Proceedings

Fifth Montana Plant Conservation Conference

February 27 and 28, 2008 • Montana State University, Bozeman, Montana

MNPS

Montana Natural Heritage Program

NRCS Natural Resources Conservation Service

National Park Service

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The Fifth Montana Plant Conservation Conference will be devoted to acquiring new tools for managing and protecting natural resources. We will hear from practitioners on several methods for monitoring vegetation and plant populations. Restoring grasslands and wetlands will be the second topic of the symposia. The second day of the conference will consist of two workshops. Botanists and resource managers will develop a protocol and appoint a committee to begin an Important Plant Areas program in Montana similar to that found in many European countries. Finally, participants will review the progress of the Plant Threats Steering Committee and update the status of threatened plants in Montana. Amateur and professional botanists alike can contribute to both workshops and help protect our state's natural heritage.

MNPS

The mission of the Montana Native Plant Society is to preserve, conserve, and study the native plants and plant communities of Montana, and to educate the public about the value of our native flora.

MONTANA Natural Heritage Program

The Mission of the Montana Natural Heritage Program is to be Montana's source for reliable, objective information and expertise to support stewardship of our native species and habitats, emphasizing those of conservation concern.

NRCS Natural Resources Conservation Service

Helping People Help the Land. The Natural Resources Conservation Service provides leadership in a partnership effort to help people conserve, maintain, and improve our natural resources and environment.

NATIONAL PARK SERVICE

The National Park Service preserves unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world.

Cover Illustration of *Salix boothii* by Claire Emery.

Schedule

Wednesday, February 27

9:00 - 9:15 Welcome. *Dave Hanna, MNPS president*

Plant Monitoring for Resource Management *Tara Carolin, moderator*

9:15 - 9:40 Monitoring Plant Populations Using Canopy Cover Estimation: Case Studies in Glacier National Park. *Jennifer Asebrook, Glacier National Park*

9:40 - 10:05 Monitoring Plant Species Composition in Grasslands Using Frequency of Indicator Species. *Dave Hanna, The Nature Conservancy*

10:05 - 10:30 What Good is Demographic Monitoring? *Peter Lesica, University of Montana*

10:30 - 10:45 Break

10:45 - 11:10 Monitoring vegetation using satellite and airborne imagery: Recent developments related to invasive species, whitebark pine decline, and long-term change detection for wetlands and rangelands. *Rick Lawrence, Montana State University*

11:10 - 11:35 Photo Monitoring: Is a Picture Worth a Thousand Data Sheets? *Jeff Mosley, Montana State University*

11:35 - 12:00 Panel Discussion

12:00 - 1:00 Lunch

Revegetation with Native Plants *Susan Rinehart & Nora Taylor, moderators*

1:00 - 1:35 The Role of Native Plant Species in Revegetation and Ecological Restoration. *Monica Pokorny, Pokorny Plant Ecology*

1:35 - 2:10 Restoring Native Hydrology as a Prerequisite to Native Flora Restoration. *Tim Griffiths, Natural Resources Conservation Service*

2:10 - 2:45 Using Native Plant Species on Highly Disturbed Soils: Revegetation Lessons from a Riparian Superfund Site. *Richard Prodgers, Bighorn Environmental Services*

2:45 - 3:00 Break

3:00 - 3:35 Using Native Plants for Grassland and Steppe Revegetation: Seed mixes and soil bioengineering. *Stuart Jennings, Reclamation Research Inc.*

3:35 - 4:05 Molecules, Meter Sticks, and Maps: Exploring the Applications of Genetic Research in Native Plant Revegetation. *Matt Horning, USDA Forest Service, Pacific Northwest Research Station*

4:05 - 4:35 NRCS Plant Materials Centers Approach to Restoration. *Larry Holzworth, Natural Resources Conservation Service (retired)*

4:35 - 5:00 Panel Discussion: Selecting native plant species for site revegetation: Locally Collected or Cultivars. *Larry Holzworth, Matt Horning*

Thursday, February 28

Important Plant Areas Workshop– Philosophy and Framework *Karen Shelly, moderator*

8:00 - 8:15 IPAs for Rare Plants. *Peter Lesica*

8:15 - 8:30 IPAs for Vegetation. *Karen Shelly*

8:30 - 10:00 Discussion and nominate committee

10:00 - 10:35 Break

Montana's Threatened Plants Workshop *Maria Mantas, moderator*

10:30 - 10:45 Overview of Previous Work. *Peter Lesica*

10:45 - 12:00 Assessment of Threats and Rank Assignment. *Maria Mantas*

12:00 - 1:00 Lunch

1:00 - 4:00 Continue workshop and wrap-up

Abstracts

Monitoring Plant Populations Using Canopy Cover Estimation: Case Studies in Glacier National Park

Jennifer M. Asebrook, Glacier National Park

Canopy cover is one of the most common measures to monitor plant community composition. Cover can be estimated using the intersection of vegetation canopy (aerial cover) or stems (basal cover) with plots, lines, or points. Advantages of using cover as a monitoring method include: (1) it can be used to measure a variety of lifeforms; (2) it is strongly related to biomass, a good estimate of how much a plant dominates an ecosystem; and (3) does not require the identification of an individual. It also is an easily visualized and intuitive measure. As with most monitoring methods, there are disadvantages as well. These include: (1) most measures of cover vary throughout the growing season and with climatic conditions; (2) cover measures are sensitive to both changes in number and in vigor, sometimes masking the cause of vegetation change; and (3) cover measures can have a higher degree of observer bias. Four case studies in Glacier National Park will outline and sometimes compare four common methods to estimate canopy cover: visual estimates of cover in a macroplot, visual estimates of cover using microplots, line intercept, and point intercept.

Monitoring Plant Species Composition in Grasslands Using Frequency of Indicator Species

Dave Hanna, The Nature Conservancy, Choteau, Montana

Stewards of grasslands need to detect trends in species composition and determine the effects of management on those trends. Livestock grazing is one widely used management practice that affects species composition in grasslands. To assess these impacts, we use a monitoring protocol that employs measurement of frequency of grazing-sensitive indicator species in subjectively located, paired macroplots. This monitoring method is easy to perform and provides information useful for directing future grazing management as well as future monitoring. This monitoring could be easily adapted to other management situations in grasslands as well as other habitat types.

What Good Is Demographic Monitoring?

Peter Lesica, Division of Biological Sciences, University of Montana

Demographic monitoring is performed by permanently marking or mapping individual plants and recording the size or fate of each individual one or more times each year. Data acquired in this fashion can serve a number of purposes. I found that *Astragalus scaphoides* populations were not declining but rather the plants demonstrated prolonged dormancy and failed to send up shoots every year. I also found that populations subject to livestock grazing were not declining. Kathy Ahlenslager and I determined that *Botrychium paradoxum* was not simply a stressed form of *B. hesperium* and that both species are short-lived perennials demonstrating prolonged dormancy. Steve Shelly and I removed spotted knapweed from half the plots where we had mapped individuals of *Arabis fecunda* and followed the fate of individuals with and without knapweed neighbors. Adult *A. fecunda* showed no effect from knapweed removal, but more *A. fecunda* individuals were recruited in plots without knapweed, demonstrating that knapweed can cause a decline in population growth. We also found that the presence of soil crusts was positively associated with recruitment. I followed the fate of mapped *Silene spaldingii* individuals for 20 years and found that plants are long-lived and demonstrate prolonged dormancy. In addition, recruitment was highly episodic, occurring in only two of the 20 years of the study. In a second study I found that *S. spaldingii* recruitment was enhanced immediately following a controlled burn compared to unburned controls. Sulphur cinquefoil (*Potentilla recta*) is a pernicious weed on TNC's Dancing Prairie Preserve. The population declined during the 8-year study during a drought, and declined more in the more productive rough fescue habitat compared to the needlegrass habitat. Sulphur cinquefoil is long-lived with high juvenile mortality and low adult mortality. Following the fate of the population in this way allowed me to predict outbreaks of flowering plants the year before they happened.

Monitoring vegetation using satellite and airborne imagery: Recent developments related to invasive species, whitebark pine decline, and long-term change detection for wetlands and rangelands

Rick Lawrence, Land Resources and Environmental Sciences Department, Montana State University

Monitoring vegetation changes, both temporally and spatially, using remote sensing imagery has several potential advantages over more traditional, ground-based monitoring. Evaluation areas are covered in their entirety, obviating the need for and limitations of sampling. It also is easier to obtain repeated measures, especially with satellites, as imagery is often obtained on a regular basis. Finally, very large areas can be surveyed with high efficiency. These advantages, however, are often outweighed by the inability to map vegetation with sufficient particularity for many purposes. Moderate resolution imagery, such as Landsat, is necessary to efficiently map moderately large areas, but has generally been considered unable to map at the community or species level. We have sought to over overcome these traditional limitations by developing and applying new classification algorithms, based on machine learning techniques, that show considerable promise for community and species level classifications from moderate resolution satellites. We have had particular success with these methods for mapping whitebark pine in the northern Rockies (96% accuracy), wetland change in the Gallatin Valley of Montana (86% accuracy), and vegetation community change in the northern range of Yellowstone (72% accuracy). These methods also have been successful in mapping invasive species using airborne hyperspectral imagery (84-86% accuracy).

Photo Monitoring: Is a Picture Worth a Thousand Data Sheets?

Jeff Mosley, Department of Animal and Range Sciences, Montana State University

Time and labor constraints often preclude resource managers from obtaining statistically valid quantitative sampling of forest and rangeland vegetation. In some cases the objectives of monitoring can be accomplished with qualitative assessments supplemented with photographs. Photo monitoring is a simple, quick, and objective way to document vegetation and the land's ecological health. Comparisons of photographs from successive dates enable resource managers to identify desirable and undesirable changes on the landscape. Photographs are very useful when communicating with others, and one good picture usually conveys a message more effectively than voluminous amounts of numerical data. When using repeat photography for detecting change in plant communities, it is important to make the commitment to take the pictures every year. People commonly become over zealous when establishing photo-monitoring locations. Resource managers should do their best to resist this temptation and remember that it is better to have a few sites where the photos actually are taken every year, rather than having a larger number of sites whose photos are only retaken infrequently. Photo monitoring often detects undesirable changes in plant communities earlier than quantitative sampling techniques, thereby providing resource managers with more opportunity to adjust management practices before significant degradation has occurred. The advent of digital photography and readily available image analysis software is currently moving photo monitoring from a largely qualitative assessment tool to quantitative assessments of plant biomass, cover, and forage utilization. The reduced time and labor requirements of photo monitoring may allow for increased sample numbers, thereby enabling the use of digital photography to increase the precision of these traditional quantitative measures.

The Role of Native Plant Species in Revegetation and Ecological Restoration

Monica Pokorny, Reclamation Research Inc., Pokorny Plant Ecology

Montana's grasslands support a diverse array of native vegetation. In a species richness study in undisturbed grassland sites we documented an average of 42 species per $4m^2$ plot, with the forb life form accounting for the majority (83%) of richness and biomass. Maintaining and restoring native plant diversity should be a primary objective of land managers because increased diversity has been found to increase community stability, productivity, support a variety of wildlife, and decrease the risk of invasion by weedy species. Our work investigating the invasion resistance of several plant groups against spotted knapweed (*Centaurea maculosa*) found that spotted knapweed density depended upon which life form groups were present. The highest spotted knapweed densities occurred where all vegetation or all forbs were removed. In addition, our results suggest that plant life form groups may vary in their soil nutrient acquisition patterns and that increased diversity decreases soil nutrient concentrations and reduces the risk of invasion. Once spotted knapweed invaded, on a per-gram-of-biomass basis, each plant group similarly suppressed invader growth. With respect to preventing spotted knapweed invasions, maintaining overall productivity is important and all plant groups may be needed to maintain overall productivity. But maintaining forbs is particularly important because removing forbs may inflate the productivity variance. It seems that intense disturbances (e.g., prolonged drought, overgrazing, herbicide application methods) that deplete multiple plant groups may be a prerequisite for weed invasion.

Maintaining and restoring native plant diversity, particularly native forb diversity, is important but how do we address this need in the field of restoration? We recommend the following: Promote sustainable and innovative land management practices that minimize impacts. Consider spot spraying herbicides instead of broadcast applications to help restore and conserve diversity. Revegetate disturbed areas with diverse, competitive species in order to prevent invasion. Use small seed island plots within a landscape to increase plant diversity. Define the economic value of the ecosystem services diverse native plant communities provide as a rational for sustainable management practices and restoration activities. Work to improve the establishment of native forbs grown for seed production to increase the diversity of species available at a reasonable cost.

Restoring Native Hydrology as a Prerequisite to Native Flora Restoration

Tim Griffiths, Natural Resources Conservation Service, Bozeman, Montana

Many aquatic ecosystems and their associated native flora have been significantly altered by manipulations in hydrology. Hydrology manipulations, however slight or severe, can and do pose serious implications to land mangers desiring native flora restoration. Too often, the focus of native plant restoration is on the specific plant propagation and fails to address the underlying problems associated with the changed hydrology. Common hydrological manipulations will be discussed as well as treatment methods and alternatives. Several local case examples will be discussed that demonstrate how dramatic changes in hydrology have impacted native plant re-establishment and proliferation.

Revegetation Lessons from a Riparian Superfund Site in Southwest Montana

Richard A. Prodgers, Bighorn Environmental Sciences, Dillon, Montana

Remediating 34.8 km (21.6 miles) of Silver Bow Creek and associated floodplain in southwest Montana entails removing 3.3 x 10^6 m^3 (4.3 x 10^6 yd^3) of tailings/mine waste, reconstructing the stream so that it effectively transports sediment, rebuilding the floodplain using an effective growth medium, and revegetating it. Approximately sixty percent of the 610-ha (1,510-acre) project has been remediated as of 2007. Revegetation objectives include protecting other elements of the remedy and returning remediated areas to a permanent, productive condition; protecting the streambank and adjacent floodplain from accelerated erosion; and promoting soil genesis to sustain vegetation. Revegetation must be self-sustaining and self-repairing, although weed control measures are necessary. Restoration further creates an approximation of preimpact vegetation and soils while creating wildlife habitat for a variety of animals and providing aesthetically pleasing landscape components. Specific challenges are:

- Finding suitable fill to replace removed tailings.
- Capillary rise of coversoil salts, including formation of surface crusts.
- Very coarse, upland, in situ soils.
- Residual contamination.
- Controlling noxious weeds.
- A sequence of six years with annual precipitation between 25 and 29 cm (10.0 and 11.4 inches) in an area where average annual precipitation in Butte is 32 cm (12.6 inches).
- Two early spring snowmelt floods.
- Using contract revegetation services.

Solutions and partial solutions include innovative seeding and transplanting techniques, compost soil amendments, adapted species, and aggressively interseeding areas where initial seedling density is unsatisfactory. Seeding has fared better and been more cost-effective than transplanting.

Simultaneously implementing remediation and restoration practices has been relatively easy.

Using Native Plants for Grassland and Steppe Revegetation: Seed mixes and soil bioengineering

Stuart Jennings, Reclamation Research Inc.

Grasslands are among the most endangered biomes in the world. The majority of arable land has been converted to cropland in Montana and around the world. Vast areas of non-arable grassland and steppe have similarly been disturbed. Restoration of grasslands has been recognized as an imperative to support diverse flora and fauna endemic to the Northern Great Plains and Intermountain West. Yet despite the need for grassland restoration, soil conditions are often significantly modified during land disturbance and diverse native grasslands are often not readily reestablished in a configuration that closely resembles the pre-disturbance plant community. Soil amendment can be used to create more hospitable rooting conditions allowing establishment of native perennial grasses, but recolonization by native forbs from adjacent undisturbed areas requires substantial amounts of time. A retrospective consideration of several native grass revegetation projects offers a perspective on the challenges of recreating diverse native grasslands.

Molecules, meter sticks, and maps: exploring the applications of genetic research in native plant revegetation and habitat restoration activities

Matt Horning, USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon

In recent years land managers have increasingly focused attention on the use of native plant species in habitat restoration and land reclamation. Moreover, managers have been striving to use locally adapted materials rather than commercially produced cultivars, especially if the cultivars are viewed as highly bred. Unfortunately, formal guidelines for developing locally adapted releases do not exist for many of the native plant species extensively utilized in restoration activities. Recently, two approaches to delineating seed movement guidelines (e.g., genecological and F_{ST} verses Q_{ST}) have been successfully applied on essential restoration species. The genecological approach (historically developed for conifers) employs common garden studies to identify patterns of phenotypic genetic variation on the landscape that can be used to create seed zones and subsequent germplasm releases. As an extension of this model, the F_{ST} verses Q_{ST} approach incorporates measures of molecular differentiation that when compared to the phenotypic patterns can identify adaptive traits used to guide seed zone delineation. In this presentation, I will present these approaches to identifying seed zones and adaptive traits and highlight their successful 'real-world' applications. Combining quantitative, molecular, and spatial analyses, these approaches are powerful tools that can be widely utilized to develop locally adapted germplasm releases for native plant species.

Selecting Native Plants for Reclamation

Larry Holzworth, NRCS Plant Materials Specialist (retired)

The replacement of vegetation and ecological function on altered or disturbed sites is an overall objective of reclamation. Specifically, it includes stabilizing soils to minimizing environmental impacts, creating a favorable plant growth media, selection of adapted species and appropriate establishment techniques, plant protection during establishment, and management of the established plant community. The USDA Natural Resources Conservation Service (NRCS), Plant Materials Centers (PMCs), together with a multitude of partners, collect, test and select plant materials and develop cultural and establishment techniques for their successful conservation use. Nationally, there are approximately 547 cultivars and natural germplasm of selected plants released by PMCs since the 1950s. The goal of the plant releases' is not complete until the plants have been successfully incorporated into the commercial seed and plant nursery industry and are available to land managers to help solve many environmental concerns, such as revegetation of disturbed areas and critical wildlife habitats, vegetative buffer strips, soil bioengineering, livestock waste management, wetland and riparian area enhancement, windbreaks, prairie ecosystem rehabilitation, and noxious-invasive plant suppression. Over the years, the use of NRCS plant releases on local conservation concerns have proven valuable and effective. Matching adapted species to existing site conditions and using performance tested, dependable and available cultivars and germplasm releases assists with the successful replacement of vegetation and ecological function to seeded sites.

Preliminary Threat Assignments for Montana Species of Concern

The Montana Interagency Plant Threats Assessment Committee was formed in 2006 at the Montana Plant Conference in Helena to assess threats and assign threat rankings to Montana Plant Species of Concern. Prior to and following this meeting, information on threats to individual species was collected from botanists, ecologists and natural resource professionals from around the state. Information gathered for each species included the severity, scope and immediacy of each listed threat. These data were then summarized and analyzed by the Committee in several meetings in 2006 and 2007 and a proposed threat ranking system was developed.

Data collected for each species characterized the severity, scope and immediacy for each threat as high, moderate, low, or insignificant. Threats data were received for approximately 70% of the plants on the MTNHP Species of Concern list. These plants were tentatively assigned one of the following four ranks in February, 2007 based on the following definitions:

Category 1 (Highly Threatened) Associated threat(s) has caused or could cause a major reduction of the state population or habitat that will require 50 years or more for recovery, *and* 20% or more of the state population has been or will be affected, *and* the threat is likely to occur within 5 years or less.

Category 2 (Threatened) Associated threat(s) exist but are not as severe, wide-ranging or immediate as for Category 1.

Category 3 (Insignificant Threats or No Threats Known) Either, no known threats, or “Severity” or “Scope” is rated as insignificant.

Not Ranked was assigned to those species that have not yet been ranked due to lack of information or conflicting information.

Impacts or potential effects associated with global climate change or global warming were not considered in this assessment.

Summary of preliminary threat rankings.

243 Species Assessed:

- 25 (10%) ranked Category 1 (Highly Threatened)
- 65 (27%) ranked Category 2 (Threatened)
- 138 (57%) ranked as Category 3 (Insignificant Threats or No Threats Known)
- 15 (6%) not ranked due to insufficient or conflicting information

Initial rankings are presented below with species grouped by Threat Level. Following each species in Category 1, Category 2 and those Not Ranked are the specific threats to each species identified from information submitted by botanists, ecologists and natural resource professionals. A list of threats and their associated codes can be found at the end of the document. For additional information concerning each species, visit the Montana Field Guide at http://fieldguide.mt.gov/

Category 1 Species (Highly Threatened)

Arabis fecunda - 3, 5, 8, 12
Arctostaphylos patula - 5, 19
Astragalus oreganus - 2, 12, 16
Athysanus pusillus - 8, 13, 22
Brickellia oblongifolia - 12
Carex comosa - 6
Carex sychnocephala - 5, 6
Cirsium longistylum - 8, 26, 27
Cypripedium fasciculatum - 28, 19, 27
Glossopetalon spinescens (G. nevadense) - 13, 20, 22
Grindelia howellii - 5, 8, 12, 27
Haplopappus aberrans - 13, 20, 22
Howellia aquatilis - 5, 6, 8, 28, 19
Idahoa scapigera - 8, 13, 22
Lesquerella carinata var. *languida* - 8
Lesquerella lesicii - 2
Oxytropis campestris var. *columbiana* - 5
Pedicularis crenulata - 1
Penstemon payettensis - 8, 9, 22
Primula alcalina - 2, 6, 27
Quercus macrocarpa – 17
Ranunculus orthorynchus - 8, 13
Senecio amplectens - 22
Sidalcea oregana - 8, 22
Silene spaldingii - 2, 5, 8, 9

Category 2 Species (Threatened)

Astragalus barrii - 3, 8, 18
Astragalus ceramicus var. *apicus* - 9, 12
Astragalus convallarius - 5, 8, 12
Botrychium ascendens - 5, 8, 24
Botrychium crenulatum - 5, 8, 19, 22, 24, 25
Botrychium hesperium - 8, 19, 22, 25
Botrychium pallidum - 8
Botrychium paradoxum - 2, 8, 13
Brayia humilis - 16
Carex craweii - 22
Carex gravida - 2, 8
Carex idahoa - 2, 3, 6, 8
Carex lacustris - 6
Carex lenticularis var. *dolia* - 4, 13
Castilleja covilleana - 8, 19, 22
Castilleja exilis - 6
Clarkia rhomboidea - 9, 28, 27
Cryptantha fendleri - 9, 12
Cypripedium parviflorum - 2, 5, 6
Cypripedium passerinum - 5, 8, 28, 13, 25
Draba densifolia - 2, 8, 12, 13, 22
Drosera anglica - 5, 6, 8, 28, 23
Elymus flavescens - 11, 12
Epipactis gigantea - 6, 7, 8, 28, 21
Erigeron linearis - 5, 8, 27
Eriogonum salsuginosum - 16
Eriophorum gracile - 5, 6, 8, 21
Gentianopsis macounii - 6
Goodyera repens - 19
Halimolobos perplexa - 8, 19, 22
Heteranthera dubia - 6, 14
Heterocodon rariflorum - 8, 12, 13, 25
Juncus acuminatus - 6
Kochia americana - 1, 6
Lagophylla ramosissima - 8
Lesquerella douglasii - 6, 12
Lesquerella humilis - 5, 13, 25
Lomatium nuttallii - 2, 3, 8, 18
Lomatogonium rotatum - 2, 6
Mertensia bella - 16
Mimulus nanus - 8, 19, 22
Nuttallanthus texanus - 16
Orogenia fusiformis - 2, 8, 12, 19, 22
Penstemon lemhiensis - 2, 8, 9, 22, 27
Petasites frigidus - 28, 13, 22, 25
Phlox kelseyi var. *missoulensis* - 5, 8, 13
Physaria didymocarpa var. *lanata* - 2, 8, 18
Polygonum austinae (P. douglasii ssp austinae) - 8
Potamogeton obtusifolius - 2, 5, 14
Primula incana - 2, 6, 27
Prunus pumila - 20, 22
Puccinelia lemmonii - 2, 8
Ranunculus cardiophyllus - 8
Ranunculus pedatifidus - 8, 17
Scheuchzeria palustris - 5, 6, 8, 27
Scirpus hudsonianus - 13, 25
Scripus subterminalis - 5, 28, 14
Spiranthes diluvialis - 2, 5, 8
Thalictrum alpinum - 2, 3, 6
Thelypteris phegopteris - 5, 6, 8, 19
Townsendia condensata - 13
Trifolium eriocephalum - 8, 19, 22
Trifolium gymnocarpon – 8, 19, 22
Vaccinium myrtilloides - 5, 19
Viburnum lentago - 28

Category 3 Species (Insignificant Threat Levels or No Known Threats)

Alnus rubra
Arabis demissa
Astragalus aretioides
Astragalus geyeri
Astragalus lackschewitzii
Astragalus racemosus
Astragalus scaphoides
Astragalus terminalis
Atriplex truncata
Bacopa rotundifolia
Balsamorhiza hookeri
Balsamorhiza macrophylla
Bidens beckii
Botrychium pedunculosum
Camissonia andina
Camissonia parvula
Cardamine oligosperma var. *kamtschatica*
Cardamine rupicola
Carex chordorhiza
Carex incurviformis
Carex petricosa
Carex rostrata
Carex tenuiflora
Cercocarpus montanus
Chrysothamnus parryi var. *montanus*
Claytonia arenicola
Cleome lutea
Cryptantha scoparia
Dalea enneandra
Delphinium bicolor var. *calcicola*
Downingia laeta
Draba crassa
Draba daviesiae
Draba macounii
Draba porsildii
Draba ventosa
Drosera linearis
Dryopteris cristata
Eleocharis rostellata
Elodea bifoliata (E. longivaginata)
Elymus innovatus
Erigeron allocotus
Erigeron asperugineus

Erigeron flabellifolius
Erigeron lackschewitzii
Erigeron leiomerus
Erigeron parryi
Erigeron radicatus
Erigeron tener
Eriogonum brevicaule var. *canum*
Eriogonum caespitosum
Eriogonum soliceps
Eriogonum visheri
Eriophorum callitrix
Euphrasia subarctica (E. arctica)
Festuca vivipara
Gentiana glauca
Gentianopsis simplex
Githopsis specularioides
Gratiola ebracteata
Gymnosteris parvula
Haplopappus carthamoides var. *subsquarrosus*
Haplopappus macronema var. *macronema*
Hutchinsia procumbens
Ipomopsis congesta var. *crebrifolia*
Juncus albescens
Juncus hallii
Kalmia polifolia
Kobresia macrocarpa
Kobresia simpliciuscula
Koenigia islandica
Leptodactylon caespitosum
Lesquerella klausii
Lesquerella pulchella
Lewisia columbiana
Liparis loeselii
Lomatium attenuatum
Lycopodium denroideum
Lycopodium inundatum
Lycopodium lagopus
Malacothrix torreyi
Mentzelia pumila
Mimulus breviflorus
Mimulus primuloides
Nama densum
Nymphaea tetragona
Ophioglossum pusillum
Oxytropis deflexa var. *foliosa*
Oxytropis lagopus var. *conjugens*
Oxytropis parryi
Oxytropis podocarpa
Papaver kluanensis
Papaver pygmaeum
Pedicularis contorta var. *ctneophora*
Penstemon angustifolius
Penstemon caryi
Penstemon flavescens
Phacelia incana
Phippsia algida
Phlox andicola
Physaria brassicoides
Poa curta
Potentilla brevifolia
Potentilla nana
Potentilla uniflora
Psilocarphus brevissimus
Psoralea hypogaea
Ranunculus gelidus
Ranunculus jovis
Ranunculus verecundus
Ribes velutinum
Sagina nivalis
Salix barratiana
Salix serissima
Saussurea densa
Saussurea weberi
Saxifraga apetala
Saxifraga hirculus
Saxifraga tempestiva
Scirpus cespitosus
Scirpus pumilus
Selaginella selaginoides
Shoshonea pulvinata
Sisyrinchium septentrionale
Sphaeralcea munroana
Sphaeromeria argentea
Sphaeromeria capitata
Stephanomeria spinosa
Sullivantia hapemanii
Synthyris canbyi
Thelypodium sagittatum
Thlaspi parviflorum
Tofieldia pusilla
Townsendia florifer
Townsendia spathulata
Utricularia intermedia
Viguiera multiflora

Species Not Ranked due to insufficient or conflicting information

Botrychium campestre - 8
Botrychium lineare - 8, 15, 22, 27
Brasenia schreberi - 1, 14
Carex prairea - 6
Chenopodium subglabrum - 9, 11
Corydalis sempervirens - 8, 9, 28, 19
Cyperus schweinitzii - 11
Dryas integrifolia - 12
Eupatorium maculatum - 8
Grayia spinosa - 2
Lomatium geyeri - 8, 19
Potentilla plattensis - 2, 8
Potentilla quinquefolia - 13
Rotala ramosior - 7
Taraxacum eriophorum - 3, 6, 8

Threats List

1 Agricultural practices
2 Domestic livestock foraging
3 Domestic livestock trampling
4 Facilities development
5 Habitat conversion/loss/development
6 Hydrologic alteration
7 Hydrologic development
8 Invasive species
9 Lack of disturbance (fire suppression)
10 Lack of disturbance (natural flooding)
11 Lack of disturbance (soil disturbance)
12 Recreation (atv/orv use)
13 Recreation (human trampling)
14 Recreation (motor boats)
15 Recreation (other motorized)
16 Resource development (ore mining)
17 Resource development (oil and gas)
18 Resource development (coal bed methane)
19 Resource development (timber mangement)
20 Resource development (rock quarry)
21 Resource development (peat mining)
22 Road construction and maintenance
23 Ski area development
24 Soil compaction
25 Trail construction
26 Weed treatment (biological control)
27 Weed treatment (herbicide control)
28 Other

If you are unable to attend the conference, the following page section can be photocopied, filled out and sent to Scott Mincemoyer, Montana Natural Heritage Program, P.O. Box 201800, Helena, MT 59620-1800 prior to the meeting.

Severity of Threat

High: loss of all individuals or destruction of habitat; irreversible or requiring >100 years for recovery

Medium: major reduction of population or habitat requiring >50 years for recovery

Low: non-trivial reduction of population or reversible reduction or habitat destruction with recover in 10-50 years

Insignificant: essentially no reduction of population or habitat or recovery within less than 10 years

Scope of Threat

High: >60% of Montana population affected; Medium: 20-60% affected; Low: 5-20%, Insignificant: <5 %

Immediacy of Threat

High: Threat is operational; Medium: Threat operational in 2-5 years; Low: 5-20 years; Insignificant: >20 years

Species____

Threat_____________________ Severity H M L I Scope H M L I Immediacy H M L I

Threat_____________________ Severity H M L I Scope H M L I Immediacy H M L I

Threat_____________________ Severity H M L I Scope H M L I Immediacy H M L I

Comments ____

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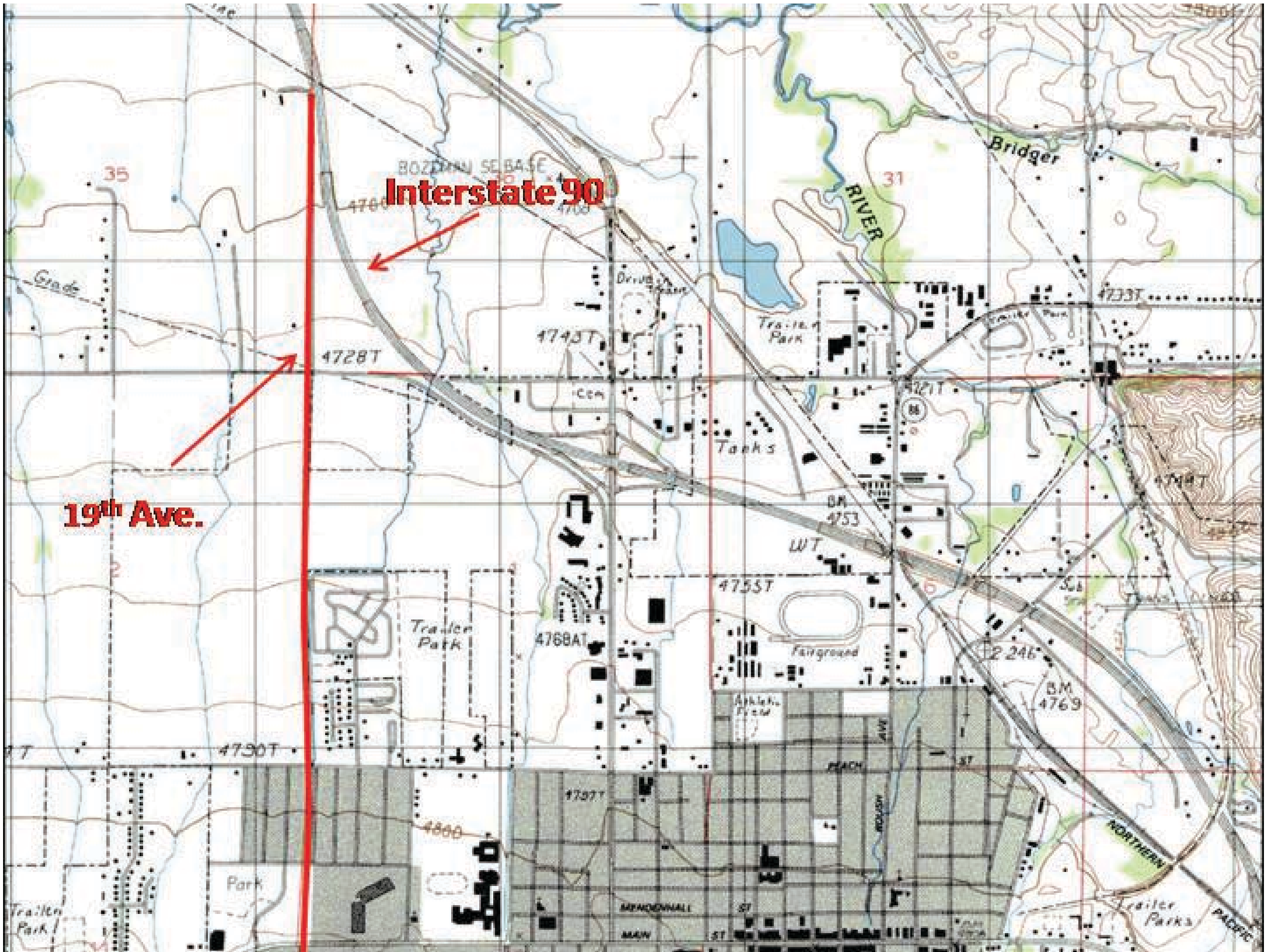

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