases d'élimination des radioéléments des organismes marins comme Mytilus sp. dans le cadre d'un Mussel Watch permet de quantifier les différentes périodes d'élimination biologiques et de les comparer avec celles obtenues dans le cadre d'expériences en situation de contamination chronique. Ainsi la modélisation de l'élimination des isotopes 103 et 106 du ruthenium conduit à des périodes biologiques inférieures de moitié en ce qui concernent la période d'élimination la plus lente. Cette constatation laisse supposer que dans le cas de situations accidentelles ponctuelles la contamination des organismes est plus labiles qu'elle ne l'est dans le cas de situation de contaminations chroniques.

L'échantillonnage des sédiments non soumis à des apports telluriques importants montre une incorporation différentes des radioéléments au sein de la colonne sédimentaire. Ainsi, au cours du deuxième semestre 1986 et en 1987 le 106Ru, 125Sb, 144Ce sont détectés uniquement dans les 2 premiers cm de surface des dépôts sédimentaires tandis que le 137Cs et 134Cs pénétrent jusque 10 cm de profondeur. Au niveau des embouchures des rivières, comme celles du Var et de l'Argens, les sédiments sont marqués plus profondemment en fonction de l'importance des apports fluviatiles, mais en 1987 les teneurs en 137Cs de l'horizon centimétrique de surface diminuent par rapport à l'horizon sous-jacent, ce qui traduit des apports récents moins marqués.

Dans les zones soumises à des rejets industriels, comme l'estuaire du Rhône, l'impact de Tchernobyl au sein des organismes marins n'a été visible que pendant une courte période de l'ordre de 90 jours pour les radioéléments comme le 137Cs, 134Cs et le 106Ru eux-mêmes rejetés dans les effluents liquides faiblement radioactifs des installations nucléaires. Au sein des masses d'eau de l'aire de dilution rhodanienne l'étude du 137Cs permet le traçage des eaux du Rhône dans l'ensemble du Golfe du Lion qu'elle traversent suivant un axe nord-est sud-est jusqu'au Cap Béar. Au niveau de la colonne sédimentaire les mesures réalisées sur des horizons centimétriques sur plus de 30 cm permet de visualiser les apports dus aux retombées de Tchernobyl des apports industriels. En particulier à partir du rapport 137Cs/134Cs, proche de 2.0 dans le cas des apports caractéristiques de Tchernobyl, l'on peut établir des taux de sédimentation dans la zone du talus prodeltaique de l'ordre de 36 cm/an qui correspondent à ce qui calculés par ailleurs.

L'exploitation de la base de données RADMED permet donc de ressituer l'incidence des retombées atmosphériques de l'accident de Tchernobyl dans le contexte radiologique du bassin nord-occidental méditerranéen en situation normale. L'extension et/ou la comparaison avec d'autres bases de données devraient permettre de généraliser ou non certaines de nos observations. Ainsi la recherche de bioindicateurs utilisables sur l'ensemble de la mer Méditerranée, comme peut l'être la phanérogame marine Posidonia oceanica , pourrait aboutir à des standards permettant la comparaison des niveaux de contamination.

X

Flux of artificial radionuclides in the Northwestern Mediterranean

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ABSTRACT

Sediment trap experiments have been used to measure the vertical flux of artificial radionuclides at several locations in the northwestern Mediterranean. Radionuclides originating from the Chernobyl accident were also measured and the mechanism for their rapid vertical transport identified. Based on similar flux studies in the North Pacific, there is evidence that the behaviour of particulate-associated ^{241}Am relative to $^{239+240}Pu$ may be different in Mediterranean waters.

INTRODUCTION

Recent biogeochemical flux studies have been instrumental in furnishing data on the vertical flux of natural and artificial radionuclides through the water column in the North Pacific and North Atlantic, however, to date similar information for the Mediterranean has been lacking. Data for several artificial radionuclides are now accruing from sediment trap studies carried out at selected sites in the northwestern basin and the Ligurian Sea. The overall goal is to establish rates at which surface-introduced artificial radionuclides are transported through the water column to the bottom sediments. Preliminary results from these studies are reviewed here and compared with similar measurements from other oceanic areas.

RESULTS AND DISCUSSION

Within the French ECOMARGE Programme, the transuranium nuclides $^{239+240}Pu$ and ^{241}Am were measured in samples from sediment traps at 80, 200 and 315 m in a 650 m water column in the Lacaze-Duthiers Canyon, Golfe du Lion (Fowler et al., 1987a). Plutonium concentrations ranging from 0.6-1.4 Bq kg^{-1} dry were somewhat lower than those which have been measured in samples from the open North Pacific; however, the average $^{239+240}Pu$ flux in the upper 315 m, 7.4 mBq m^{-2} d^{-1}, was one to two orders of magnitude higher than has been found in the North Pacific due to the much greater mass fluxes (e.g. up to 13 g m^{-2} d^{-1}) in the high energy environment of the Lacaze-Duthiers Canyon. Considering that the majority of the atmospheric fallout has taken place since 1958, a total integrated $^{239+240}Pu$ deposition of roughly 67 MBq km^{-2} can be computed for the 25-year period. This is in good agreement with the value of 78 MBq Pu km^{-2} calculated for fallout during the same period at 43°N by the US Health and Safety Laboratory. However, from cores taken in the Golfe du Lion, the Pu inventory in the sediments is only about 30 MBq km^{-2}. This suggests that a substantial fraction of the particulate-associated Pu is not retained in the sediments.

Similar measurements were made during the DYFAMED I experiment (April-May 1986) at a station in the Ligurian Sea (Fowler et al., 1987b). An automated time-series sediment trap was moored 15 nautical miles off Calvi, Corsica at a depth of 200 m in a 2200 m water column. The six consecutive samples, each one set to collect over a 6.25 day interval, contained $^{239+240}Pu$ concentrations ranging from 1.6-9.6 Bq kg^{-1} dry. All samples were very rich in undegraded organic material with an average C/N ratio of approximately 8. Corresponding plutonium fluxes 0.17-1.1 mBq m^{-2} d^{-1} were lower than those observed in the Golfe du Lion because of the much lower particle mass flux in the Ligurian Sea.

Studies from the VERTEX Programme in the North Pacific have shown that ^{241}Am, because of its greater reactivity with particles, is scavenged preferentially from the water column compared to $^{239+240}Pu$ (Fowler et al., 1983; 1985). Activity ratios of $^{241}Am/^{239+240}Pu$ as high as 3.0 have been measured in large particles from sediment traps at depth. In contrast, while ^{241}Am also appears to be removed rapidly from the water column in the Mediterranean, its relative reactivity compared to plutonium may be different as evidenced by much lower activity ratios of approximately 0.1 to 0.4 in trapped and suspended (Ballestra et al., 1981) particulates.

During the DYFAMED I experiment, the Chernobyl accident occurred on 26 April 1986 which resulted in the introduction of substantial amounts of artificial radionuclides into the Mediterranean region over the following few days. Sediment trap analyses for both alpha and gamma emitters showed maximum downward fluxes through 200 m approximately seven days after the peak radioactivity was delivered to the surface on 3 May. Fluxes in Bq m^{-2} d^{-1} through 200 m during the period 8-15 May averaged 1.3 for ^{95}Zr, 1.3 for ^{103}Ru, 0.1 for ^{134}Cs, 0.2 for ^{137}Cs, 0.7 for ^{141}Ce, 0.7 for ^{144}Ce and 0.003 for $^{239+240}Pu$. Microscopic examination indicated that most of the sinking particles were zooplankton fecal pellets. Concentrations of the same radionuclides in fecal pellets produced by copepods in the surface layers were similar to levels found in the trapped particles confirming pellets as the prime conveyors of radionuclide flux out of the euphotic zone.

Dry and wet fallout measurements made at Monaco during May 1986 were used to establish deposition inventories for several of the radionuclides (Holm et al., in press). Coupling these measurements with total integrated flux of the Chernobyl-derived radionuclides suggests that up to 76% of $^{239+240}Pu$ and 50% of the Ce nuclides deposited in this region of the Ligurian Sea had passed through 200 m depth by 21 May. For the less particle-reactive ^{137}Cs, only 0.2% of the total amount deposited had reached 200 m by the same time indicating that most of the ^{137}Cs inventory remained in the upper water column after the DYFAMED experiment. Similar studies carried out in collaboration with the Italian ENEA during the following July indicated that less particle reactive elements such as the Ru and Cs nuclides were still being transported by sinking particles at all depths down to 250 m off the coast of La Spezia (Fowler et al., in prep.). However, no fallout signal was detected in bottom sediments at 500 m at the same site. This preliminary observation suggests the presence of a mechanism that considerably slowed the downward descent of these contaminated particles in deeper waters and their eventual incorporation in bottom sediments. More cores from deeper waters are needed to discern the exact time frame for the vertical transport of Chernobyl-derived radionuclides in the Northwestern Mediterranean.

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X-III9

Radionuclide activity-depth profiles in sediments of the Gulf of Venice (Italy)

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The use of radionuclides like Cs-137 and Pb-210 as geochronological tools makes it possible a quantitative investigation of present and recent sedimentation on continental shelves.

In order to obtain the first data on sedimentation rates and mechanisms in the area of fine sediment deposition in the Adriatic Sea north of the Po delta, seven gravity cores were collected in September 1986. A Shipek grab was used at each station to sample the superficial layers. Fig. 1 shows the sample locations (5-7 km offshore).

The cores were sectioned into 1-3 cm thick slabs. Cs-137 activity was determined by direct gamma counting of dried sediment using an intrinsic germanium detector and a multichannel analyzer. The Po-210 method was used for Pb-210 analyses, assuming secular equilibrium between the two isotopes. The dry density of samples was determined from the weight percent water composition.

Comparison between core and grab samples reveals that a small portion (a layer 0.5-1.5 cm thick) of superficial sediments was lost in most cases during core collection. This topmost layer, which is present only in core 57, should contain Cs-137 and Cs-134 from the Chernobyl accident.

Fig. 2 shows the activity-depth profiles of Cs-137 and excess Pb-210 (over a background of supported radioactive lead of 0.7 dpm/g dry weight) for core 35.

Cs-137 depth profiles show some interesting similarities but are hardly interpretable. Generally speaking cores present at least three peak activities and this makes it difficult to assess even an approximative chronology.

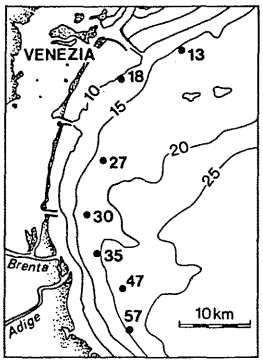

Fig. 1

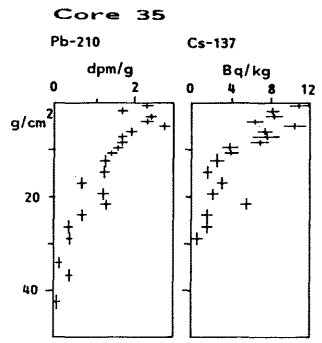

Fig. 2

Furthermore significant amounts of Cs-137 can be found at depths comparable with those of the excess Pb-210. This may be due to diffusion phenomena through the interstitial waters. The lack of similarity to the fallout profiles supports the hypothesis that the Cs-137 in cores originates from the river inputs.

Since radioisotope activities in the superficial layer are not homogeneous we can exclude that mixing (bioturbation and resuspension) occurred in recent times. Moreover no significant presence of benthic fauna was noticed during grab sampling.

Pb-210 depth profiles show an approximately exponential decline with depth even if there are significant increases in concentration at certain levels. This may be due to some variations of the sediment deposition rates and/or to inputs of particulate matter from different sources. Core 30, located off the harbour of Chioggia, shows the most irregular profile.

At this stage it is only possible to obtain apparent accumulation rates because we do not know yet the role played on modifying the profile by short time scale phenomena. The accumulation rates can be calculated from the slope of the semilogarithmic plots of activity versus depth, assuming a constant initial concentration of unsupported Pb-210 (Table 1). A constant flux model (Appleby & Oldfied, 1978) should give, in this case, more reliable data but accurate Pb-210 inventories are needed. Moreover we are not sure to what extent the assumption of the two models are compatible with the actual fenomenology.

TABLE 1. - Apparent accumulation rates and radionuclide inventories in cores.

CORE	Accum. Rates g/cm²yr	Cs-137(¹) dpm/cm²	Pb-210 dpm/cm²
13	0.61	8.7	43.4
18	0.96	14.8	61.1
27	0.41	7.6	35.9
30	1.04	20.5	77.7
35	0.54	8.3	45.2
47	0.54	16.7	88.9
57	0.82	17.5	107.3

(¹) Corrected taking into account the lost topmost levels.

Cores 13, 27 and 35 show Pb-210 inventories in the order of those derived from the fallout input (13-67 dpm/cm²; Appleby & Oldfield, 1983).

The highest sedimentation rates and inventories can be noted in the areas that are mostly influenced by riverine discharges and outlets of Venice lagoon. This areas turn out to be shifted southwards with respect to the outlets: this has to be connected to the general circulation of Adriatic Sea (counter-clockwise), which diverts southward the river plumes. The locations 47 and 57, for instance, seem to refer to Adige prodelta.

These first observations will have to be completed with independent indications to identify and analyze the effects of discontinuities in sedimentation and shifts in sediment sources. In particular mineral magnetic measurement (Oldfield & Appleby, 1984) seems to be the technique of choice to reveal stratigraphic anomalies.

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X-III10

Characteristics of Chernobyl fallout in the Italian coastal marine environment

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Abstract

Following the Chernobyl accident, investigations were carried out, in order to characterize the behaviour of Chernobyl radionuclides in the Italian coastal environments.

Introduction

The radionuclides released by the Chernobyl accident were injected into the atmosphere with processes substantially different from those of nuclear tests. Consequently, the behaviour of these radionuclides might be considerably different from bomb fallout produced in the period 1945-85.
Selected matrices were then analysed focusing on the accumulation/dilution processes of Chernobyl radionuclides in coastal environments.
The existing National Network for the Survey of Environmental Radioactivity was used as the basis for sampling.

Material and Methods

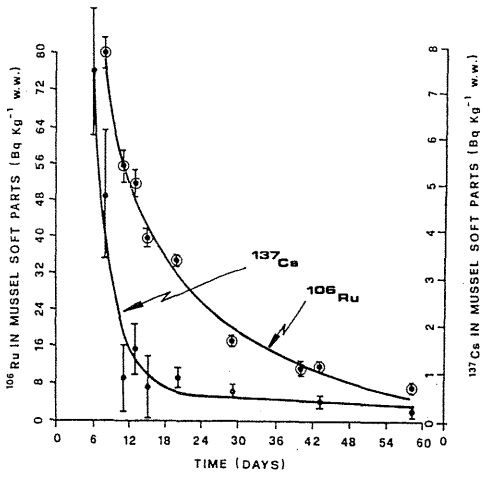
Surface sea water was collected at an average depth of - 5 m.
Particulate matter was separated using 0.45 u membrane filters.
Sediments were taken with a Van Veen grab and with a modified Reineck corer (Papucci et al., 1986).
Mussels were sampled in a protected area of the La Spezia harbour. Some 500 g of soft parts were analized each time on wet matter to avoid losses of volatile elements.
Samples were subjected to gamma spectrometry using HPGe detectors connected to a computerized spectrometric system.

Discussion

In the Ligurian Sea, the maximum concentrations of Chernobyl radionuclides in surface seawater (475 Bqm-3 of 137-Cs and 290 Bqm-3 of 103-Ru) were found in the first days of May 1986.

Particle associated radionuclide from Chernobyl underwent a solubilization that was very rapid for Cesium and slower for Rutenium; this fact allowed a considerable fraction of Ruthenium isotopes to rapidly reach the sea floor in shallow water environments. After 3 weeks contact with seawater only 2-5% of the radionuclides still present were in the particulate form. Similar behaviour was observed by Kempe & Nies (1986) in the North Sea and by Fowler et al. (1986) in the Mediterranean. 137-Cs activity in seawater dropped to 58 Bqm-3 in June and 14 Bqm-3 in October (pre-Chernobyl value: 4 Bqm-3). Radionuclide concentrations in the Adriatic Sea were consistently higher than in the Tyrrhenian Sea.

In the first days of June, most activity in shallow water sediments was due to Ruthenium isotopes; 6-12 months later about 10% of the Cesium isotopes deposited at the sea surface were found in the upper 2-4 cm of sediment.



Change of mussel (soft parts) contents of ^{137}Cs and ^{106}Ru with time.

The depuration curves were calculated by using biological half-lives of 2 and 14 days for 106-Ru and 2 and 63 days for 137-Cs.

Maximum radionuclide concentrations in the soft parts of mussels were found 2-4 days after the maximum radionuclide deposition (137-Cs 7.7 Bq.kg-1,w.w.;103-Ru 235 Bq.kg-1,w.w.). From the radionuclide elimination curve, a two compartment system was identified, with biological half lives of 2 and 63 days for Cesium and 2 and 14 days for Ruthenium (fig.1).

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Y-I1

Sediment trap for hard bottom community studies

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Résumé

Une méthode pour l'étude de l'influence de la sédimentation sur les communautés de substrat dur est presentée. Dans ce but a été réalisé un modèle de piège à sédiments approprié pour l'échantillonnage dans les eaux cotières.

Several authors have pointed out the trophic role of suspended matter for benthos (Smetacek, 1982), but this relationship was studied essentialy for soft bottom communities.

The quali- quantitative composition of organic and inorganic suspended matter could play a significant role also in determining the structure and functions of the benthic rocky biocoenoses.

To study this less known aspect, samples of particulate matter in the water column and in traps placed along a cliff near the Portofino Promontory (Riviera Ligure di Levante) were carried out during an yearly sampling. The change of traps was effected bimonthly by diving. At the same time biological samples were collected to study the benthic community.

Four non-cylindrical sediment traps were placed vertically at both 16 and 24 m depth in different situations of turbulence and water current.

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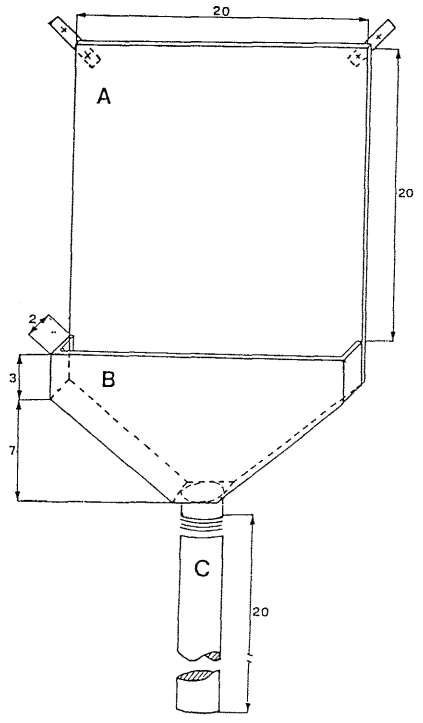

Fig. 1. The proposed sediment trap with baffle (A), rectangular funnel (B) and cylindrical collector(C). Measures are in centimetres.

According to Sato & Sawada (1979), funnel type traps are unsuitable in shallow waters, because water movement strongly influences the sedimentation rate. Also the design is important: generally funnels undertrap while narrow mouths and wide bodies consistently overtrap (Gardner, 1980; Butman et al., 1986).

The proposed trap (Fig. 1) has a square baffle of 400 cm² allowing the sediment to fall into a rectangular funnel with a mouth of 2 cm x 20 cm and eventually into a 2 cm Ø, 20 cm long cylinder. The ratio between height and mouth opening (= 10) is important in determing the particle retention and to collect also the silt and clay fraction.

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Y-I2

An application of a portable current meter for flow measurements near bottom by scuba diving

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Hydrodynamic forces have long been recognized to exert a strong influence on distribution and morpho-functional adaptations of benthic organisms. In this framework, interactions between water movement and benthos at the water-bottom interface are of major importance (Nowell & Jumars, 1984). However, due to the difficulties of performing flow measurements on a small scale, benthic studies usually do not include quantitative evaluations of this parameter.

Among the different kinds of instruments available to measure flow on a small spatio-temporal scale, electromagnetic current meters are probably the most suitable for field studies.

In the present paper we report the application of a bi-directional electromagnetic current meter (Marsh-McBirney 500 series instruments; 8595 Grovemont Circle, Gaithersburg, Maryland 20877,U.S.A.) in a study on the flow dynamics in seagrass beds.

The characteristics of the Marsh McBirney 500 series current meters are: ability to measure both X and Y vector components of velocity in the horizontal plane; fast response and/or long-term averaging capability ; small-sized spherical sensors (from 2 to 8cm in diameter) that are easily handled by a SCUBA diver as well as by a boat operator; and last, but not least, they are relatively inexpensive.

The sensor is connected to the meter by a cable of suitable length (Fig.1). Functionality of sensor is not affected by fouling films or contacts with bottom structures (e.g. seagrass leaves). The flow sensing volume is a sphere about three times that of the sensor diameter ; the velocity range detectable varies between 0 and 300cm/sec.

One of us performed a preliminary set of measurements using model 511 of the 500 series within a Zostera marina bed and , as control, outside it in bare sands off San Juan Island (WA,U.S.A.) to evaluate the effect of Zostera canopy on flow. The sensor, attached to a graduated rod inserted into the substrate, was placed, by a SCUBA diver, at varying distances from the bottom and from the Zostera canopy . Orientation of the sensor was controlled by the diver. Readings of the velocity components (three minutes for each point) were recorded by the operator stationed on the boat (Fig.1). Velocity profiles were drawn from the measurements so obtained (Fig.2). Velocity profiles are extremely useful to define flow environment and benthic boundary layer features (Vogel ,1981; Nowell & Jumars,1984).

Our results were similar to those reported by Fonseca et al. (1983) and more recently by Eckman (in press) who used a similar procedure with the same current meter.

Other models of the 500 series are suitable also for flume laboratory studies, others are equipped with a geomagnetic compass and can be interfaced with automatic data recorders.

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FIG.1

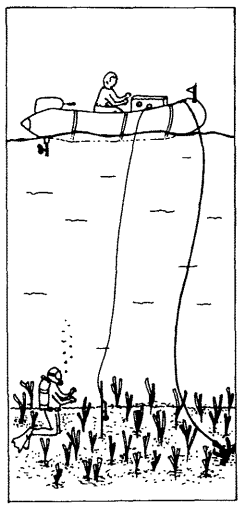
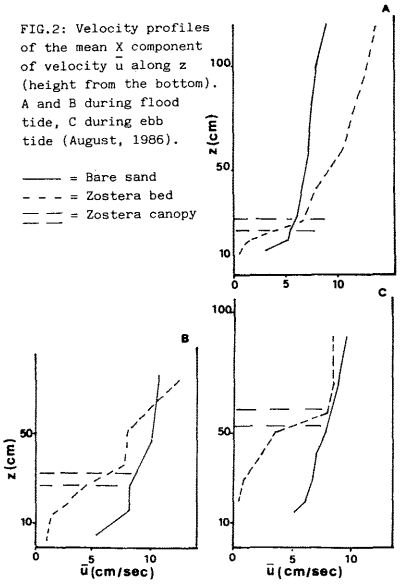


FIG.2: Velocity profiles of the mean X component of velocity $\bar{u}$ along z (height from the bottom). A and B during flood tide, C during ebb tide (August, 1986).

——— = Bare sand
- - - = Zostera bed
— — = Zostera canopy



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A simple and fast method to obtain rough density maps of the Posidonia oceanica beds

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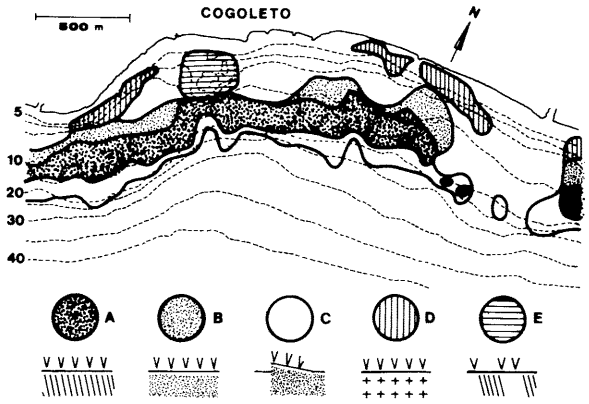
Maps of Posidonia oceanica beds are usually realized by direct (SCUBA divers or exploratory submarines) or indirect observations (side-scan sonar or aerial photography). Both techniques present disadvantages: the first is time-consuming and hardly extensible on a large scale; the latter is too expensive for many users and gives no information on the conditions of the sea-grass bed (MEINESZ, CUVELIER and LAURENT, 1981). We propose a method which integrates the less expensive echo-sounding techniques with a reduced number of underwater observation based on a statistical sampling design. Although echo-sounders have never been extensively used to map sea-grass beds, it is known that, besides depth, these instruments may give information on the characteristics of the sea bed itself; it is possible to recognize if it is smooth or rough, soft or hard and layers of sea-bed deposits may be also revealed (FORBES and NAKKEN, 1972). Adjusting the "gain" and the "white line" intensities on the echo-sounder, we have identified a series of signals characteristic for the various densities and morphologies of the P. oceanica meadow. Thus a map of the distribution of the meadow can be obtained surveying the area with a systematic design on crossing profiles. The echoes with the same intensity and shape allow to identify a number of homogeneous strata in the distribution; subsequently applying a stratified random sampling design, it is possible to plan a reduced number of underwater observations on the descriptive parameters of the meadow. The statistical background of this survey provides the measure of the standard errors of the estimates within each statum, and thus it is possible to plan new underwater observations where the uncertainty is too high. A precise and more informative map of the measured parameters is then drawn with low cost.In fact the described



Gulf of Cogoleto (Ligurian Sea). Posidonia oceanica beds on: A) mattes, B) sandy bottom, D) hard bottom; C) shaded inferior limit of the prairie without mattes; E) patchiness of living and dead prairie.

method requires only the following tools: a small boat, a compass, a small or portable recording echo-sounder, the SCUBA-diving equipment and bathimetric charts of the area to be mapped (1:25000 scaled or more detailed). It would be better if the depth contour spacing on the charts were 5 meters at least, between 0 m and 50 m depth. The figure reports, as an example, the map drawn up by the echo-sounder records of the P. oceanica meadow off Cogoleto (Genova, Ligurian Sea); the map was obtained in two days work during the summer 1986 from thirty, 100 m spaced parallel profiles. Normalized symbols (MEINESZ et al., 1983) have been used.

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Note préliminaire sur la végétation marine de l'île de Gökçeada (mer Egée-Nord, Turquie)

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Abstract :

112 seaweeds and three seagrasses were determined during these studies. These were distirbuted as 66 species of RHODOPHYTA, 23 species of PHAEOPHYTA, 18 species of CHLOROPHYTA and five species of CYANOPHYTA where these were made of 58.92%, 20.53%, 16.07%, 4.46% percentages respectively of the total.

La végétation marine benthique de l'île de Gökçeada est très peu connue. Ce travail donne un bref aperçu sur les répartitions des espèces végétales que l'on peut rencontrer au niveau des étages supralittoral, médiolittoral et de l'horizon supérieur de l'infralittoral.

L'île de Gökçeada, qui est la plus grande île de Turquie en Mer Egée, se situe près de l'entrée du détroit des Dardanelles dans la partie nord de cette mer.

Les répartitions des espèces marines de cette île sont influencées par des eaux moins chaudes et moins salées (de 11°C à 13°C en Hiver, de 20°C à 22°C en Eté pour la temperature de surface, de 30‰ à 35‰ pour la salinité de surface) originaires de mer Noire. Tandis que dans la partie sud de la Mer Egée la température (de 15°C à 16°C en Hiver, de 20°C à 23°C en Eté) et la salinité de surface (de 38‰ à 39‰) sont plus élevées.

Nos recoltes ont été effectuées entre 1972-1973 et 1986-1987 d'une manière saisonnière dans les quatres stations (Fig:1; ZEYBEK, 1973).

Au cours de ces travaux, nous avons déterminé 114 espèces d'algues et 3 phanérogames marines. Les répartitions de ces espèces dans differents groupes ont été présentées sous forme d'un tableau.

D'après ce tableau, 66 espèces de Rhodophycées, 23 espèces de Phéophycées, 18 espèces de Chlorophycées et 5 espèces de Cyanophycées constituent respectivement 58.92%, 20.53%, 16.07% et 4.46% du nombre total d'espèces dénombrées.

Groupes d'algues	Nombre d'espèce
CYANOPHYCEAE	
Chroococcales	1
Hormogonales	4
RHODOPHYCEAE	
Bangiales	2
Acrochaetiales	2
Nemalionales	1
Gelidiales	3
Gigartinales	6
Cryptonemiales	13
Rhodymeniales	3
Bonnemaisoniales	1
Ceramiales	35
PHAEOPHYCEAE	
Ectocarpales	1
Sphacelariales	5
Dictyotales	6
Chordariales	3
Fucales	8
CHLOROPHYCEAE	
Ulvales	5
Siphonocladales	7
Dasycladales	1
Codiales	3
Caulerpales	2

Tab.1-Répartitions des algues dans les groupes systematiques.

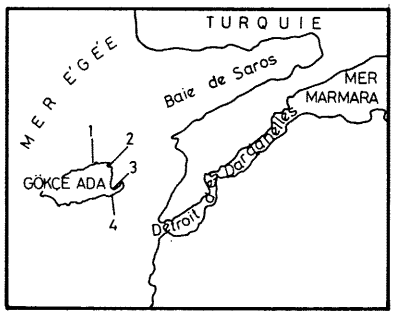

Fig.1- Emplacemants des stations et carte de la région. (St.1- Kaleköy, St.2- Kuzulimanı St.3-Aydıncık, St.4-Tuzgölü civarı)

La répartition verticale des espèces caractéristiques des différents étages ressemble beaucoup à celle observée dans les autres endroits des côtes turques de la Mer Egée (CIRIK, 1978). Mais pourtant les espèces à affinitées chaudes, appartenant en particulier aux genres **Liagora, Amphiroa, Sargassum, Valonia** sont moins fréquentes.

D'autre part, la trentaine d'espèce existante également en Mer Noire suit une bonne répartition sur les côtes de cette île.

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Y-II2

Comparison of the benthic fauna of three Aegean Islands

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The benthic fauna of shallow soft substrata was studied on three islands of the Northern Sporades in the spring of 1985. Four sites were visited on the island of Skiathos : a very exposed site in Aselinos (Asl - As3) on the northwest coast, two less exposed beaches in Koukounaries (Kl - K3) and Aghia Paraskevi (Al - A3) facing south and a sheltered site in the bay where the harbour is found on the southeast coast (Pl - P3). At those sites samples were taken at 5, 7 and 10 m depths with a 0.05 m² Ponar grab. On the island of Pelagos, one site was sampled in the very enclosed bay of Planetes (F) at 10 m depth, while on the island of Yioura one site (El - 23 m deptn) was located on the very exposed east coast and another (E2 - 16m depth) more sheltered in a small bay on the south coast. Sampling on the last two islands was carried out by a 0.1 m² van Veen grab. Two samples were obtained at each station. The diversity was calculated using the index of Shannon-Wiener. The results were submitted to a Detrended Correspondence Analysis using the computer program DECORANA (Hill, 1979).

The sediment consisted of sand in all stations except for El where it was muddy gravel and for F where it was finer consisting of muddy sand. In stations Pl, P2 and Kl it contained a large proportion of shell fragments .

212 species were identified on the whole of which only one, Typosyllis hyalina was found on all the islands. Yioura and Pelagos had 2 species in common, Skiathos and Yioura 11 species and Skiathos had 21 species in common with Pelagos. The total number of species found on each island were 33 on Yioura, 46 on Pelagos and 166 on Skiathos. In all stations, except for the Aselinos where the Mollusca dominate, the polychaetes dominate in both number of individuals and species. The second numerous group in the Aghia Paraskevi site and Yioura are the crustacea whereas in the Planetes and the rest of Skiathos stations are the mollusca. The less numerous group in all stations are the echinodermata. Species with wider distribution and greater density on Skiathos were Lumbrineris gracilis (found at 66 % of the stations and with maximum density of 210 inds./m² at st. P2), L. latreilli (66 %, 200 inds./m²

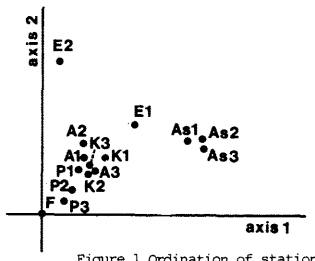

Figure 1 Ordination of stations. Axis 1 plotted against Axis 2.

Table 1

STATION	H´	J
Pl	4.58	0.94
P2	4.89	0.88
P3	5.08	0.90
Kl	5.69	0.94
K2	4.99	0.90
K3	5.31	0.93
Al	4.67	0.82
A2	4.53	0.83
A3	4.92	0.91
Asl	3.06	0.80
As2	2.82	0.85
As3	2.05	0.55
El	2.52	0.90
E2	3.64	0.76
F	4.49	0.81

at st. K2), Paradoneis lyra (75 %, 160 inds./m² at st. P2), Exogone gemmifera (75%, 350 inds./m² at st. Al) and Aricidea cerruti (75 %, 270 inds./m² at st. A2). The above species were practically absent from Aselinos were the dominant species was the mollusc Spisula subtruncata with densities as high as 360 inds./m². In Yioura the most abundant species were the polychaetes Kefersteinia cirrata with 320 inds./m² and Paradoneis armata with 250 inds./m². In Pelagos, finally, the most abundant species were Notomastus latericeus (280 inds./m²) and L. latreilli (220 inds./m²).

The diversity ranged from 2.05 in station As3 to 5.69 in station Kl. In general it was lower at the most exposed sites and greater at the sites with intermediate exposure (Table 1.).

In the correspondence analysis the first two factors had considerably higher eigenvalues, 0.731 and 0.515, and were the only ones taken into consideration. Plotting of the two axes in Fig.1. shows that the most exposed stations in Aselinos have higher values on Axis 1 while the most sheltered in Planetes bay have the lowest values. It is suggested that Axis 1 represents exposure to wave action. Axis 2 appears related to sediment characteristics. A Spearman Rank Correlation between the percentage of sand and the scores on Axis 2 was significant at the $0.005<P<0.001$ level ($r=0.704$). Thus, the main factors of variability in the fauna were exposure and percentage of sand in the sediment. The analysis did not separate the islands between them which suggests that the differences in their fauna are not as much due to their geographical separation as to the difference in their geomorphological characteristics.

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Y-II3

Considérations biogéographiques sur le peuplement Annélidien de l'île de Capraia (Archipel Toscan, Italie)

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ABSTRACT - BIOGEOGRAPHICAL OBSERVATIONS ON THE POLYCHAETE FAUNA OF THE CAPRAIA ISLAND (TUSCAN ARCHIPELAGO, ITALY)

Ninety-two polychaete species were collected on rocky bottoms 0 to 10 m depth. Besides to a large number of cosmopolitan species, thermophile species are more abundant than boreal ones, in contrast with what observed in deeper soft bottoms. This suggests the hypotesis that the shelf habitats of the Tuscan Archipelago already exhibit a "Ligurian" character, due to the general water mass circulation, while the littoral ones are still "Tyrrhenian", thanks to a warmer winter climate.

Capraia (lat. 43° 2' N, lon. 9° 49' E) est une des petites îles de l'Archipel Toscan les plus éloignées du continent; sa position à la limite entre mer Ligure et mer Tyrrhénienne, rend intéressante son étude biogéographique. Des récoltes de polychètes sur les fonds rocheux entre le mésolittoral et 10 m de profondeur (ABBIATI et alii, 1986; CASTELLI et alii, 1987) offrent l'opportunité d'une étude de ce type.

Les 92 espèces récoltées au total ont été séparées en 7 groupes biogéographiques différents, à savoir:
- large distribution ("cosmopolites"): espèces panocéaniques ayant une large distribution latitudinale au moins dans un des océans.
- circumtropicales: espèces panocéaniques présentes essentiellement dans les régions tropicales, débordant de façon plus ou moins accusée dans les zones tempérées-chaudes.
- endémiques méditerranéennes: à la suite de TORTONESE (1985) on considère dans cette catégorie les espèces reportées seulement pour la Méditerranée au sens strict; on les qualifie de "présumées", parce que la distribution de beaucoup de ces espèces n'est pas encore suffisamment connue.
- atlantico-méditerranéennes: espèces endémiques de la province atlantico-méditerranéenne, comprenant - d'après FREDJ (1972) - les régions lusitanienne, maurétanienne et méditerranéenne s.str.
- boréales: espèces qui rejoignent les côtes nord-européennes.
- indopacifiques: espèces connues de la mer Rouge, de l'océan Indien et/ou du Pacifique occidental.
- divers: sont cumulées dans cette catégorie les espèces ayant des aires de distribution disjointes pour les causes les plus variées (cas d'introduction favorisée par l'homme, de confusion d'espèces voisines mais différentes, ou bien répartitions larges insuffisamment connues).

Les résultats (voir tableau) montrent la large dominance d'espèces à large distribution et un nombre d'endémiques très réduit, ce qui semble être fréquent chez les Polychètes (RULLIER, 1958); trois de ces endémiques sont des espèces nouvelles (appartenant aux genres *Autolytus*, *Platynereis* et *Oriopsis*) qui seront décrites dans un travail ultérieur.

Bien que dans le cadre d'une affinité atlantico-méditerranéenne accusée, typique pour la Méditerranée nord-occidentale, les espèces à affinité froide (boréales) sont en nombre plus faible que les espèces à affinité chaude (indo-pacifiques plus circumtropicales). Le nombre élevé d'espèces thermophiles est surtout dû aux syllidiens, qui sont toujours le groupe dominant sur les petits fonds rocheux littoraux de Méditerranée, et correspond à ce qu'avait noté SAN MARTIN (1984) aux îles Baléares.

Cette affinité chaude, d'autre part, est en contradiction avec les observations de ALBERTELLI et alii (1984) qui, dans le benthos des fonds meubles sublittoraux de Capraia, trouvent une faune lusitano-boréale; par contre il est en bon accord avec la tendance des phytosociologues de reconnaître une flore thermophile chez les algues des côtes de l'Archipel Toscan et de l'île voisine de Corse. Ces différences confirment le rôle de plaque tournante biogéographique que joue l'Archipel Toscan entre mer Ligure et mer Tyrrhénienne et suggèrent l'hypothèse que les eaux de fond du plateau appartiennent déjà au circuit ligure, tandis que les eaux superficielles sont encore tyrrhéniennes, jouissant d'un refroidissement moins accusé pendant l'hiver. Cette hypothèse devra être vérifiée lors de nouvelles recherches étendues à des groupes différents.

Espèces	No	%
Présumées endémiques méditerranéennes	9	9.78
Atlantico-méditerranéennes	15	16.30
Boréales	14	15.22
Indo-pacifiques	11	11.96
Circumtropicales	10	10.87
Large distribution	30	32.61
Divers	3	3.26

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Structure des communautés médiolittorales des Polychètes en fonction de l'exposition dans une petite île méditerranéenne

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ABSTRACT - STRUCTURE OF MIDLITTORAL POLYCHAETE COMMUNITIES IN RELATION WITH EXPOSURE IN A SMALL MEDITERRANEAN ISLAND

Although the communities in exposed areas have the highest number of individuals, those in intermediate situations are the most diverse. Algal cover could play an important role too.

L'exposition joue un rôle fondamental dans la zonation des communautés littorales (LEWIS, 1964); les petites îles se prêtent bien aux études qui prennent en compte l'importance de l'exposition, étant donné qu'elles offrent, dans une aire géographique restreinte, toute la gamme des différentes expositions. En outre elles jouissent, en général, d'une faible charge anthropogénique.

Le but de ce travail est de vérifier les modifications des peuplements d'Annélides Polychètes de la roche mediolittorale autour d'une île de l'Archipel Toscan: Capraia (lat. 43° 2' N, lon. 9° 49' E). Les vents dominants sont le mistral (NO), le sirocco (SE) et la grécale (NE). (Fig.1).

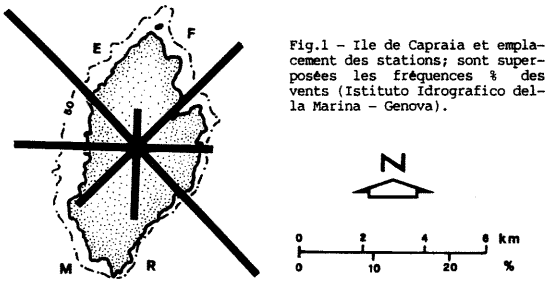

Fig.1 - Ile de Capraia et emplacement des stations; sont superposées les fréquences % des vents (Istituto Idrografico della Marina - Genova).

Pour évaluer l'influence de ces différences d'exposition, nous avons choisi 4 stations (Fig.1): F (Formiche), R (cala Rossa), M (cala Moreto) et E (cala Ergastolano); les stations ont été fixées sur des parois rocheuses verticales, trois exposées aux vents dominants (F, R et E) et une dans une zone plus abritée (M). Les stations F et R, les plus exposées, étaient caractérisées par la présence du trottoir à *Lithophyllum tortuosum*, qui manquait au contraire à la station M; la stat.E, bien qu'orientée au NO, était toutefois placée dans un endroit relativement abrité et le trottoir n'y était pas développé.

Les prélèvements ont été effectués par grattage d'une surface de 400 cm^2 chevauchant le "zéro biologique", établi sur le terrain d'après le critère phytosociologique proposé par BOUDOURESQUE et CINELLI (1976).

Les modifications structurales des peuplements de Polychètes ont été évaluées sur la base du nombre total d'individus (N), de la richesse spécifique (S) et des indices de diversité de Shannon-Weaver (H'), d'équitabilité de Pielou (J) et de variété spécifique de Margalef (D). Des précisions sur les méthodes, aussi bien que la liste des espèces récoltées, sont présentées par ABBIATI et alii (sous presse).

Les données obtenues sont reportées dans le Tab.I. Elles mettent en évidence que la relation entre structure et exposition est complexe et, apparemment, parfois contradictoire; toutefois, on peut en tirer quelques indications.

Tab.I - Valeurs des paramètres structuraux dans les quatre stations.

stat.	N	S	H'	J	D
F	740	20	2.15	0.49	1.99
R	485	15	2.26	0.57	1.57
M	206	14	2.50	0.65	1.69
E	465	23	2.99	0.66	2.48

Le peuplement de mode plus calme (stat.M) est moins riche, soit en individus (N) soit en espèces (S), par rapport à ceux de mode battu, bien que le nombre d'espèces soit faible même à la stat.R. La richesse du peuplement de la station la plus battue (stat.F), surtout en ce qui concerne le nombre d'individus, est due à l'explosion numérique de quelques espèces (notamment *Platynereis dumerilii*), plus tolérantes à l'égard du facteur hydrodynamique, la diversité étant faible. Au contraire, le peuplement le mieux structuré est celui de la station modérément exposée (stat.E), où les valeurs de diversité (H'), aussi bien que celles des composantes d'équitabilité (J) et de variété spécifique (D), sont les plus élevées. Il semble possible de conclure que les conditions intermédiaires sont les plus convenables, ne présentant ni le stress hydrodynamique des zones trop battues, ni l'insuffisance de l'humectation qui peut se vérifier dans les zones les plus calmes. Il faut rappeler, néanmoins, que les différentes couvertures algales (trottoir opposé à algues molles) peuvent jouer un rôle très important pour la faune vagile (dont les Polychètes), limitant l'influence de l'hydrodynamisme par la création d'abris différents soit au choc des vagues soit à la déshydratation.

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Bryozoaires actuels et fossiles de quelques régions de la Grèce insulaire

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Note préliminaire sur les résultats de comparaisons entre une série d'échantillons de faune bryozoologique actuelle (île d'Othoni) et passée (Crête centrale et orientale principalement et Lefkada, Aegina, Kythira et Milos accessoirement) (Voir Tableau).

I. Prélèvements.

Othoni: Prélèvements sur plage; formes encroûtantes: 96,5%, érigées: 3,5%. - Crète: Sédiments de Miocène supérieur (Tortonien); spécimens en majorité épizoaires (sur Clypeaster et Ostrea): f. encroûtantes: 75%, érigées: 25%. La prédominance de formes circumlittorales ainsi que la faune accompagnante (Echinides, Mollusques, etc) indiqueraient un climat tropical-subtropical. - Lefkada, localité Vassiliki: Marnes bleues miocènes (Tortonien): f. encroûtantes: 100%. Mêmes indications en ce qui concerne les conditions climatiques. - Aegina, local. Aghia Marina: Marnes pliocènes: f. encroûtantes: 100%. Indications: climat tropical-subtropical, faciès calme. - Kythira, local. Platia Ammos: Marnes jaunâtres pliocènes: f. érigées: 100%: faciès bien agité. - Milos, local. Apollonia et Sarakinike: Sédiments pliocènes (super.?): f. encroûtantes: 57%, érigées et libres: 43%. Indications (faune accompagnatr.: Mollusques, Brachiopodes, Spongiaires, etc): climat tempéré.

No	FAUNE	FORME		ILE					
		ENCROUTANTE	ERIGEE	OTHONI	LEFKADA	KYTHIRA	CRETE	AEGINA	MILOS
	Cyclostomata								
1	Cardioecia watersi		+	+					
2	Diaperoecia major (J)		+	+		+	+		+
3	Diaperoecia tubulosa		+	+					
4	Diplosolen obelium	+		+					
5	Frondipora verrucosa L.		+	+			+		
6	Hormera cf.frondiculata		+			+			
7	Idmidronea sp.		+						+
8	Idmidronea cf.atlantica		+	+					
9	Lichenopora (Disporella) hispida(Fh.)	+		+			+		
10	Lichenopora radiata	+					+		
11	Plagioecia patina	+					+		
12	Tubulipora plumosa		+			+			
	Cheilostomata								
	a) Anasca								
13	Aeta sica (COUCH)	+					+		
14	Calpensia nobilis (E.)	+		+			+	+	
15	Cellaria salicicornioides (L.)		+			+			
16	Copitozoum tenuirostre (H.)	+					+	+	
17	Cibrilaria innominata	+		+					
18	Cupuladria canariensis (B.)	+					+		
19	Micropora papyracea (R.)	+			+				
20	Parellisina curvirostris	+		+					
21	Scrupocellaria scruposa		+						+
22	Smittipora disjurcta	+		+					
23	Spiralaria gregaria	+		+					
	b) Ascofora								
24	Adeonella pallasi (R.)		+	+					
25	Escharina sp.	+					+		
26	Escharina vulgaris (M.)	+		+					
27	Hemismittina elongata	+					+		
28	Hippaliosina depressa	+		+					
29	Hippopodinella lata (B.)	+					+		
30	Margaretta cereoides (E.&S.)		+	+		+			
31	Metrarabdotos moniliferum		+				+		
32	Microporella ciliata (P.)	+		+			+		
33	Porella sp.		+				+		
34	Porella tubulifera		+						+
35	Reptandeonella violacea (J.)	+		+			+		
36	Rhynchozoom sp.	+		+					
37	Schizomavella auriculata (H.)	+		+					
38	Schizomavella labiata	+			+				
39	Schizoporella unicornis (J.)	+					+	+	
40	Schizoporella sp.	+					+		
41	Sertella sp.		+				+		
42	Sertella complanata		+	+					
43	Smittina cheilopora (R.)	+							+
44	Smittoidea reticulata	+		+					
45	Turbicellepora armata	+		+					+
46	Turbicellepora coronopusoidea	+							+
47	Turbicellepora sp.	+					+		

II. Discussion.

A. Se référant à HARMELIN J.G. (1968) et à HAYWARD P.J. (1974), en relevera: 1. La présence à Othoni de 4 endémiques de la Méditerranée orientale et de la zone de Madère (Nos 17,22,24,28) et d'une de Méditerranée (No23, HARM.) ou 2 (No 30, HAYW.). 2. Une espèce indo-pacifique suivant HARM. ou endémique méditerr. encore, suivant HAYW. 3. La présence d'Hippopodinella lata (No29) en Crète, espèce des régions tempérées boréales, dès le Miocène sup., ce qui ne s'accorderait pas avec l'hypothèse de HAYWARD qui placerait l'entrée en Méditerranée des espèces tempérées boréales au Pliocène. B. Des comparaisons portant sur 5 espèces présentes à Othoni tout comme dans des sédiments fossilifères des autres îles (Nos 2,14,19,30,32) n'ont pas mis en évidence des différences morphologiques et anatomiques essentielles.

Y-II6

Congruences phytogéographiques des communautés benthiques des îles mineures de la Sicile

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Abstract:A study of the syntesis of the researches on the benthic communities of the smaller sicilian isles has revealed their phytogeographical features.The resulting flora is composed of 663 species and 60 minor taxa of these species.The chorological analysis together with the R/P value of the different isles,has made possible a valuation of the roles of these isles in the phytogeographical characterization of the seas surrounding Sicily though a comparison with Sicily and the entire Mediterranean basin.

Au cours des dernières vingt .... années la végétation des îles mineures de la Sicile,a été étudiée amplement par les auteurs,comme le prouvent les précédentes recherches qu'ils ont effectuées sur chaque aire prise en considération:Iles Egades (Giaccone G.,Sortino M.,1974),Ile d'Utique (Giaccone G.,1967;Giaccone G.et alii,1985),Iles Eoliennes (Giaccone G.,1969),Iles de Malte (Cragg A.,1965),Iles Pélages (Cinelli F. et alii,1976),Ile de Pantelleria inclus les bancs de vieille Pantelleria,Scherchi,Talbot (Giaccone G.et alii,1973;Calvo S.,Sortino M.,1979).

La flore des îles mineures est composée par 663 espèces et par 60 taxa inférieurs à l'espèces (sous-espèces,variétés et formes),dont 84 sont des espèces pas signalées en Sicile.Dans son ensemble,la flore ne s'éloigne pas de celle de la Sicile (858 espèces et 97 variétés) et à peu prés 76% des espèces végétales sont en commun aux îles mineures et à la Sicile.

Il y a des différences significatives dans la consistance floristique des divers plans de la végétation à cause de la diversité des biotopes causés par divers facteurs climatiques et édaphiques presents dans les secteurs biogéographiques où les îles se trouvent (Giaccone G.,Sortino M.,1974).

En comparant les régions phytogéographiques des espèces siciliennes avec celles des espèces retrouvées dans les îles mineures on ne remarque pas de différences appréciables.L'endémisme méditerranéen a valeurs comparables en Sicile (25.7%) et dans les îles mineures (24.5%).Dans les îles Pélages on a la valeur la plus basse en espèces atlantiques (45.6%) et la plus élevée en espèces indopacifiques (2.14%) à l'égard de celles des autres îles,en mettant en evidence le caractère oriental de la mer Africaine.

Pour ce qui concerne l'île de Pantelleria et les îles Egades on observe la valeur la plus élevée des espèces atlantiques (plus de 50%) et une valeur relativement basse des endémismes méditerranéens;ces données sont une consequence du fait que ces îles ressentent une influence meridionale dûe au courant atlantique.

Parmi toutes les îles celle qui a les caractéristiques méditerranéennes majeures est Utique où on retrouve une valeur élevée en espèces endémiques (24.1%) et une valeur relativement basse en espèces atlantiques (46.36%);le caractère subtropical de cette île est confirmé ultérieurement par la valeur du rapport R/P (3.14).

	M	A	IP	C	CB	CT	R/P
ILES EGADES	16.0	50.5	0.5	25.8	2.6	4.7	2.0
ILE D'UTIQUE	24.1	46.36	1.4	22.3	2.8	3.04	3.14
ILES EOLIENNES	21.5	50.0	0.9	21.5	2.8	3.3	2.89
ILES DE MALTE	13.5	50.3	1.0	27.5	2.6	5.2	3.4
ILES PELAGES	25.7	45.6	2.14	21.2	1.3	4.0	3.0
ILE DE PANTELLERIA + BANCS	21.3	50.8	0.8	21.8	1.8	3.6	2.45
TOTAL	24.5	47.7	2.2	21.0	2.0	2.6	3.0
SICILE	25.7	47.3	3.0	19.6	2.1	2.2	2.9

Tab.I : Spectre chorologique % de la flore marine des Îles mineures et comparaison avec les valeurs de la Sicile

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Y-III1

Ichthyoplankton of the Egyptian Mediterranean waters II - Distribution and occurence of Pomatomus saltator larvae

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The present results are based on the analysis of plankton samples collected seasonally through the period from January 1982 to October 1984.The samples were collected from the S.E. Mediterranean waters overlying the continental shelf off the Egyptian coast between longitudes 29°45'E and 33°45'E. The study area is divided into twelve sections more or less perpindicular to the coast.Each section comprises 3 stations representing coastal,middle and offshore zones. Plankton samples were collected using an Ichthyoplankton net of 100 cm mouth opening,0.5 mm mesh size, fitted with flowmeter. In each sample the larvae of Pomatomus were sorted and counted,the counts were converted to represent No./1000 m3. The length of the larvae were measured to the nearest 0.5 mm.

RESULTS AND DISCUSSION

In the present work, a total of 16212 larvae of Pomatomus were recorded in the plankton samples collected in the summer and autumn cruises i.e. from July to late November . This suggests that the breeding of Pomatomus in the Egyptian waters begins in late June and ends in late November. The water temperature during this period varied between 21.5 °C and 29.5 °C. The peak of larval intensity occurred in mid August , where about 99.7% of the total collected larvae were recorded during this cruise. The water temperature ranged between 26.3 °C and 29.5 °C. These results are in close agreement with those reported by Perlmutter (1939)&Deuel et al.(1966) who reported on the occurrence of running ripe females during late June July and August.

As shown in Table 1 , Pomatomus larvae were highly abundant in the inshore water during the time of high spawning activity(August), while toward the end of the spawning season (October , November 1984) they were rare in the middle and offshore zones. During the larval peak (August), the larvae were confined to the western part of the area (Agami-Rosetta) and the highest abundance 10551 L/1000m3 was recorded in the coastal waters off Agami.

Figure 1 describes the distribution and abundance of the different size groups of Pomatomus larvae during August cruise . The pattern of distribution during the time of active spawning indicates that the newly hatched larvae up till 7 mm represents about 69% of the larvae and were aggregated in the inshore waters off Agami and also shows that the larvae in the offshore waters were of small sizes. This pattern of distribution suggests that the species perform a spawning migration towards shallower depths at the time of high spawning activity. The inshore waters of Agami region seem to be an important spawning ground for the species , recorded temperature and salinity were 27.3°C and 38.89‰ , respectively.

Table 1.Average density of Pomatomus larvae(No./1000m3) in the different zones.

Month	Inshore	Middle	Offshore
August 1982	621.40	3.7	0.04
October1984	0.70	7.2	12.80
November 1982	0.22	1.5	0.20

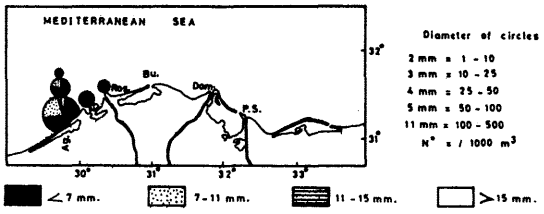

Figure 1.Distribution and abundance of size groups of P.saltator during August 1982.

This finding agrees with Faltas(1983),who reported that the fishing season of Pomatomus extends from May to October and that the best catch occurred in the western area between AbuQir(AQ) and Agami(Ag). Figure 2a&b shows that towards the end of the spawning season (October-November),the distribution of the newly hatched larvae was shifted eastwards mainly in the middle and offshore zones.It is most probable that the western stock performs a spawning migration early in the season and congrated in the inshore waters of Alexandria(AbuQir-Agami). After spawning the first patch,the fish may start another migration eastwards and spawn in the middle and offshore waters from Damietta(Dm) to Port-Said (PS) late in the season.

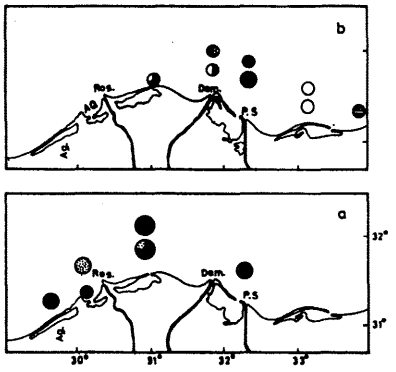

Figure 2a&b.Distribution and abundance of size groups during October1984&November1982.

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L'ichthyoplancton des eaux côtières marines Libanaises : oeufs et larves de Téléostéens (1)

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Abstract. 92 plankton net samples collected monthly from inshore and offshore stations along the coast of Lebanon during 1986-1987, provided 52 taxa of eggs and Teleost larvae belonging to 30 families. The spring and summer seasons are the richest period in ichtyoplankton. Hydrographic conditions (T°, Salinity) seem to be the most important factors upon the spawning, hatching and development activities.

L'ichtyoplancton des eaux maritimes côtières du Liban en particulier et du Bassin levantin en général est encore peu connu. Par contre la faune ichtyologique adulte est plus étudié (Mouneimné, 1978). Pour la première fois depuis nos recherches sur le zooplancton du Liban, nous avons essayé de connaître la composition et les distributions saisonnières de ce groupe qui constitue une fraction importante de la biomasse du plancton libanais (Lakkis, 1971; 1983). Des pêches mensuelles effectués en 1986 et 87 dans 4 stations côtières et au large de la côte avec le dispositif de deux filets de 60cm. de diamètre, 2,5m de long et 200 et 500 microns ont fourni 92 échantillons. Des traits horizontaux et verticaux (200-0) tirés au moyen d'un bateau de recherches fournissaient des échantillons de 100m^3. Les données hydrologiques ont été rapportées en détail ailleurs (Lakkis et Zeidane, 1987). Plusieurs références de base ont été consultées pour les déterminations des oeufs, larves, postlarves et juvéniles, notamment D'Ancona et al. (1931-1956), Aboussouan (1964), Marinaro (1971). En plus des déterminations et des examens morphologiques et biométriques, des comptages ont été effetués portant sur l'ensemble de l'échantillon afin de rapporter le nombre intégral d'oeufs et de larves. (2)

Les résultats généraux rapportés au Tableau I, montrent que le nombre d'espèces, de genres ou de familles déterminés, qui est 52 taxa, est très loin du nombre d'espèces adultes qui dépasse les 250. Ceci est dû d'une part aux difficultés dans les déterminations des formes larvaires voisines et des oeufs, d'autre part aux effectifs obtenus et contenant un nombre limité d'espèces. Par ailleurs, des pêches serrées dans le temps (e.g. hebdomadaire) seraient plus efficcaces pour décrire et suivre les différents stades larvaires, ce qui n'a pu être exécuté, faute de facilités. Ce tableau indique les conclusions suivantes:

- La période riche en ichtyoplancton (oeufs et larves) est celle située entre avril et septembre avec un maximum en juin.
- Bien que les effectifs soient faibles (de 0,1 à 5 ind./m^3), le nombre des oeufs en général reste 3 à 8 fois plus important que celui des larves et post-larves. Ceci est peut être dû aux techniques de pêches utilisées qui demandent une amélioration.
- Si l'effectif larvaire montre des variations mensuelles remarquables allant de 1 ind./échantillon en décembre à 283 en juin, celui des oeufs est beaucoup plus important variant entre 0 (décembre) et 810 en juin .
- Les types larvaires contribuant à la richesse des oeufs sont Engraulis, Coris julis, Sardinella aurita, Sparidae spp., Gobiidae, Serranidae et les Apodes; alors que la richesse en larves est due aux Sparidae, Gobiidae, Engraulis, Epinephelus sp., Arnoglossus spp.. On trouve des formes pélagiques (Engraulis, Sardinella, Scombridae), des formes mésopélagiques (Cyclothone, Myctophum, Stomias boa etc... et des formes démersales (Scorpaenidae, Bothidae, Soleidae. Notons que Stephanolepis diaspros est une espèce typiquement orientale.

TABLEAU 1. Liste des oeufs et larves de poissons trouvés et déterminés dans l'Ichtyoplancton des eaux côtières libanaises entre 1986 et 1987. La distribution mensuelle d'abondance est donnée pour chaque type larvaire. Les chiffres expriment le nombre d'individus (oeufs et larves combinés) par échantillon de 96m^3 d'eau de mer filtré. Les variations mensuelles de la température, de la salinité et du biovolume du plancton sont données. Le symbole X, espèce présente.

ESPECES	J	F	M	A	M	J	J	A	S	O	N	D
Température °C	18,20	17,07	17,90	22,00	24,56	27,48	27,80	29,46	28,70	26,06	23,76	20,26
Salinité ‰	38,60	38,50	38,75	38,90	39,00	39,10	39,20	39,40	39,30	39,20	39,20	39,00
Biovolume du Zoopl.(cm3/échant.	19,00	21,00	58,00	145,00	51,00	142,00	68,00	26,00	42,00	12,00	10,00	88,00
Zooplancton Total (Indiv./éch.)	42800	24400	29100	96300	62500	187500	200800	125900	173100	80000	103500	248700
Phytoplancton (cell./l)	60000	75000	100000	200000	270000	130000	100000	69000	110000	180000	160000	45000
Sardinella aurita	-	-	-	-	-	75	15	-	-	-	-	-
Engraulis encrasicolus	1	-	-	-	1	350	475	250	175	10	5	-
Stomias boa	-	1	1	1	1	1	1	-	-	-	-	-
Synodus saurus	1	-	1	1	1	-	-	-	-	-	-	-
Apodes (non dét., non comptés)	-	-	-	-	X	X	X	-	-	-	-	-
Sudis hyalina	-	-	-	-	X	X	X	-	-	-	-	-
Cyclothone microdon pygmaea	-	-	-	-	-	1	-	-	-	-	-	-
Cyclothone braueri	-	-	-	1	1	1	1	-	1	-	1	-
Myctophum sp.	1	-	1	1	-	-	1	-	-	-	-	-
Lycodontis unicolor	-	-	-	-	-	75	-	-	10	-	2	-
Dalophis imberbis	-	-	-	-	-	-	80	8	-	-	6	-
Ariosoma balearicum	-	-	-	-	-	-	1	-	-	-	-	-
Hippocampus ramulosus	-	-	-	-	-	1	1	-	-	-	-	-
Sphyraena sp.	-	-	-	-	X	X	X	-	-	-	-	-
Lepidopus caudatus	-	-	-	-	-	-	8	7	6	-	-	-
Lampanyctus pusilus	1	1	-	-	-	1	-	-	-	-	1	-
Zeus faber	-	-	-	1	1	-	-	-	-	-	-	-
Serranus cabrilla	-	-	-	-	2	4	8	3	-	-	-	-
Serranus hepatus	-	-	-	-	2	1	1	-	-	-	-	-
Anthias anthias	-	-	-	-	-	1	1	-	-	-	-	-
Alectis djeddaba	-	-	-	-	X	X	X	-	-	-	-	-
Epinephelus sp.	-	-	-	-	-	6	1	-	-	-	-	-
Apogon nigrippinnis	-	-	-	-	-	-	1	1	-	-	-	-
Sparus pagrus	-	-	-	-	-	-	1	-	-	-	-	-
Boops boops	-	-	-	4	1	-	-	-	-	-	-	-
Pagellus acarne	-	-	-	425	85	10	-	-	-	-	-	-
Oblada melanura	-	-	-	1	1	1	-	-	-	-	-	-
Sparidae spp. (oeufs)	-	-	-	-	-	450	4	90	-	-	-	-
Chromis chromis	-	-	-	-	-	7	-	-	-	-	-	-
Coris julis	-	-	-	-	420	81	6	-	-	-	-	-
Thalassoma pavo	-	-	-	-	5	-	-	-	-	-	-	-
Xyrichthys novacula	-	-	-	-	-	-	-	-	1	-	-	-
Sparisoma cretense	-	-	-	-	45	-	-	-	-	-	-	-
Trachinus vipera	-	-	1	-	-	-	-	-	-	-	-	-
Uranoscopus scaber	-	-	-	-	-	-	-	-	1	-	1	-
Auxis rochei	-	-	-	-	-	-	1	47	1	-	-	-
Euthynnus sp.	-	-	-	-	X	X	X	-	-	-	-	-
Tetrapterus belone	-	-	-	-	-	-	1	1	-	-	-	-
Gobius niger & Gobiidae	1	1	1	1	85	8	6	4	1	-	-	-
Gobiesocodae	-	-	-	-	-	-	-	3	2	-	-	-
Callionymidae spp.	-	-	-	-	6	7	1	-	1	-	-	1
Blennidae	-	-	-	-	71	-	-	-	-	-	-	-
Ophidium barbatum	-	-	-	-	-	-	-	-	1	-	-	-
Parophidion vassali	-	-	-	-	1	-	6	1	1	-	-	-
Scorpaena spp.	1	-	1	-	1	-	-	-	1	-	-	-
Lepidotrigla cavillone	-	-	-	-	1	-	-	-	-	-	-	-
Arnoglossus spp.	-	-	1	-	3	1	1	-	1	-	-	-
Microchirus variegatus	-	1	3	-	-	-	-	-	-	-	-	-
Symphurus nigrescens?	-	-	-	-	1	-	-	-	-	-	-	-
Stephanolepis diaspros	-	-	-	-	-	4	6	8	-	-	-	-
Cynoglossus sp.	-	-	-	-	X	X	X	-	-	-	-	-
Diplecogaster bimaculata	-	-	-	-	1	1	-	-	-	-	-	-
Oeufs et larves indéterminés	-	-	2	30	55	75	40	25	15	2	4	-
Nombre total d'oeufs	4	4	8	390	675	810	425	310	115	6	10	0
Nombre total de larves	2	2	1	45	67	283	209	113	88	4	6	1
Nombre total d'individus	6	6	11	465	797	1168	674	448	218	12	20	1

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(2) Nous remerçions Mr. A. Aboussouan d'avoir aimablement examiné et déterminé quelques spécimens.

Tri-dimensional model of the circulation of the Ligurian Sea

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Abstract

The circulation of the Ligurian sea is studied with a 3-D model. Attention is focused on the role played by the deep water formation on the generation of horizontal motions. The model is forced on an annual cycle by imposing a cooling at the surface of the ocean during the three month of winter. It is found that a cooling corresponding to realistic values of air sea thermodynamical exchanges generates a strong vertical convexion and a baroclinic horizontal circulation the transport of which is close to observed values. Horizontal wave like motions similar to those observed by satellite are found during the forcing period. They are supposed to be linked to baroclinic instability phenomena. At the end of the forcing period a dome is formed which lasts until the end of the year and preconditions the convexion starting the following year.

The model is a C grid model with 12 levels on the vertical. The grid size is 10 km which is the scale of the first baroclinic radius of deformation. Sensivity studies were done with different grid sizes and different values of the horizontal and the vertical diffusion coefficients.

Y-IV2

Modeling the sewage assimilative capacity of coastal waters in the Mediterranean

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A B S T R A C T

The marine environment can assimilate to a certain degree pollutant substances of domestic origin. For organic loads this assimilation is doing through three main processes: (a) transport from marine environment to sediments, atmosphere and organisms (sedimentation, sorption, aerosol formation, interaction with biota), (b) transport within the water body (convection by currents and waves, turbulent diffusion and dispersion) and (c) transformation (biodegradation, chemical and photochemical degradation). For the proper design of the environmental engineering works, such as submarine outfalls and sewage treatment plants, it is very useful to analyse and model the assimilative capacity of a coastal environment to organic pollutants. Modeling the involved processes is the most important step following the description of the marine system and preceeding the management and decision phase. In view of the complexity of the various processes, complete modeling is almost impossible so that simplifications and assumptions are to be introduced. Before using spatially distributed models, assessment of the relative importance of the involved mechanisms can be done from the data series and evaluation of the input - output relations can lead to a definition of various water quality areas of the coastal system.

This methodology is illustrated for the case of Thessaloniki bay. Seasonal fluctuations of water quality parameters such as pH, dissolved oxygen and nutrients have been recorded in nine stations during the period 1984-1987. Measurements have been performed for every station at three points: surface, mean depth and bottom. As for example, in Fig. 1 the time evolution of the dissolved oxygen is shown at station 1 near the city. Oxygen deficiency below 5 ppm can be seen for relatively long periods especially in summer and close to the bottom. The observation of the irregular fluctuations of the nutrients (NO_2^-, NO_3^-, PO_4^{3-}, SiO_4),

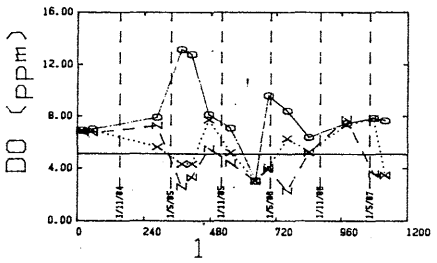

Fig. 1 Dissolved oxygen fluctuation at station 1 -o- surface, -x- mean depth, -z- bottom.

together with the results of current measurements shows that transport and turbulent dispersion mechanisms in the bay are relatively more important than biogedradation. Furthermore, the assimilative capacity is evaluated using the following input - output modeling. The coastal area is divided in three parts: the inner, central and outer bay. For every part, pollutant loads are evaluated in terms of COD (kg/year). From the current measurements and the hydrodynamic models the cycling-time of water is estimated at 4 days in the inner and 15 days in the central parts. Using the value 0.2 g/m^3/day of COD as the maximum load which can be discharged in a confined sea-water body (Laporte et al., 1982) the assimilative capacity found is in agreement with the measurements and the available historical data.

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Y-IV3

Concentration field in an area of a sunken ship loaded with a toxic substance

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ABSTRACT

Traffic of ships loaded with large quantities of liquid toxic substances is being increased due to greater need and production. When such ships sink they present a potential local (or an international) ecological catastrophy. In case the ship sunk in a deeper water, the unloading procedure may be very dangerous itself, the planning of operations lenghty and the possibilities range from leaving the ship to leak slowly, to releasing the substance all at once.

A modelling case study of vinyl chloride is presented to help evaluate the impact of several strategies. After the leackage has been detected or a test leaking performed, the first step is to estimate parameters of a stationary and a nonstationary distribution. The parameters may include the intensity of the source, the mean sea current vector, an extinction coefficient and the dispersion coefficent (1). The estimation procedure is neccessary since the complete behaviour of the substance in real conditions is not known . Upon the completion of the estimation procedure, simulation of several cases may be attempted (2). First, the results concerning transient concentration field following momentary release are presented. Second, the results of several stationary distributions following different rates of release are compared.

Finally, a monitoring procedure is proposed for measurements that are neccessary to obtain the essential parameters.

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Y

Measurement of mass transfer coefficients of pollutants across the atmospheric air-sea interphase

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The rate of transfer of pollutant loads from the atmosphere to the sea water depends, among other physicochemical parameters on the mass transfer coefficient of each pollutant across the air-sea interphase, and the change of this coefficient with temperature. The knowledge of the exact values of the mass transfer coefficient for the various pollutants homogeneously dissolved in the atmosphere (carbon monoxide, nitrogen oxides, sulfur oxides, hydrocarbons, etc.) permits the calculation of the absorption rate of these substances by the sea water, and therefore of the depletion rate of the air from the above substances.

The new technique of Reversed-flow gas chromatography, developed in our laboratory, is employed. This technique has no far successfully been applied to various physicochemical measuremetns and three reviews on it have been published[1-3], together with a book[4].

A very simple experimental set-up is used, consisted of a slightly modified gas chromatograph. The sea water is placed at the bottom of a diffusion column (1 m X 4 mm I.D.), and the interphase is fed with the pollutant by gaseous diffusion, whereas pure air (as carrier gas) passes through another column, perpendicularly connected to the previous column at a remote distance from the gas-liquid boundary. This arrangement resembles very much to the actual natural process of movement of the air pollutants to the sea surface.

By repeatedly performing flow reversals of short duration (15-60 s), extra chromatographic peaks (sample peaks) are obtained. These are narrow and symmetrical, their height h from the baseline as a function of time being given by the equation

$$h = \frac{N_2}{1+1.801V_G'/V_G}\left[(1+\frac{Z}{Y})\exp(-\frac{X+Y}{2}t_o) + (1-\frac{Z}{Y})\exp(-\frac{X-Y}{2}t_o)\right]$$

where X, Y and Z are functions of the diffusion coefficient D of the pollutant in the air, its overall mass transfer coefficients K_G and K_L, in the gas and the liquid phase, respectively, and its partition coefficient K between the two phases in contact.

By analyzing the experimental data with the help of the above equation, one can determine accurately in a single experiment lasting only a few hours, both overall mass transfer coefficients of the pollutant under study across the air-sea interphase, together with the relevant partition coefficient. The mathematical equations have been derived from the solution of a system of partial differential equations, under given initial and boundary conditions.

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Modeling for estimation of input of toxic metals into a bay

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ABSTRACT

Marinas with their services and small shipyards pollute marine environment with toxic metals. Most often such marinas are situated in bays. It is interesting therefore to determine the rates of sedimentation and flashing rates of such toxic elements and to determine their actual input. Our aim is to demonstrate the usefulness of mathematical models in solving this problem. A case of Punat Bay is analyzed. This is a small bay with the area of 2.5 km**2, on the island Krk (Northern Adriatic). The total input of Pb, Cu and Zn is determined from current measurements, measurements of these metals in water and muddy sediment of the Bay.

A. Currents. Tidal currents are measured and reconstructed by a standard two-dimensional model. Monte Carlo methods are used to determine the clearance of the bay due to tidal current. A component of residual current which influences the clearance has been identified. This component is caused by underwater wells. The strength of wells is determined by two different models with practically the same result. The total wash-out due to two considered currents is estimated.

B. Metals. Concentrations in water have large fluctuations and it is necessary to take samples in time sequences to determine mean values and fluctuations of concentrations. Because of small concentrations of such metals in water it is difficult to determine their concentrations in samples, so that an extensive sampling was abandoned. However, concentrations in muddy sediment of the Bay are high enough and have been easily determined by X-ray spectroscopy. In addition, content of a metal in the muddy sediment results from an accumulating process so that the fluctuations of concentrations are less pronounced than in water. By using transport models the extinction constants are determined for three considered metals, and consequently the rates of sedimentations are estimated.

C. Inputs. Inputs are calculated from the rates of flashing and sedimentation by using the transport model and topography of the Bay.

Since the source of a toxic metal is diffuse and cannot be easily estimated in a direct way, we propose here the estimation of input based on clearance mechanisms of a bay by the following procedure. Clearance mechanisms are analysed by mathematical models. Concentrations in sediments are used for fitting parameters and then concentrations in water are used for scaling. Since the input is equal to the output caused by all clearance mechanisms, it can be estimated from the obtained models.

Y-IV6

Input/output conceptual model for the Chromium in the Mex Bay

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SUMMARY

Chromium enters Mex Bay (West of Alexandria) marine environment from tanneries effluents and an agricultural drain.
Chromium was measured by AAS in effluents, sea water, biota of different trophic levels and sediments of the Bay.
The rates of input and output of chromium to and from the Bay were estimated.
Box models were used to describe the relation between the problem and the ecosystem, as a first step in modelling.

Y-IV7

Simulation model for Mercury pollution in Mex Bay, Alexandria (Egypt)

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SUMMARY

A simulation model for mercury pollution in Mex-Bay was constructed, on the basis of data obtained by the Aquatic Pollution Unit of the University of Alexandria.

OBJECTIVES OF THE MODEL:

-to set up a mass balance of mercury for the bay.
-to relate effluents quantities of mercury with mercury concentrations in biological components. Of special interest is the mercury concentration of fish used for human consumption.
-to predict future trends in mercury concentrations in sea water and biological components, if the discharge of mercury is not reduced or is reduced to a defined level
-to give a better understanding of the mercury cycling in Mex Bay.

MODEL DESCRIPTION:

-As the proposed model is relatively complex, it was preferred to present the model by use of several conceptual diagrams.
-The governing equations are based upon the mass conservation principle.
-The model consists of forcing functions, state variables, processes described as equations and parameters.
-The processes (equations) relate forcing functions and state variables. Given the forcing functions (e.g., discharge of mercury and meteorological conditions), the model will give the state variables.
-The model still requires calibration and validation.

This model can be considered as one of the first simulation models allover the Mediterranean to solve the mercury problem in a given area.

Y

Mercury profiles and the sedimentation rate in the coastal area west of Alexandria

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SUMMARY

More than 18 sediment cores collected from the coastal area west of Alexandria (Mex Bay) were analysed for their mercury concentrations.

The depth profiles showed significant features in the vertical distribution of mercury. Taking into consideration the operational date of the adjacent Chlor-alkali Plant, and assuming a constant sedimentation rate, the authors explain the changes in the vertical distribution of mercury to changes in the industrial activity in the Chlor-alkali Plant.

The authors made use of mercury profiles in Mex Bay sediments to calculate the settling rate in the area.

Formal model of the marine inshore phytoplanktonic community

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ABSTRACT

A formal model of the Romanian eutrophicated inshore area is described using exclusively the loop represented by phytoplankton.

Man-made changes on the marine phytoplanktonic ecosystem were presented in other papers. We used here some results of our research to point particular workgates and forcing factors (BOLOGA et al.,1985; MIHNEA and VOINESCU, 1977 a,b; 1978; MIHNEA, 1978 a,b; MIHNEA et al., 1980 and personal unpublished data).

Symbols significance:

POC_1: particulate organic carbon as alive phytoplankton; POC_2: particulate organic carbon as alive bacteria; POC_3: dead particulate organic carbon; DOC: dissolved organic carbon; Indol: β - indolil acetic acid; B: Marine bacteria; F: Marine fungs; G: Grazing; M: Mortality; A: Anoxy; Gross pr. in mg C m^{-3} d^{-1}; Biomass in mg m^{-3}; Chlorophyll a in mg m^{-3}.

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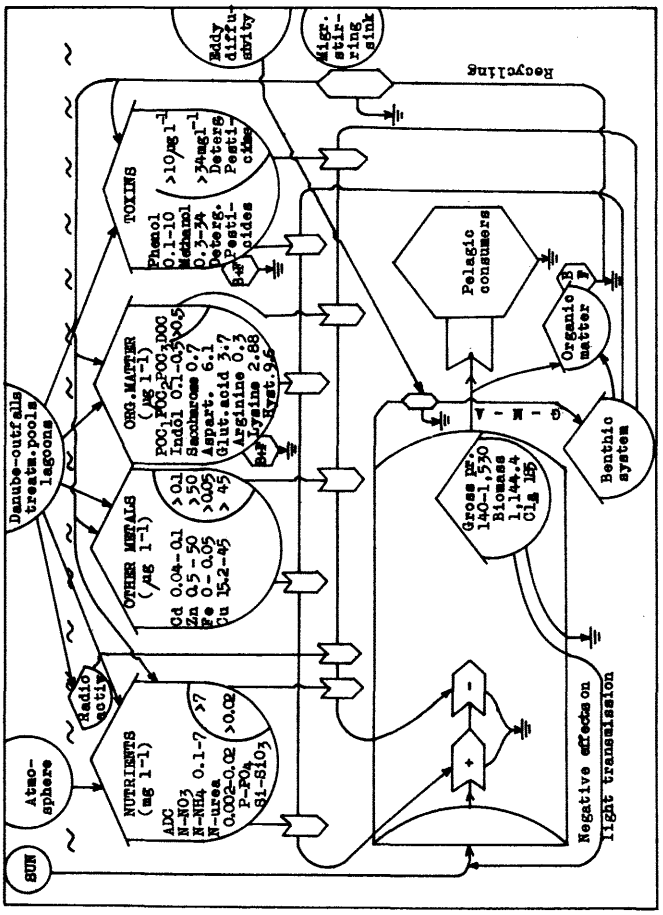

Y-IV10

A multiple regression model to determine Diatom abundance in an eutrophic area

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ABSTRACT: In an eutrophicated area (İzmir Bay, Aegean Sea), the variations of diatom cell numbers in hydrographic properties and nutrient concentrations of the environment were investigated seasonally and vertically. Statistically significant relationships between ln(cell numbers),σ_t, ln(N/P) and Si were determined.

According to our results, cell numbers of diatom might be represented with a multiple regression model as,

$$\ln(\text{DIAcells/l}) = -0.9217\ \sigma_t - 0.6492 \ln(N/P) + 0.0221\ Si + 37.3716$$

due to 70 percent success.

Y-IV11

Modelling the deep chlorophyll maximum in oligotrophic areas

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Mathematical models have been extensively developed in recent years, becoming a very important tool in understanding and analysis of marine systems (Wroblewski, 1975, 1976; Wroblewski and O' Brien, 1976; Dugdale, 1967, 1971; Eppley, 1969, etc). However, we have not yet completely understood and quantified the mechanisms that take place in the nitrogen cycle regulation and their uptake/release by marine phytoplankton or bacteria, particularly in oligotrophic ocean areas where is almost always present a deep chlorophyll maximun (Anderson, 1969; Cullen, 1982; Schulenberg, 1978).

Considering this, we combined now-accepted criteria into a simulation modelo, on the purpose to discuss their uselfulness and quantify the order of magnitude of each process.

Beginning with simple initial-conditions which include routine oceanographic variables like nitrate, ammonium, phytoplankton, light and a few model parameters we obtained, after a certain number of iterations, a stationary solution. Up to now, is a one dimensional modell, which simplify calculations and we uniquely fixed bottom values as boundary conditions. We logically included diffusion, advection and light intensity at sea-surface.

We done several runs varying the main parameters; during these tests we analysed the fluctuations experimented by the deep chlorophyll maximun, the nitrogen and phytoplankton concentrations. This depth is obviously regulated by light and, in a less amount, by diffusion. It appears to be a critical depth of a few meters with enough light (generally below de 1% level) and enough nutrients provided by diffusion, generally at the beginning of the nitracline.

Atmospheric inputs of nitrogen, phosphate and silicate are now considered as important as diffusion (in absolute values) and should not be neglected. On the other hand, in strong oligotrophic areas, the Monod equation could be of less interest in evaluating cinetic uptake by marine phytoplankton, since it is proportional to PN-ON, a second order equation.

Y

Trace element analysis of the Shrimp tissue (MA-B-3/TM-reference material)

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ABSTRACT

Instrumental neutron activation analysis method has been applied for the determination of 22 elements in the shrimp tissue biological reference material, MA-B-3/TM.

INTRODUCTION

It is well known that the marine organisms are able to concentrate in their tissues micropollutants from the surrounding sea water and therefore it is important to determine the trace element concentration in the organism, since this content may indicate heavy metal pollution of the marine environment.

This work presents our results obtained by instrumental neutron activation analysis of lyophylised Mediterranean shrimp tissue - a biological reference material labelled MA-B-3/TM.

EXPERIMENTAL

Applying the instrumental neutron activation method the concentration of 22 elements has been determined after a short and long irradiation time in 10exp12 - 10exp13 n/cm*exp2*sec flux. A 65 cm*exp3 Ge(Li) detector, (2 keV resolution), connected to a multichannel analyzer has been used for the measurements. The MA-M-2/TM mussel tissue that has been also analysed by us 3 years ago in an intercomparison run (1) has been used as a standard.

RESULTS AND DISCUSSION.

The concentration values of the elements determined are presented in the Table 1. It must be pointed out that the concentration of the most elements in shrimp tissue are much lower than in mussel tissue. Thus the concentration ratio for the macroelements Na, Cl, Ca, Mg as well as for the trace elements Br, Mn, Sc, Co, and Au are between 4:40. The Hg and As concentration in shrimp tissue is two and six times lower than in the mussel tissue, respectively. Only the major element K and the microelements Se, Cs, Zn and Sb are approximately equally distributed in both marine samples.

TABLE 1 - Elemental content in shrimp tissue (MA-B-3/TM - reference material) -Error in parenthesis-

Element	Concentration (ppm)
Al	37 (3)
As	2.2 (0.3)
Au	0.0019 (0.0004)
Br	16 (1)
Ca	3840 (307)
Cl	2380 (60)
Co	0.045 (0.004)
Cr	0.34 (0.05)
Cs	0.079 (0.008)
Fe	97 (4)
Hf	0.018 (0.004)
Hg	0.00036 (0.00005)
K	10700 (427)
Mg	1130 (45)
Mn	4.0 (0.2)
Na	2200 (44)
Rb	2.0 (0.2)
Sb	0.038 (0.007)
Sc	0.005 (0.001)
Se	1.5 (0.4)
Sr	23 (2)
Zn	108 (5)

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Instrumental neutron activation analysis of two Macrophytes from the Romanian Black Sea Beach

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ABSRACT. The macro and microelement content of the Macrophytes Enteromorpha linza and Ceramium rubrum, sampled from the beaches of Rumanian littoral zone in October 1986, has been investigated by instrumental neutron activation analysis. Totally 33 elements have been determined. Comparing these results with those obtained in 1972, concerning the same species, the elements Na, K, Fe, Mg and Cl present a lower concentration. The elements Zn, Ce and Sc present a higher content in C. rubrum while a lower content was found in E. linza .

INTRODUCTION.

It is of interest to know the content of the marine algae in macro and microelements since, as it is reported, the radionuclides when enter into the sea may follow similar pathway as their stable elements. Therefore, the study of the concetration of certain elements in the same algae species, which have been studied by us 14 years ago, would be usefull for studying pollution levels, (1), (2).

EXPERIMENTAL.

The algae Enteromorpha linza and Ceramium rubrum, sampled from the Rumanian Black Sea beach at Mangalia, were rinsed with distilled water, dried and then grounded into a fine powder. About 100 mg of each sample were irradiated along with an equal quantity of standards, under the same conditions, in the VVRS-2 reactor in Bucharest (flux 10exp12-13 n/cm*exp2*sec). Counting have been performed by using a 65 cc Ge(Li) detector (2 kev resolution) coupled with a pulse height analyser 4096 channels.

RESULTS AND DISCUSSION.

The concentration of the 33 elements determined is given in TABLE 1. By using these we can obtain ratios of the respective elemental content in the two species. Comparing these ratios with those reported previously by us we can obtain the elemental variation of the ratios in the two investigated species, during the last 14 years.

The observed ratio "E. linza/C. rubrum" values for the elements determined is given below, together, with those corresponding to 1972 sampling in parenthesis: Ce:0.39 (1), Co:0.32 (1.8), V:0.45 (1.1), Rb:0.70 (0.65), Sc:0.21 (1.1). The values obtained for Sc, Ce and Zn are higher in C. rubrum and lower in E. linza. The concentration level for Na, K, Fe, Mg and Cl is decreasing in both Macrophyte species. It seems that C. rubrum is more resistant than E. linza due to its higher mineralisation.

TABLE 1. Instrumental neutron activation analysis of some Macrophytes samples on the Black Sea Romanian shore at Mangalia, 6 October 1986

Element		*Enteromorpha linza*	*Ceramium rubrum*
Al	(ppm)	5360 ± 420	1560 ± 120
As	(ppm)	1.5 ± 0.4	3.4 ± 0.6
Au	(ppb)	30 ± 7	27 ± 7
Ba	(ppm)	185 ± 30	406 ± 80
Br	(ppm)	508 ± 10	1010 ± 20
Ca	(%)	14.8 ± 1.4	16.6 ± 1.2
Ce	(ppm)	7.9 ± 0.6	20 ± 1
Cl	(%)	3.42 ± 0.10	3.67 ± 0.11
Co	(ppm)	1.9 ± 0.1	5.9 ± 0.3
Cr	(ppm)	5.8 ± 0.6	33 ± 2
Cs	(ppm)	0.29 ± 0.06	1.41 ± 0.15
Eu	(ppm)	0.21 ± 0.04	0.45 ± 0.06
Fe	(%)	0.33 ± 0.02	0.10 ± 0.06
Hf	(ppm)	0.25 ± 0.04	11.7 ± 0.09
Hg	(ppm)	<0.5	<0.6
I	(ppm)	50 ± 10	275 ± 27
K	(%)	3.79 ± 0.38	3.23 ± 0.33
La	(ppm)	2.6 ± 0.1	6.4 ± 0.2
Lu	(ppm)	0.04 ± 0.01	0.10 ± 0.01
Mg	(%)	5.00 ± 0.83	2.03 ± 0.38
Mn	(ppm)	295 ± 15	890 ± 40
Na	(%)	1.66 ± 0.02	2.03 ± 0.03
Rb	(ppm)	24 ± 3	34 ± 4
Sb	(ppm)	0.23 ± 0.08	0.58 ± 0.16
Sc	(ppm)	0.90 ± 0.02	3.61 ± 0.05
Sm	(ppm)	0.47 ± 0.02	1.03 ± 0.03
Sr	(ppm)	718 ± 70	738 ± 75
Tb	(ppm)	0.11 ± 0.03	0.30 ± 0.09
Th	(ppm)	0.75 ± 0.08	2.8 ± 0.1
U	(ppm)	0.6 ± 0.3	2.8 ± 0.8
V	(ppm)	9.9 ± 1.6	22 ± 3
Yb	(ppm)	0.3 ± 0.1	0.7 ± 0.1
Zn	(ppm)	80 ± 3	438 ± 15

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Y-V3

Instrumental neutron activation analysis of Mytilus galloprovincialis from the Romanian Shore

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ABSRACT. Mytillus galloprovincialis specimens sampled from two sampling sites of the Rumanian shore of the Black Sea have been analysed by instrumental neutron activation analysis. 27 elements have been determined in shoft tissues and byssus. Higher elemental content has been found in the shoft tissues than in byssus.

INTRODUCTION. Mussels have the capacity to accumulate various pollutants, heavy metals or radionuclides from sea water and therefore are considered as suitable marine pollution indicators. It is of interest to get information about the variation of the trace element concentration in mussels from north to south of the Rumanian shore in Black Sea.

EXPERIMENTAL. Mytillus galloprovincialis specimens have been collected in October 1987: at 36 km offshore East Sulina and 7 km in the front of Serpents Islands on a silty clay facies, 38 m depth and at 7.3 km offshore East Mangalia on a rocky facies, 37 m depth. After rinsing with distilled water and removal of shells of M. galloprovincialis the shoft tissues and byssus have been separated dried and grounded into a fine powder. About 100 mg of each sample were irradiated along with an equal quantity of the IAEA standard reference material MA-M-2/TM, in the VVRS-2 nuclear reactor of Bucharest (thermal neutron flux 10exp12-13 n/cm*exp2*sec). All measurements were carried out by using a high resolution (2 kev) Ge(Li) detector coupled with a multichannel analyser.

TABLE 1 - Instrumental neutron activation analysis of *Mytilus galloprovincialis* sampled on the Black Sea, Romanian shore during 1987

Element	Location and date of sampling			
	East Sulina 8 Oct. 1987, 38 m depth.		Mangalia (Vama Veche) 13 Oct. 1987, 37 m depth.	
	Byssus	Soft tissue	Byssus	Soft tissue
Al ppm	168 ± 13	223 ± 20	364 ± 27	1470 ± 110
As ppm	5.1 ± 0.3	10.3 ± 0.4	4.3 ± 0.2	10.3 ± 0.4
Au ppb	10 ± 1	18 ± 2	10 ± 1	25 ± 2
Br ppm	105 ± 2	145 ± 3	104 ± 2	205 ± 5
Ca %	0.78 ± 0.09	1.89 ± 0.17	1.01 ± 0.10	0.73 ± 0.08
Ce ppm	0.5 ± 0.2	1.1 ± 0.3	0.7 ± 0.2	2.1 ± 0.3
Cl %	2.28 ± 0.06	2.40 ± 0.06	1.73± 0.04	2.31 ± 0.06
Co ppm	0.35 ± 0.04	0.45 ± 0.04	0.59± 0.06	0.89 ± 0.09
Cr ppm	0.6 ± 0.2	1.2 ± 0.3	1.4 ± 0.2	3.5 ± 0.5
Cs ppm	<0.13	<0.2	<0.13	0.36 ± 0.13
Fe ppm	128 ± 22	516 ± 40	426 ± 40	1460 ± 60
Hg ppm	0.03 ± 0.01	0.09 ± 0.03	0.3 ± 0.1	0.4 ± 0.1
I ppm	6.4 ± 2.4	12 ± 3	5.5 ± 2.5	10 ± 3
K %	0.14 ± 0.04	<0.19	0.16± 0.05	0.42 ± 0.10
La ppm	<0.14	0.23 ± 0.08	0.21 ± 0.06	0.89 ± 0.10
Mg %	0.38 ± 0.06	0.41 ± 0.08	0.50 ± 0.07	0.62 ± 0.11
Mn ppm	18 ± 1	40 ± 2	57 ± 3	140 ± 6
Na %	1.51 ± 0.015	1.65 ± 0.016	1.36 ± 0.014	1.56 ± 0.015
Rb ppm	<2.6	<1.5	2.3 ± 0.6	4.1 ± 1.2
Sb ppm	0.19 ± 0.06	0.14± 0.04	0.09 ± 0.03	0.16±0.05
Sc ppm	42 ± 8	81 ± 8	84 ± 8	305 ± 30
Se ppm	2.8 ± 0.5	5.0 ± 0.7	3.9 ± 0.1	5.2 ± 0.1
Sm ppm	≤0.01	0.05± 0.01	0.03 ± 0.01	0.15 ± 0.01
Th ppm	0.06 ± 0.02	<0.05	0.08 ± 0.03	0.22 ± 0.04
U ppm	<0.4	<0.6	<0.4	<0.5
V ppm	0.6 ± 0.2	0.7 ± 0.3	0.9 ± 0.2	5.5 ± 0.8
Zn ppm	2630 ± 65	2430 ± 60	2230 ± 60	2070 ± 50

RESULTS AND DISCUSSION. The data concernig 27 elements determined in M. galloprovincialis collected from Sulina and Mangalia in Black Sea are given in TABLE 1. The following conclusions shoud be pointed out: a) Mineralisation is increasing from north to south in the Black Sea at about the same depth. b) Shoft tissues have higher concentration of trace element than byssus. c) The Hg content found in shoft tissue (0.09 ppm) and in byssus (0.03 ppm) from Sulina samples is four and ten times lower, respectively than in the corresponding samples collected from Mangalia.

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Y-V4

Distribution of trace elements in the hemolymphae of Mytilus galloprovincialis

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Summary. The concentration of 16 elements from the low molecular weight protein fraction of the hemolymphae of *Mytilus galloprovincialis* has been determined by the instrumental neutron activation method.
Resume. La fraction protéinique à petite masse moléculaire dans l'hémolyphe de la moule *Mytilus galloprovincialis* a été analysée par l'activation neutronique instrumentale. On a identifié 16 éléments.
Material and Method. Specimens of *Mytilus galloprovincialis* were collected in September 1987 from the Black Sea (North Constantza).

The spowning mussel was rinsed with the deionised water. After the shell opening the soft tissue was also thoroughly cleaned with deionised water. The hemolyphae was collected by long cuts of mussel body. The analysed fraction was prepared by deproteinisation and delipoidation with benzene. The aqueous fraction purified by vacuum evaporation of the benzene was dried. Two different concentrated samples extracted by the above method have been analysed.

The samples and reference material have been irradiated for two hours in a 2.10^{12} $n.cm^{-2}.s^{-1}$ flux. After 6 ÷ 30 days cooling time the measurements have been carried out making use by 65 cm^3 Ge(Li) detector with 2 keV energy resolution. The measurement time was 1 ÷ 7 hours.
Results and Discussion. The results expressed in g/ℓ, mg/ℓ or µg/ℓ are presented in Table 1.

Our method for hemolymphae preparation has concentrated the macroelements Na, K, Ca, Br. The samples are also high in Sr, Fe, Zn, Ba, Rb. The high strontium level in samples was associated with its role in shell formation [1]. The concentration of some oligoelements is also determined. The role of Se as an essential trace element in human and animal nutrition as well as its toxic effects at higher concentrations is well established [2].

The low molecular weight protein fractions isolated by our method are involved in the concentration of metals. Tolerance of mussels to increased tissue metals concentration may be related to the presence of detoxifying mechanisms. A process that may be important in metal detoxification in mussels is the binding of metals to low molecular weight proteins similar to metallothionein [3] and to the high molecular weight protein fraction which contains metalloenzymes [4].

TABLE 1 - Elemental composition of isolated low molecular protein fraction from the *Mytilus galloprovincialis* hemolymphae

Element		Concentration	
		Sample 1	Sample 2
Na	g/ℓ	1.19 ± 0.019	6.96 ± 0.139
K	g/ℓ	0.632 ± 0.063	2.537 ± 0.381
Ca	mg/ℓ	88 ± 9	158 ± 24
Br	mg/ℓ	12 ± 1	56 ± 2
Sr	µg/ℓ	1366 ± 260	2323 ± 63
Ba	µg/ℓ	607 ± 195	1161 ± 370
Fe	µg/ℓ	455 ± 108	1689 ± 370
Rb	µg/ℓ	347 ± 43	633 ± 53
Zn	µg/ℓ	195 ± 22	1267 ± 106
Cr	µg/ℓ	139 ± 7	259 ± 16
Ni	µg/ℓ	130 ± 43	264 ± 105
Se	µg/ℓ	39 ± 4	95 ± 11
Co	µg/ℓ	13 ± 1	42 ± 4
Hg	µg/ℓ	11 ± 2	9 ± 2
Sb	µg/ℓ	2.3 ± 0.4	5.9 ± 0.8
Au	µg/ℓ	0.14 ± 0.03	0.12 ± 0.05

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Concentration factors of certain stable elements of radioecological significance in Boops boops

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ABSTRACT. Concentration factors of the stable elements Ag, Se, Co, Cs, Zn, Rb, Cr, Fe and Sc, were determined in flesh, liver, heart and spleen of the edible pelagic fish Boops boops. Instrumental neutron activation analysis and gamma spectrometry were applied for the determination of the above elements in the tissues of the fish and sea water, sampled from Aegean Sea. Comparison of the stable element concentration factors found in the parts of the fish was made.

INTRODUCTION. It is well known that artificial radionuclides introduced into the sea by various sources can be concentrated by marine biota and enter the food chain. The characterisation of the marine species as indicators of certain stable elements or radionuclides, is of great importance for the pollution research. Moreover the study of the distribution pattern of the elements in various organs of the animal, can provide information on the incorporation sites of the stable element or radionuclide in the organism itself and this is also important for the protection of the marine population (1). In order to get information on the radiation effect to the organisms it is important to know the capacity of the organism to concentrate stable elements possessing radioisotopes of radioecological significance. Stable element chemistry of the organism is a valuable factor for the determination of the food chain reconcentration of certain radionuclides by marine species (2). In the present work, concentration factors, K, of Se, Cr, Cs, Sc, Rb, Fe, Zn, Co and Ag were obtained in Boops boops in an attempt to provide data on the concentration, under natural conditions, of certain stable elements of radioecological interest in a common pelagic fish species of the Aegean Sea.

EXPERIMENTAL. Ten Boops boops specimens were collected from North Aegean Sea ,Sporades Island, in September 1987. Sea water samples were also taken from the same area. From each fish, a portion of muscle, the heart, liver and spleen were taken and freeze dried prior to analysis. The size and weight of the fish were also recorded. Sea water samples were also lyophilized. Instrumental neutron activation analysis and gamma spectrometry were used to determine the trace elements Se, Cr, Ag, Cs, Sc, Rb, Fe, Zn and Co. Samples and standards were sealed in quarz tubes, irradiated for 30 h at a thermal neutron flux 2.7 exp13 n/cmexp2*sec. After a 20 day-cooling (40 d for sea water), samples were counted on a 37 cc Ge(Li) detector connected to a 4000 channels pulse height analyser.

RESULTS AND DISCUSSION The concentration factors K of stable elements in tissues of Boops boops are given in Table 1. They express the ratio of the mean value derived from ten single specimen analysis, divided by the corresponding mean value of six water sample analysis.

Concentration factors expressed in relation to wet weight reflect the ability of the organism to concentrate chemical elements from the aqueous medium. However it should be noticed that the differences in the physicochemical form between the radionuclides and their stable elements may influence the biogeochemical behaviour of both isotope and stable element. From the results presented in Table 1, it can be concluded that the essential elements Fe, Se, Zn and Co, are those highly concentrated in the organs of the fish, compared with the other determined elements. Significant differences for iron accumulation , three orders of magnitude, were found between muscle and spleen, while the K value for liver and heart was similar and hundred times higher than the lowest value found in muscle. The distribution pattern trend of the elements Se and Zn is similar to iron accumulation, but K values are much higher for Se than for Zn, while Co follows the same pattern, roughly, in a lesser extent possessing the lowest K values.

TABLE 1. Stable element concentration factors (K), in Boops boops (on wet weight basis).

	TISSUE			
Element	Muscle	Liver	Heart	Spleen
Se	1200	21100	21500	28100
Cr	3	38	43	100
Cs	43	21	19	29
Sc	14	24	64	13
Rb	10	7	7	3
Fe	19	2780	2080	15000
Zn	180	1210	765	2970
Co	23	528	208	124
Ag	67	80	97	70

The remaining elements present medium and low K values. No difference in K values was observed between the organs of the fish for Ag, Rb and Sc, but Cr showed a slightly higher K value in spleen compared with the muscle K value. It has been pointed out that neutron activation products of biologicaly essential stable elements, like Fe-55, Co-60, Zn-65 and Ag-110m were found in the flesh and liver of certain pelagic fish species from the Pacific Ocean long ago (2). This findings enhance the need for a systematic study on the stable element concentration factors, also in other fish species from the Aegean Sea, in order to be able to characterise the most suitable pollution indicator organism.

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