THE BLACKFEET RESERVATION:

Ecological Significance, Biological Diversity and Conservation

Document prepared by Tara A. Luna, East Glacier Park, Blackfeet Nation, Montana. November 30th, 2012.

PREFACE

This document was prepared for the Blackfeet Environmental Office and the Blackfeet Tribal Business Council, November 2012. It is intended for use by all Tribal offices, tribal members, descendants and other interested persons.

Ecosystem descriptions have been adapted from the Montana Natural Heritage Program's Ecological System Field Guide, 2010, authored by Tara Luna, Steve Cooper, Linda Vance and Cat McIntrye.

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EXECUTIVE SUMMARY

The Blackfeet Reservation represents one of the greatest expanses, concentrations and diversity of northern Cordilleran and Great Plains ecosystems within the United States and adjacent Canadian provinces. It therefore represents one of the most significant conservation opportunities in North America. The Blackfeet Indian Reservation encompasses approximately 1.5 million acres of land, five watersheds, and 73 subwatersheds, over 51,582 acres of wetlands and over 17,367 acres of lakes. Indeed, the Blackfeet Reservation is the most biologically and ecologically rich Indian reservation within the United States.

The ecosystems on the Reservation are highly valuable due to their location near headwaters, concentration, diversity and quality not found elsewhere in this region. This high diversity of ecological systems supports very high biological diversity, representing a wide range of plant communities and animal species found within the biological crossroads of the Great Plains and Northern Rocky Mountain ecosystems.

Over 50% of all known native plants, amphibians, and reptiles within the state of Montana are present on the Blackfeet Reservation (MNHP 2012). Over 65% of all known native birds and fish are present and over 80% of all native mammals. A total of 109 species occurring on the Blackfeet Indian Reservation are known to be biologically rare (Species of Concern) within the state of Montana. The presence of a largely natural landscape, lack of development, and large intact buffers of Glacier National Park and Badger Two Medicine support the high level of ecosystem function and diversity. Natural landscape, in combination with high water and air quality, and ecosystem diversity makes the Reservation a highly significant biological and ecological resource.

However, the full extent of the biological diversity and ecosystem diversity of the Blackfeet Reservation is incomplete to date. It is entirely possible that many more biologically rare species are present on the Reservation but have yet to be inventoried and documented. Furthermore, the full extent of Blackfeet cultural plant populations, their size and ecological condition, has yet to be assessed. Additional inventory work and conservation efforts by the Blackfeet Tribe will ensure that both cultural traditions and land uses, as well ecosystem integrity and the species that depend on them, are present for future generations of Blackfeet people.

The following document provides an overview of the major ecosystems and biological diversity of the Reservation and conservation criteria that can be used to protect these invaluable resources. It cannot be over-emphasized how significant the Blackfeet Reservation is in preserving rare and common species, cultural species and ecosystems that have disappeared or have been severely impacted elsewhere within their natural range. Conservation efforts on the Blackfeet Reservation have high potential for success due to its proximal position to protected areas, high biological and ecosystem diversity, and its relatively intact ecological condition compared to other areas of the western Great Plains and Rocky Mountain Front in Montana.

Introduction

The Blackfeet Reservation represents one of the greatest expanses, concentrations and diversity of northern Cordilleran and Great Plains ecosystems in the United States. The ecosystems here are so valuable because of their location near headwaters, concentration, quality and diversity. It can easily argued that no other area within the state of Montana can match its overall ecosystem and species diversity. The Blackfeet Indian Reservation is located in northwestern Montana and encompasses approximately 1.5 million acres of land, five watersheds, and 73 subwatersheds, over 51,582 acres of wetlands and over 17,367 acres of lakes. It also includes large expanses of intact forests, grasslands and other ecosystem types representative of the Great Plains and northern Rocky Mountain regions.

The ecosystems on the reservation are highly valuable due to their location near headwaters, concentration, diversity and quality not found elsewhere in the Great Plains region of Montana. This high diversity of ecological systems supports very high biological diversity, representing a wide range of plant communities and animal species found within the biological crossroads of the Great Plains and Northern Rocky Mountain ecosystems. Virtually all known wetland and riparian ecosystems known to occur within the state of Montana are present on the reservation. Some of the largest expanses of upland ecosystems are present as well, some of which have largely disappeared elsewhere in their historical range and extent.

Wetland and riparian ecosystem diversity includes high concentrations of glacial prairie potholes, open, closed and saline depressional wetlands, marshes, wet meadows and fens, as well as riparian areas that range from headwaters from the mountain summits to major tributaries of the Milk, Saint Mary and Upper Missouri watersheds; the former two which represent international waters that flow into adjacent Canada. Compared to other areas in the Montana Great Plains, and the Great Plains region as a whole, these wetlands are in relatively good ecological condition and contain a diversity of plant communities and species not found further to the east of the reservation.

The wetlands of the Blackfeet reservation support hundreds of thousands of migratory waterfowl and shore birds on annual spring and fall migrations. Many species breed and nest on the Reservation during spring and summer months. As prairie wetlands continue to be degraded by oil and gas development and impacted by climate change, elsewhere in the pothole region, Blackfeet wetlands will become even more important to migratory wildlife. Due to their location near headwaters, groundwater connectivity and the greater number of permanent and semi-permanent wetlands, wetlands on the Reservation may contain water for longer periods in the face of climate change than areas further to the east. The prairie potholes on the Blackfeet Reservation have been recommended as conservation and protection sites for over 20 years (Lesica 1987;1990;1993), and have been described as one of the best conservation opportunities in the Great Plains region (Lesica 1993).

On the western boundary of the Reservation, the headwaters of three major river systems and their associated tributaries represent a diversity of riparian systems that

range from alpine springs and alpine streams to subalpine to montane forested streams and rivers that are structurally diverse and species rich. Groundwater discharge and precipitation from snowmelt at the headwaters within the mountains of the reservation and Glacier National Park contribute to the high, unimpaired water quality of Reservation streams and rivers. Groundwater within Glacier National Park is classified by the EPA as Class 1 waters: Ecologically Vital Groundwater (EPA 2012). As such, high water quality contributes to outstanding quality riparian and wetland systems on the Reservation, which serve as the first storage and discharge points for the headwaters of the upper Missouri, Milk and Saint Mary rivers. Further out on the Great Plains, the Two Medicine, Milk and Saint Mary rivers support cottonwood floodplain forests that are in better ecological condition compared to other rivers within the state of Montana.

Because the Blackfeet Reservation occurs at the biological crossroads of the Great Plains and Northern Rocky Mountain ecosystems, it also contains diverse upland (non-wetland) ecosystem types that are dependent and benefit from the presence of wetlands and riparian habitats within them. For example, the Northwestern Boreal Great Plains aspen parkland forest belt of the foothills and plains is the best representation and includes the largest, intact expanse of this plains/ boreal aspen forest type in the lower 48 states. Most of this ecosystem is gone in southern Canada and it is critical habitat for bears, moose, elk, deer, red fox, wolves, fisher, coyotes, and many other mammal species. In addition, it is critical nesting habitat for hundreds of migratory and resident song birds and birds of prey. Plant species diversity within these aspen forests can be very high: up to 57 species of plants have been recorded within these forests on the Blackfeet Indian Reservation (Cooper and Heidel, 1997), many of which are Blackfeet cultural plants.

The grasslands of the Reservation are some of the last, best representations of the montane fescue grassland ecosystem in the northern Great Plains region. Most of this grassland ecosystem type is gone in southern Canada and only isolated areas are found outside the Indian reservations in northern Montana. The fescue grassland ecosystem supports many species of northern prairie animal and plant species. The presence of native grassland supports the health and value of the wetlands and riparian areas within them. Therefore, prairie wetlands that are surrounded and buffered by large intact expanses of grassland are capable of maintaining higher levels of ecosystem function value and biological diversity compared to other areas of the northern plains in Montana and adjacent Canadian provinces, where agricultural conversion and oil and gas development have fragmented this ecosystem and impacted the associated wetlands.

Biological Diversity of the Blackfeet Reservation

This rich diversity of wetland, riparian and upland ecosystem types, from the alpine to the Great Plains, supports very high biological diversity. Over 50% of all known native plants, amphibians, and reptiles in Montana are present on the Blackfeet Reservation (MNHP 2012). Over 65% of all known native birds and fish are present and over 80% of all native mammals. A total of 109 species within the Blackfeet Indian Reservation are

known to be biologically rare (Species of Concern) within the state of Montana. The presence of a largely natural landscape, lack of development, and large intact buffers of Glacier Park and Badger Two Medicine support the high level of ecosystem function and diversity. Natural landscape, in combination with high water quality, and ecosystem diversity makes the Reservation a highly significant biological and ecological resource. Indeed, the Blackfeet Reservation is the most biologically and ecologically rich Indian reservation within the United States.

This document provides an overview of the biological diversity within the major ecosystems found on the Blackfeet Indian Reservation. I have also included a discussion of the Blackfeet cultural plants, as well as biologically rare and common species of plants, animals, birds, reptiles and amphibians found within each ecosystem type. The full extent of the biological diversity of the Blackfeet Reservation is incomplete to date. A comprehensive inventory of lichens, mosses, and invertebrates has never been undertaken on the Reservation. It is entirely possible that many more rare species in these groups, as well as additional rare plants and animals are present on the Reservation.

Many additional vascular plant species, including cultural plants that are not known within the Reservation's boundary at this time, as well as biologically rare species, and additional Species of Concern, are likely present on the Reservation but have not yet been documented. For example, two plant Species of Concern, fleshy starwort (*Stellaria crassifolia*) and northern bladderwort (*Utricularia ochroleuca*) were recently documented in a rare prairie fen wetland on the Blackfeet Reservation (Lesica 2012). The Blackfeet reservation occurrence of northern bladderwort is the only known record within the state. Only three other locations of fleshy starwort are known from southwestern Montana within the state. Therefore, this occurrence on the Blackfeet Reservation is significant. During past survey work, at least 42 other rare plant species have been recorded on the Reservation. Additional rare species and additional occurrences of known rare species are likely present.

Furthermore, additional ecosystem types, including those that are small patch types, need to be searched for, mapped, documented and inventoried. Unique or poorly described plant community types within some of these ecosystems also need to be documented and described. This work will provide the foundation of additional conservation work for small patch type or unknown ecosystem types on the Blackfeet Reservation.

Conservation includes the study of species decline and its causes, and techniques to conserve rare, endangered and other species of conservation interest. Within the Blackfeet Reservation, emphasis is placed on habitat conservation, species conservation, and cultural area conservation, all three which are interconnected. Critical areas can be identified that connect key features such as wildlife corridors, waterways and proximal locations to intact ecosystems that are represented on the reservation. For all areas of interest, habitat conservation of rare or cultural species is described as in-situ conservation and is the most desirable management technique.

The goal of in-situ conservation is maintenance of healthy natural populations of rare species or other species of cultural interest. Because the reservation is buffered by protected lands on the western boundary, that support numerous species and connecting ecosystems and waters, conservation projects on the Reservation have high potential for success, over the long term. This in turn supports traditional and cultural areas and practices, even in the face of climate change.

On the whole, tribal lands are important refugia for biological diversity and for rare species. Many tribes manage rare species by surveying for the presence of these species on proposed projects or are actively engaged in assessing the biological diversity of tribal lands. Others have initiated strategies for habitat protection and monitoring of rare species within the tribe or in conjunction with other land management agencies. For example, the Blackfeet Land Trust have created the first Indian Land Trust in the nation. It is a modeled on the Nature Conservancy and protects unique prairie fen habitat; home to rare plant species as well as providing habitat and a travel corridor for several animal species of concern; including grizzly bears.

The term "rare" can mean many things to many people. It can mean infrequent, uncommon, or unusual. Therefore, in most cases, rare species are referred to as "Species of Concern." These species are those that are state- or federally-listed as Endangered or Threatened, and are on the State Natural Heritage list species of concern. In any case, impacts to special-status species must at least be addressed when assessing potential effects of proposed human activities on the environment. For example, approximately 20,000 species are native to North America. One-fifth of these plant species are “rare” because they are found in very low numbers and do not have any legal protected status. This may be because their habitats are naturally rare due to climate or geography, but many have become rare because of pollution, development, over-collection for commercial trade, and invasion by exotic species.

Biologically, the term "rare" typically refers to a species’ limited geographic distribution, limited population size, or limited numbers. Taxa (a taxon is a distinct entity such as a species, variety, or subspecies) can be considered rare if they occur as infrequent individuals but scattered over a wide geographic area, as abundant individuals with a very narrow geographic range, or as infrequent individuals with a narrow geographic range. The term endemic is also frequently used to refer to taxa restricted to a particular locality. Geographic distributions, habitat specificity and local population size are all related to rarity of a species. A full description of the ranking description of biologically rare species, referred to as Species of Concern within the state of Montana is found in Appendix 1.

In most cases, little is known about population dynamics, life history characteristics, effects of land use practices, or even why many of these species are rare, or in the case of Blackfeet cultural plant species, why their numbers may be declining. Monitoring methods are designed to meet several needs: (1) to acquire information that would assist in the protection and preservation of habitats; (2) to assess the effects of changes in management regimes on rare plants and communities; (3) to assist managers of

prospective and designated Natural Areas on the reservation; and (4) to conduct original demographic research for the rare plant species or cultural species of concern.

Due to lack of funding, however, qualitative methods can be implemented to provide tribal resource managers with an immediate tool to assess ecosystem health and biodiversity. The Rapid Assessment method can be used by field personnel that would assist in assessing habitat condition and trends, effects of land management practices, prioritizing habitat restoration work, and identifying areas for protection or reference site conditions. This same Rapid Assessment model could also be applied to individual species of interest (such as cultural plant species) to assess their population size, reproductive success, and ability to persist in the presence of stressors. The long term goal is to begin identifying environmental stressors, easily implemented restoration practices, such as deferred grazing. This will allow for the development of more intensive quantitative monitoring efforts of habitats and species of cultural and conservation concern on the Reservation, if funding can be located.

Ethnobotanical Diversity of the Blackfeet Reservation:

Historically, the Blackfeet Territory included most of Montana and southern Alberta. Within this large territory, at least 172 plant species have been documented by ethnographers as Blackfeet cultural plants. At least 131 species have been used for medicine, 82 species as traditional food, and at least 100 of these same species are or have been used for other purposes, such as ceremony, traditional games, dyes, utilitarian objects, fibers, tools, and other uses (McClintock 1910; Hellson and Gadd 1974; Johnston 1987; Moerman 1998; Barney and Peacock 2001).

Significantly, at least 110 of these Blackfeet cultural plant species occur on the present day Blackfeet Reservation, in part due to the ecosystem diversity of the Reservation. However, 10 of these species on the Reservation are of limited distribution or population size, due to being on the edge of its natural range on the Reservation, habitat specificity or other factors. At least 2 species were known to be seeded by Blackfeet people; there are no observed occurrences of these two species at this time. The remaining 19 species not present on the Reservation are known from other areas within Montana to the west, east and south of the Reservation.

At least one Blackfeet cultural plant species is also a northern Rocky Mountain endemic species; which is a species that may be locally common but restricted in overall geographic range to the northern Rocky Mountains of Montana and adjacent extreme southwestern British Columbia and southeastern Alberta. This species is found at subalpine elevations within Glacier National Park and Badger Two Medicine, however it is only known from one subalpine area on the Blackfeet Reservation. This species is considered to be one of the most venerated and important plants of the Blackfeet. Therefore, access to and use of this plant is limited for tribal members. Other cultural plants, especially those occurring in sensitive ecosystems, such as depressional wetlands and fens, may become vulnerable to the effects of climate change, water removal or changes in water quality. Conservation efforts must also address Blackfeet

cultural plants, their vulnerability to environmental changes, as well as preserving traditional plant gathering areas, that are often closely tied to sacred and ecologically valuable areas.

Compared to many other Indian reservations, the relative intactness of whole breadth of cultural plant species on the present day reservation is highly significant. This provides the Blackfeet Tribe and future generations with direct contact and use of these plant resources for the continuation of cultural tradition. Additionally, there are many tribal members from other tribes that reside on the Blackfeet Reservation; including but not limited to members of the Assiniboine, Cree, Chippewa, Salish, and Kootenai. Additional plant species of cultural significance to these tribal members are also utilized on the Blackfeet Reservation.

Wetland Conservation Needs

The Northwestern glaciated prairie pothole region of Montana and adjacent southern Alberta and Saskatchewan is rich in both concentration and diversity of depressional wetlands that vary in size and flooding regime. These wetlands exhibit high variability on both temporal and spatial scales, influencing plant community dynamics seasonally and annually. The size, depth, and concentration of wetlands varies across the landscape, from small, isolated shallow wetland depressions to wetland complexes that exhibit differences in hydrology and hydroperiod. This diversity of size, shape, and depth, along with considerable annual variation in hydroperiod, contributes to highly dynamic communities of vegetation, invertebrates, and other fauna. Within this semi-arid region, wetlands support an abundance of species that cannot exist in the surrounding mixed grass prairie or agricultural croplands. In essence, they can be viewed as islands of biodiversity.

Because wetlands in the western prairie pothole region are uniquely important biological refugia, and because they are at high risk, particularly from climate change and oil and gas development, their conservation and restoration is critical. Climate warming scenarios suggest that all wetland types (temporary, seasonal, and semi-permanent) may experience significant loss in water volume, hydroperiod, and annual frequency of flooding in the western region of the Great Plains (Johnson et al. 2010). Of these, temporary and seasonal wetlands which are dependent primarily on precipitation for recharge are highly vulnerable (Winter 2000). Elsewhere in Montana and the northern Great Plains, federal, state, tribal, and private lands within the western prairie pothole region harbor concentrations of wetlands and associated grasslands, but they currently fail to provide the network of representative conservation areas that would be required for long-term ecological viability. Therefore, conservation and restoration of Blackfeet wetland complexes, satellite isolated wetlands, and associated native upland ecosystems will ensure that biological linkages are maintained to aid in gene dispersal, adaptation, and persistence in the face of climate change.

Wetland complexes currently provide critical nesting and brood-rearing habitats for migratory waterfowl. The majority of depressional wetlands in this region are freshwater

emergent wetlands that are temporarily or seasonally flooded (McIntyre et al. 2011). These wetlands become ice free and recharge with snowmelt runoff in early spring. They are shallower wetlands containing a high abundance of aquatic invertebrates – a crucial food source for migrating and nesting waterfowl and shorebirds. The larger, deeper semi-permanent wetlands, which are uncommon in the north-central and northeastern region, remain frozen until later in the spring. In early summer, when seasonal wetlands usually become dry, waterfowl broods, molting ducks, and other wetland vertebrates move to the deeper, semi-permanent depressional wetlands, some of which have been converted into deeper stock ponds and reservoirs.

Thus, because climate change predicts earlier drying of seasonal wetlands, conservation and maintenance of future waterfowl populations in this region will depend upon their ability to adapt to fewer basins containing water in any one breeding year and earlier drying of those temporary and seasonal wetlands that do contain water. The females' ability to move broods to aquatic food resources will depend on relatively close proximity of seasonal and semi-permanent wetlands. Conserving and restoring wetland complexes that provide a range of sizes, depths, and hydroperiods will help ensure that at least some basins will contain water and food resources at different times during the breeding and migration seasons and between years.

Many wetland species populations are rendered vulnerable by their regional and ecosystem-specific distributions, limited ability to disperse to new areas, specific habitat requirements, and narrow climate and hydrological envelopes. There is growing concern about decreasing distributions, population sizes, genetic variation, and habitat diversity with the continuation of warmer and dryer climate trends in this region. How species and populations respond to climate change may depend on the rate at which they are able to disperse to more suitable wetlands and on their ability to persist and adapt in fewer wetlands capable of maintaining hydrologic and ecological function. Conservation and restoration efforts must ensure landscape-level connectivity between wetlands to facilitate dispersal, accommodate range shifts, ensure persistence of wetland flora and fauna and maintain biological linkages, through preserving wildlife corridors and native vegetation.

Analysis of the region using GIS provides an overview of the scope, degree, and complexity of stressors affecting wetlands in this region. These diverse wetlands are influenced by many interactions and feedback loops. Long-term and proximate climate patterns, hydroperiod, landscape position, and biogeographic location are interrelated and directly influence a wetland's biological communities. Relative density, distance, condition, and stresses influence species annual recruitment and long-term biodiversity. Concentrations of wetlands of varying sizes and flooding regimes can be targeted as high priority areas for conservation and restoration. In such an approach, wetland flora and fauna have greater potential to disperse and migrate to other wetlands in close spatial proximity. Concentrations of wetlands and identified, isolated linkages represent a range of temporally variable periods of water. This will contribute to greater potential for long-term perpetuation of these highly dynamic wetlands and the species that depend on them.

Conservation and restoration needs within the Blackfeet Nation are crucial due to immediate concerns associated with oil and gas exploration and proposed development. The greatest overriding threat to Blackfeet reservation wetland and riparian areas over the next few years is oil and gas exploration and development, increasing demands on surface and groundwater associated with drilling operations, and fragmentation of natural buffers by the construction of access roads. Given the past and existing threats to wetlands on the Reservation, it is essential that a wetlands conservation initiative be developed and implemented to assure that no further impacts to and losses of wetlands occur.

The Blackfeet Wetlands Conservation Strategy (WCS) would provide the necessary framework to protect, conserve or restore wetlands and their associated landscape buffers. The WCS will facilitate and improve the Tribe's ability to effectively and efficiently identify needed areas of improvement and opportunities in holistic wetlands protection. Goals of the Wetlands Conservation Strategy are to achieve conservation and protection of wetlands on the Blackfeet Reservation by:

1) Identify unique and outstanding wetlands and high priority protection sites, within each watershed of the Reservation, and fully protect them from development. This will include culturally significant wetlands, such as areas used for Blackfeet traditional plant gathering for protection, critical wildlife corridors between Glacier National Park and Lewis and Clark National Forest, along streams and rivers on the Reservation, and identifying additional wildlife management areas, such as prairie pothole complexes for protection and restoration.

2) Initiate wetlands easements and/or acquisitions program to conserve and protect existing priority or outstanding wetlands on fee, tribal and allotted lands within the Reservation.

3) Nominate and protect outstanding natural areas of the Blackfeet Reservation, including examples and expanses of upland ecosystems for conservation, as well as associated upland buffer zones around wetland and riparian areas.

Under difficult and changing economic conditions, funding for extensive restoration efforts may dramatically decrease over the next few years. Conservation and restoration efforts involving whole wetland complexes and associated natural upland buffers is an integrated, cost-efficient approach that is necessary to maintain ecosystem function and biological diversity. This approach provides Blackfeet Land managers with an active plan to identify high quality wetland areas, and to implement conservation and land management practices that enhance and restore wetland integrity and ecological function. By viewing conservation and restoration efforts from an inclusive standpoint, managers can ensure that ecological and cultural integrity is being conserved, promoted, or restored to the greatest extent possible on the Reservation. Conserving and effectively restoring the Blackfeet Reservation's concentrations of high quality wetlands, aspen parklands, grasslands and other ecosystems will continue to be a crucially important issue over the coming decades.

Designation of Wetland and Upland Conservation Areas

Currently, within the Blackfeet Reservation, conservation areas are extremely limited in size and scope. Designating representative, high quality vegetation ecosystems would conserve important areas of biological diversity. However, because culture and cultural uses of resources is priority for the Blackfeet people, cultural uses, sites, traditional gathering areas and other cultural uses will be used in designation of conservation sites.

Important Cultural and Biological features of a nominated conservation area may represent or contain:

1) Traditional plant gathering areas or other areas used for traditional or spiritual purposes.
2) Significant populations or concentrations of Blackfeet cultural plant species.
3) Other cultural and archeological or traditional resources or sites, current or historical.
4) Significant populations of rare or endemic species as well as peripheral or disjunct populations of species and associated habitat.
5) Ecosystems or plant community types or a range of plant community types that are rare, disjunct or on the periphery of occurrence within the state or ecoregion.
6) Ecosystems that are relatively secure throughout their range, but are in excellent ecological condition (ie. relatively undisturbed by anthropogenic disturbances).
7) Unusual occurrences of a diversity of communities or species rich communities, as a result of local variation in abiotic features such as geology and soils, hydrology, climate patterns, topography or elevational gradient.
8) Large intact expanses or concentration of pristine woodland, forests, grasslands, riparian areas and wetlands.
9) Protection of highly sensitive ecosystems, such as alpine and subalpine ecosystems and fens.
10) Critical migratory and resident habitat and travel corridors for wildlife.

There are several functions to conservation areas: 1) To preserve examples of all natural ecosystems, (2) to preserve cultural traditions, practices and beliefs (3) provide educational and research areas for cultural, ecological and environmental studies (4) to preserve gene pools of native plants and animals and (5) maintain buffer and corridor connections to other protected areas. All of these functions are critically important for long term planning, especially in the face of predicted climate change in western Montana and the Western Great Plains regions.

The most commonly used biological criteria for consideration of conservation areas include representativeness, rarity, diversity, uniqueness and integrity. In biological conservation efforts, representativeness generally refers to an area that contains biological and environmental characteristics or both, that represent the range of natural variability within a region. Representativeness includes biological features such as characteristic species composition, vegetation structure, species richness, rare and

endemic species, range of successional stages, and ecotonal or ecoclinal gradients between communities.

Rarity can mean presence of populations of rare species, groups of rare species, rare community types or examples of rare ecosystems. Rare species are those which are biologically rare or are rare on a local scale. This can include Blackfeet cultural plant species that are limited in distribution on the reservation or elsewhere.

Diversity can mean occurrences of a diversity of species or communities or species rich communities, as a result of local variation in abiotic features such as geology and soils, climate patterns, topography or elevational gradient. Mid to upper elevational grassland and shrub dominated communities are frequently interspersed with forest or woodland communities, and the ecoclinal gradients between these communities often contribute to greater overall species richness.

Uniqueness can mean unique occurrences of communities within an eco-region, such as fens within mixed grass prairie of the northern Great Plains. Uniqueness also refers to occurrences on unusual substrates or soils. Unique assemblages of species are usually relatively small patch types that occur due to unusual edaphic or hydrologic conditions, and are found within a matrix of more common community types for the ecosystem.

Integrity (or high quality plant communities) are those in excellent ecological condition and have high potential for maintaining ecological function. These communities are those that are found within or adjacent to a large natural landscape buffer, including matrix and large patch communities that typically cover wide areas. The buffer and communities indicators of ecological function, such as high water quality, soil surface integrity, and presence of cryptobiotic soil crusts. They have been subjected to the least amount and intensity of human disturbance.

A significant portion of Montana’s low to mid elevational grassland and shrubland ecological communities occur on federal lands. These two ecosystem types account for more than two-thirds of the state’s area, and protected areas are poorly represented in total acreage. These communities often occur as mosaics within the landscape, and are distributed based on patterns of topography, soils, climate and geographic range of dominant species within the community. The heavy use of grassland and shrubland communities at lower elevations has altered their appearance and composition.

Similarly, lower elevation forest types, such as those that occur in the Great Plains region of Montana, are poorly represented in conservation efforts throughout the range of the forest type. Some forest types within Montana have been subjected to catastrophic fires, mortality due to biotic vectors, climate change, over grazing, and invasion by weeds. Thus, non-disturbed examples of these forests that are in excellent ecological condition are extremely valuable for all the aforementioned functions of a conservation area.

Within mountainous terrain, grassland and shrubland communities frequently occur on drier sites that are interspersed by forested communities. They can occur as complex mosaics or as extensive upland communities. These occurrences represent boundary communities at ecotonal gradients; being controlled by differing environmental and biological factors than similar communities at lower elevations. The mosaic pattern of upland grassland and shrubland communities often contributes to greater overall species richness.

Some community types are often overlooked because they may not be deemed as magnificent or they are viewed as common and do not require inclusion for conservation efforts. Other community types may be viewed as impoverished, of limited extent or are poorly defined under current vegetation classification standards. These communities may also be overlooked as potential conservation areas. Yet, these communities often contain species or ecotypes that may represent important genetic and ecosystem resources over the long term. Development of a conservation network is crucial to ensuring that biological reserves are maintained to aid in gene dispersal, adaptation, persistence and range shifts in response to climate change. Finally, how a relatively undisturbed community type or types are responding to current stresses such as climate change will provide invaluable information for future land management, conservation and restoration work.

Peripheral populations of species or communities are those which occur at the edge of their geographic range. All species and communities have limits to distribution. Populations that demarcate margins of geographic distribution reflect an end point in adaptation to changing environmental parameters. Peripheral populations or communities therefore are of particular conservation interest as they represent limits to survival and adaptability and that may alter with climate change.

Peripheral populations or communities exist under conditions that differ for core populations or the main geographic range of a community type, and are characterized by variable environmental conditions compared with core populations. They are expected to be genetically diverse and exhibit adaptation to extreme conditions. These populations exhibit variation in genetic expression, physiological tolerance, reproductive biology, or demography. They are significant genetic resources for the ongoing evolution, adaptation and range shift of species in response to climate change. Due to their location and other factors, they may also be buffered against biological stresses such as disease or insect infestations that now commonly occur within the main geographic core of the population or community type.

Species and communities have limits to distribution and populations that demarcate margins or edges to distribution and reflect an end point in adaptation to changing environmental parameters. The interface between one vegetation community and another can be variable, depending on whether it is abrupt (ecotonal), as seen in natural treeline communities, or whether it is diffuse, as one vegetation community gradually merges with another (ecocline), as often seen in boundaries between shrubland and grassland communities. In the latter case, some of this expression may be due to past

land uses or other alterations. Ecotonal and ecoclinal communities reflect adaptability to environmental stresses and represent other significant biological features such as community species richness. They may also be buffered against biological stresses such as disease or insect infestations that now commonly occur within the main geographic core of the community type. Thus, they also represent important genetic resources.

The complexity of ecoclinal gradients between communities at all elevations on the Blackfeet Reservation offer outstanding ecological and environmental monitoring opportunities. Quantitative monitoring is needed for documenting change, which may be just as ecologically significant as the movement of discreet boundaries at higher elevation community types. Thus, these areas fulfill all potential conservation area functions: presence of a large buffer zone, a wide diversity of community types in a range of successional stages, presence of rare or uncommon community types, and representative community types occurring in marginal environments that serve as important genetic resources.

A proposed conservation area can include plant community types that are relatively secure throughout their range, but are in excellent ecological condition and poorly represented in other protected areas. Indeed, common vegetation community types are important for inclusion in conservation efforts because they are often heavily utilized or disturbed in non-protected areas, and would provide invaluable data for improving current land management and restoration practices. High quality examples of mixed grass and rough fescue prairie on the reservation are also important genetic resources and can serve as seed collection sites and reference sites for restoration work.

Ecosystem Descriptions

The ecosystem descriptions have been rewritten and adapted from state wide ecosystem descriptions developed by the Montana Natural Heritage Program; authored by Tara Luna, Steve Cooper, Linda Vance and Cat McIntyre.

1. WETLANDS and RIPARIAN ECOSYSTEMS

Overview:

Wetlands are areas of land that are saturated with water either year-round or seasonally, that contain unique soils and aquatic plants. Riparian areas are areas adjacent to streams and rivers; often with forest or shrub communities. Wetlands and riparian areas provide many ecological functions that greatly benefit humans, wildlife and the surrounding ecosystem as a whole. Wetland and riparian areas protect, filter and clean water. They improve water quality by filtering and trapping nutrients, pollutants and sediments. They also store floodwaters, recharge aquifers (groundwater tables) and maintain surface water flow during dry periods. Wetlands and riparian areas also cycle and store carbon, nitrogen and phosphorus, which are vital processes to a healthy environment. The presence of wetlands and riparian areas support the health of the adjacent upland ecosystems. Indeed, the vast biological richness of the Reservation is due to the abundance of wetlands and riparian areas that in turn support the species richness of the upland ecosystems.

Wetland functions maintain biological productivity and provide habitat to numerous macro-invertebrates, insects and mollusks, which serve as a food source to water and shore birds, songbirds, amphibians and fish, which in turn serve as food sources for mammals and humans. All fish, amphibians, birds and mammals spend all or part of their life cycle within wetlands and riparian habitats. Wetland and riparian areas also provide habitat for many Blackfeet cultural plant species, used for medicine, ceremony, traditional foods and other purposes. Several Blackfeet cultural plants are restricted to wetlands and riparian areas and do not occur in upland ecosystems.

A wetland or riparian ecological system, or ecosystem, contains species that usually occur together under similar environmental conditions such as regional climate, landscape position, soils, hydrology, and topography. Site-specific environmental factors and biotic influences determine the range of variation exhibited by an ecological system, so that no two examples are exactly alike. Vegetation dynamics within a wetland are dictated primarily by hydroperiod, but also are influenced by water depth, water chemistry, soils, disturbance, and the existing seed bank. The variable life history characteristics exhibited by wetland and riparian plants contribute to the highly dynamic expression of plant communities within the region.

Again, an ecological system can be defined as a characteristic assemblage of species that usually occur together under similar environmental parameters such as regional climate, landscape position, soils, hydrology, and topography. Recurring assemblages

of species, known as plant communities, tend to be found together within an ecological system where specific environmental and biological conditions support their growth and reproduction.

Plant associations, also referred to as plant communities, are usually dominated by one or two (rarely three) species which comprise the majority of vegetation cover. Some associations are very simple in terms of species diversity, while others may include many species in addition to the dominant ones. Plant associations also indicate the disturbance regimes at a particular site. A relatively undisturbed, extremely rich fen, for example, supports a moderately to highly complex mosaic of plant associations, while a closed depressional wetland that has been subjected to heavy disturbance may only support one or two associations. Vegetation of a given ecological system can be described, mapped, and delineated into distinct plant associations that indicate the variability of hydrology, soils, organic matter accumulation, and other factors found across the ecosystem.

In the western prairie pothole region, many depressional wetlands and marshes are ecologically similar, and frequently contain the same or very similar plant associations. However, they exhibit differences in hydrology: although much of the water in these wetland systems comes from spring snowmelt, but the relationship between the wetlands and groundwater tables is complex and variable. Depending on precipitation and recharge of the groundwater table, these wetlands exhibit variable periods of water availability from year to year. A wetland's hydrologic function (recharge, discharge, flow-through) is determined by variations in climate and by its position in the landscape, the configuration of the associated water table, and the underlying geologic parent material (Euliss et al. 1999). Hydrology defines the hydroperiod, the chemical characteristics of the water, and ultimately the plant communities and the species within the wetland. It should be emphasized, however, that species richness on the Blackfeet Reservation is due to the proximity of these wetlands to a diversity of upland ecosystem types that are relatively intact and their geographic location and topographic position.

The vast majority of depressional wetlands in the western PPR are categorized as temporary, seasonal, or semi-permanently flooded wetlands. Permanently flooded wetlands, usually larger in size, are more common on the Blackfeet Reservation that further east in the rest of the western prairie pothole region. However, this region does contain numerous deeper prairie potholes that typically contain water year-round, and these can be classified as permanent wetlands. Semi-permanent wetlands often have either a flow-through, recharge and discharge functions. Temporary wetlands usually recharge groundwater, whereas seasonally flooded wetlands can have either a recharge or flow-through function. Hyper-saline wetlands can exhibit seasonal or temporary flooding regimes, and tend to function mostly as discharge sites. Small, ephemeral wetlands (or vernal pools) are numerous but are not currently classified as wetlands (Cowardin et al. 1979). This variability in hydrology and hydroperiod contributes to the highly dynamic characteristics of wetlands in this area.

Many examples of wetland and riparian ecological systems are in fact a mosaic of ecological wetland systems. For example, a fen may grade into a marsh, which in turn grades into transitional wet meadow or wet prairie. Within a riparian floodplain system, there may be shrub- and tree-dominated communities as well as riverine marshes and wet meadows. A thorough assessment of the wetland restoration site will define the variability of the ecological system, which may exhibit characteristics of one or more systems across the wetland complex.

Wetland Plant Community Dynamics

A given plant association or plant community occupying a particular wetland ecological system is directly related to the hydroperiod or length of inundation, depth of inundation or lack of inundation Hydroperiod, in turn, is determined by precipitation events, wet-drought cycles, and in many depressional wetland systems, connectivity to ground water. It is also influenced by water removal. Flora may differ between wetlands within a complex, or within a single wetland at different times, primarily due to differences in hydroperiod. A depressional wetland, for example, may be dry and dominated by a particular set of plant communities in the spring, but its floristic composition could completely change if the wetland receives substantial rains in early summer and becomes inundated. In another year, the wetland could be dominated by submergents and emergents in spring and early summer, but become dry by mid-summer through evaporation. In this case, annuals that require warm, exposed moist soils will germinate, and perennials adapted to longer periods of draw down become prevalent components of the vegetation during the latter half of the growing season.

Wetland plant communities in the western prairie pothole region are highly dynamic; they change according to water input, deficit, or removal, as well as the presence and longevity of seeds in the seed bank. The dynamic nature of hydroperiod, especially in shallower and ephemeral wetland systems, prevents establishment of species that require longer hydro periods and water depth in their life history. Extreme annual and seasonal fluctuations in water depth are characteristic of many of the wetland systems in northern Montana. Thus, most dominant species within these communities exhibit life history characteristics that allow them to germinate from dormant seeds, or persist during periods of drought as dormant rhizomes and root systems that are capable of regeneration during favorable periods. Thus, to fully assess the plant community dynamics of many depressional systems in this region, plant communities must be described based on the variations in hydroperiod from year to year.

The range of occupation or ecological amplitude of a given species is primarily dictated by hydroperiod, but water depth, water chemistry, and soils also play a part. Some species can be dominant or frequent across the range of resource levels. The establishment of a species best adapted to the physical and biological conditions of a site can play an inordinately important role in determining community structure in wetland systems. Some herbaceous wetlands may contain only one or two plant associations, while others may contain more associations that occur along a water depth gradient. Typically, when two or more of these zones are present, one plant

association occupies the central, deeper part of the wetland basin, while the others form concentric peripheral bands. Seasonal and annual changes in water chemistry also affect the distribution of plant communities and species diversity (Stewart and Kantrud 1972). Some species can tolerate a range from fresh to saline, but generally, species diversity decreases with increasing salinity. Depending on annual or seasonal hydroperiod and the corresponding changes in water depth and water chemistry, the floristic composition of a wetland can change dramatically from year to year.

Great Plains Prairie Potholes

Prairie potholes are found across the northern glaciated Great Plains of Montana. Potholes occur in shallow, glaciated depressions. The region is distinguished by a thin mantle of glacial drift underlying stratified sedimentary material; these form a glacial landscape of end moraines, stagnation moraines, outwash plains and lakeplains. The glacial drift ranges from steep to slight local relief with fine-grained, silty to clayey soils. Limestone, sandstone, and shales are the predominant parent materials, and highly mineralized water can discharge from these rocks. The prairie pothole ecological system is a closed basin that receives irregular inputs of water from the surroundings and exports water as groundwater (Figure 1). Effects of geology, geomorphology and surface water/ground water interactions, evapotranspiration, recharge, and climate influence hydrology. These can vary considerably depending on topography and watershed position (Cohen et al. 2006).

Many of the temporary depressional wetlands in the north-central and northeastern portion of northern Montana may be dry during drought cycles and may contain water only during years of high precipitation. Thus, the deeper prairie potholes of the Reservation, and their topographic position which supports groundwater connectivity, are highly important during summer months for waterfowl that travel from shallow basins to deeper potholes during molting and fledgling stages. If climate trends and groundwater removal continue in north-central and northeastern Montana, Blackfeet potholes will become highly critical habitat and perhaps in another 50 to 100 years, some of the only remaining habitat, to migratory waterfowl in Montana.

Depressional wetland complexes can be connected to one another through surface water and groundwater tables (Winter and Rosenberry 1998, van der Valk 2005, Johnson et al. 2010). In these cases, water retention between wetlands is greater than in systems where surface inputs and evaporation occur (Winter and Rosenberry 1995). Depending on their influencing geology and hydrology, wetlands can be recharge sites, discharge sites, or flow-through sites. Topographic position alone does not fully indicate prairie pothole hydrology (Leibowitz and Vining 2003). Flows can also reverse on a seasonal basis: an individual pothole can be a discharge wetland in the spring, receiving ground water from uplands, and later become a recharge wetland in summer as evapotranspiration creates a groundwater sink (Winter 1989).

The hydrology of this system is complex, and the concentration of dissolved solids results in water that ranges from fresh to extremely saline, with chemical characteristics varying seasonally and annually. Most prairie potholes and associated lakes contain

water that is alkaline. Water accumulates rapidly in potholes during spring months, especially when soil frost is sufficiently deep to forestall all infiltration until after the ground thaws. Most water loss occurs through evapotranspiration, which exceeds precipitation during summer months.

Evapotranspiration is the primary water loss, although potholes also lose water by seepage. The hydrology of this system is complex, and the concentration of dissolved solids results in water that ranges from fresh to saline, with chemical characteristics varying seasonally and annually. Most prairie potholes and associated lakes contain water that is alkaline (pH >7.4). Vegetation and species diversity within this wetland ecosystem is highly influenced by hydrology, salinity, and dynamics. Potholes can vary in depth and duration, which determines the local gradient of plant and invertebrate species, which in turn influences waterfowl and shorebird use.

Prairie potholes of the Blackfeet Reservation support a wide variety of wildlife, waterfowl, shore birds and prairie birds. Grizzly bears, black bears, fox, elk, deer and coyote have been observed in these wetlands near the mountains. Historically, pothole vegetation ecology has been largely influenced by bison use. Swift fox are found within these wetlands on the reservation. Numerous water bird Species of Concern, such as white pelican, piping plover, common tern, black tern, Forester's tern, Clark's grebe, Horned grebe, American bittern, black crown night heron, black-necked stilt, Great blue heron, Franklin's gull, Trumpeter swan, white faced ibis, peregrine falcon and La Conte's sparrow have been observed in pothole wetlands on the reservation.

In addition, thousands of more common migratory waterfowl and shore birds use this habitat during spring and fall migrations. Many common species nest and rear their young in these wetlands on the reservation during summer months. Significant populations of snow geese, Canada geese, tundra swans, northern pintail, northern shoveler, mallard, cinnamon teal, goldeneye and other ducks have been observed in reservation depressional wetlands. Rare amphibians such as western toad and northern leopard frog are also found within these wetlands. Common amphibians include tiger salamander, Columbia spotted frog and western chorus frog.

While other areas of the western Great Plains in Montana and North Dakota are impacted by oil and gas development, water removal and climate change, the depressional wetlands of the Blackfeet Reservation will become even more critically important to the migration and population of one of the largest waterfowl populations in the world. Populations of birds from both the Pacific and Central flyways use Blackfeet reservation wetlands.


(Figure 1: Great Plains Prairie Pothole near East Glacier Park, Blackfeet Reservation)

Open Depressional Wetlands

Open depressional wetlands are lowland depressions that occur within larger watersheds that have a permanent water source throughout most of the year (Figure 2), and are connected by ground and surface water inlets and outlets to other wetlands. They also occur along lake borders that have more open basins and a permanent water source through most of the year. Unlike the closed depressional wetland, this system typically has a significant connection to the groundwater table. Soil pH varies from neutral to slightly alkaline. In Montana, this system is especially well represented along major and secondary tributaries of the Milk and Two Medicine Rivers on the Blackfeet Reservation. Due to their connectivity to groundwater and proximity near headwaters at higher topographic positions, open depressional wetlands often contain surface water throughout the year.

These wetlands support a variety of plant communities. Submergent and emergent communities are similar as described for Great Plains prairie potholes, however, open depressions near the western boundary of the reservation often contain shrub communities are the periphery, dominated by willow (*Salix* species). In addition, stands of sweetgrass (*Hierochloe hirta*) are common. These wetlands are traditional gathering areas for sweetgrass as well as other cultural plant species that are only found in wetland and riparian habitats. Other cultural significant Blackfeet plants present in these wetlands include wild mint (*Mentha arvensis*), silverweed (*Argentina anserina*), licorice

(*Glycyrrhiza lepidota),* skullcap (*Scutellaria galericulata*), yarrow (*Achillea millefolium*), penstemon (*Penstemon procerus*), among others (Johnston 1987; Moerman 1998).

The open depressions of the Blackfeet reservation support a wide variety of wildlife, waterfowl and other birds. Grizzly bears, black bears, moose, elk, deer and coyote have been observed in these wetlands near the mountains. The tribal bison herd pastures contain several open depressional wetlands. Numerous water bird Species of Concern, such as white pelican, piping plover, common tern, black tern, Forester's tern, Clark's grebe, Horned grebe, American bittern, black crown night heron, black-necked stilt, Great blue heron, Franklin's gull, Trumpeter swan, white faced ibis, peregrine falcon and La Conte's sparrow have been observed in the open depressions. Dozens of additional, more common species of water birds, songbirds and predatory birds occur within these wetlands on the Reservation; many of which nest and rear young, while the remainder use these areas during spring and fall migrations.

Rare amphibians such as western toad and northern leopard frog are found within these wetlands. The Plains spadefoot is likely present on the eastern edge of the reservation. Common amphibians include tiger salamander, Columbia spotted frog and western chorus frog.

(Figure 2: Open depressional wetland, Blackfeet Indian Reservation)

Closed Depressional Wetlands

Closed depressional systems are similar to open depressional systems and prairie potholes, but are usually isolated depressions without obvious inter- wetland surface drainage systems (Figure 3). They are primarily small, depressional basins found on flat, enclosed upland areas or on level shallow lake basins. The major sources of input

water are precipitation and snow melt, and water loss occurs through evapotranspiration. Although they have been considered to be strictly isolated, studies may confirm that closed depressions contribute some recharge to the groundwater table, similar to playas in the southern Great Plains. The basins are typified by the presence of an impermeable layer such as dense clay that is poorly drained. Subsurface soil layers are restrictive to water movement and root penetration. Closed depressions experience irregular hydroperiods where most fill with water only occasionally and dry quickly, influencing the plant communities that are present. They are important during early spring waterfowl migration, because they are ice free earlier in the migration period, serve as a resting area and early food source, compared to deeper depressional wetlands and potholes during early spring months.

(Figure 3: Closed Depressional Wetland near East Glacier Park, Blackfeet Reservation)

Saline Depressional Wetlands

This wetland ecological system is very similar to both the Open Freshwater Depressional Wetland and the Western Great Plains Closed Depressional Wetland. However, this system differs in its increased soil and water salinity that causes these systems to become brackish (Figure 4). This high salinity is attributed to increased evaporation and the accumulation of minerals dissolved in the water. This wetland system is typically a discharge site, where water high in dissolved salts moves from the regional groundwater system into the depression. Hydroperiods vary depending on precipitation and snowmelt, the primary source of water. Water is prevented from percolating out of the depression by impermeable dense clay. Salt encrustations can occur on the surface due to slow water movement. On the Blackfeet Reservation, water samples collected from saline depressions had conductivity values that ranged from 1,550-40,000 µmhos/cm (Lesica and Shelley 1988). Soils have silty-clay to clay texture, and the soil surface is covered with salt crusts. Principal salts are sulfates and chlorides of sodium and magnesium.

Vegetation within this system is highly influenced by soil salinity and soil moisture and is composed of salt-tolerant and halophytic species. Plant zonation related to soil salinity is often apparent in these systems with distinct rings occurring around the fringe of the depression. In extremely halophytic habitats, red swampfire (*Salicornia rubra*) is the dominant species. Red swampfire frequently occurs in the drawdown zone that is flooded during the early part of the growing season but the water table drops below soil surface by late spring or early summer. It is one of a very few species that can persist in these hyper-saline conditions when the water table drops below the soil surface.

Saline depressional wetlands of the Blackfeet Reservation support a wide variety of wildlife, waterfowl and other birds. Numerous water bird Species of Concern, such as white pelican, piping plover, common tern, black tern, Forester's tern, American bittern, black crown night heron, black-necked stilt, Great blue heron, ferruginous hawk, loggerhead shrike, Franklin's gull, Trumpeter swan, white faced ibis, peregrine falcon and La Conte's sparrow have been observed in the reservation saline wetlands. Dozens of additional, more common species of water birds, songbirds and predatory birds occur within marshes on the Reservation; many of which nest and rear young, while the remainder use these areas during spring and fall migrations.

Rare amphibians such as western toad and northern leopard frog are found within these wetlands. The Plains spadefoot is likely present on the eastern edge of the reservation. Common amphibians include tiger salamander.

(Figure 4: Saline Depressional Wetland near Browning, Blackfeet Reservation)

Fens

Fens occur infrequently throughout the Rocky Mountains, from Colorado to Montana, and become more common north into Canada. Fens are confined to specific environments defined by groundwater discharge, soil chemistry, and peat accumulation. Fens form at low points in the landscape or near slopes where groundwater intercepts the soil surface. Groundwater inflows maintain a fairly constant water level year-round, with water at or near the surface most of the time. The constant flow of water at the surface leads to the accumulation of peat.

Fens act as natural filters, cleaning ground and surface water. They maintain stream water quality through denitrification and phosphorus absorption. Thus, they are critical to water quality. Fens also act as sponges by absorbing heavy precipitation, then slowly releasing it downstream, minimizing erosion and recharging groundwater systems. Persistent groundwater and cold temperatures allow organic matter to accumulate, forming peat. Peat accumulates at the rate of 8 to 11 inches per 1000 years. Several fens of the Blackfeet reservation are known to have peat layers up to several feet deep. Thus, these important wetlands are a repository of 10,000 years of post-glacial history.

Fens are highly important storage and discharge areas to connected streams, wet meadows and marshes that occur at lower topographic positions within the same watershed. Due to their sensitivity to changes in water chemistry, groundwater discharge, fragile substrate, and high ecological and functional value to connected wetlands, fens must be identified and protected from disturbance. Fens are not easily restored and recover very slowly from the aforementioned changes. They require an adequate natural landscape buffer zone to maintain high levels of ecological function.

Within the Blackfeet reservation, fens are classified as poor, rich or extremely rich fens. Poor fens tend to have neutral to slightly acidic water chemistry, whereas rich and extremely rich fens are calcium and magnesium rich, with alkaline water chemistry. Poor fens tend to support mostly sedge dominated plant communities whereas extremely rich fens support high species diversity, including rare species that are adapted and restricted to calcareous water chemistry. Thus, due to unique water chemistry, fens support many bryophyte, plant, mollusk, insect and animal species, many of which are biologically rare, that are not found in other wetland types. Some of the extremely rich fens sampled on the Blackfeet Reservation contain up to 65 vascular plant species. The full extent of biodiversity contained within these wetlands on the Reservation has yet to inventoried and documented.

Fens of the Blackfeet Reservation have been known to be biologically and ecologically significant over 20 years (Lesica, 1990). The largest fen complex, the Flat Iron fen, was designated as a tribal conservation land trust, the first of its kind in the nation (Figure 5). This wetland complex and riparian areas downstream serve as an important travel corridor for wildlife between the reservation and Glacier National Park and contains several rare plant species. Fens are often frequented by grizzly bears during summer

months, as well as many other mammals and birds, several of which are biologically rare.

(Figure 6: The Flat Iron Fen Natural Reserve, Blackfeet Land Trust, Blackfeet Reservation. Photo by Alex Gladstone)

In very rare cases, fens can occur within prairie grasslands in the glaciated Northwestern Great Plains region. A biologically significant, extremely rich, spring-fed prairie fen within the Blackfeet Reservation was identified in 2009 by the Blackfeet Environmental Office and the Vegetation Ecologist of the Montana Natural Heritage Program. The owner, in collaboration with the Blackfeet Tribe, and NRCS, placed this special wetland into a conservation easement (Figure 6). Electrical conductivity from this fen is 1330 uS; nearly three times as high as the Nature Conservancy's Pine Butte Swamp Reserve, near Choteau, Montana (Lesica 2012).

Six rare vascular plant species have been identified from this wetland to date; including one species that is the only known location within the state of Montana (Lesica 2012). Four of the six rare species are ranked as S1 (extremely rare within the state), while the other two species are largely known only from Glacier National Park and the Blackfeet Reservation, and are ranked as S2 (MNHP 2012). A family of ferruginous hawks, a Species of Concern, was observed in this prairie fen during August of 2012. Swift fox have been sighted near this prairie fen during the summer of 2009.


(Figure 6: Extremely rich, rare, spring-fed prairie fen; Connelly Fen, Blackfeet Reservation)

Fens are considered to be highly sensitive wetlands, critical to water quality and are not wetlands that can be restored in a measurable period of time following impacts. Additional fens are present near the headwaters of drainages from Chief Mountain, Pike Lake area, Middle and South Fork of the Milk River, and Willow Creek. These areas need immediate conservation and protection.

Northern Rocky Mountain Subalpine to Montane Wet Meadow

These moderate-to-high-elevation systems are found throughout the Rocky Mountains and Intermountain regions, dominated by herbaceous species found on wetter sites with very low-velocity surface and subsurface flows. This system typically occurs in cold, moist basins, seeps and alluvial terraces of headwater streams or as a narrow strip adjacent to mountain lakes and ponds (Hansen et al., 1996). They are typically found on flat areas or gentle slopes, but may also occur on sub-irrigated sites with slopes up to 10 percent. In alpine regions, sites typically are small depressions located below late-melting snow patches or on snowbeds. The growing season may only last for one to two months. Soils of this system may be mineral or organic. In either case, soils show typical hydric soil characteristics, including high organic content and/or low chroma and redoximorphic features.

This system often occurs as a mosaic of several plant associations, often dominated by graminoids and a mixture of forbs. On the Blackfeet Reservation, some mesic to wet meadows support extensive stands of camas (*Camassia quamash*); an important cultural plant (Figure 7) and sweetgrass (*Hierochloe hirta*). Camas and sweetgrass stands tend to be found near the outer edge of wet meadows, whereas the wetter portion of the meadow supports vegetation dominated by sedges (*Carex* species),

rushes (*Juncus* species), and a variety of forbs. Forb cover can be high in wet meadows where there is frequent disturbance by digging by bears, and historically, by plant gathering, by indigenous peoples. The vegetation composition of wet meadows is variable depending on elevation.

At all elevations, wet meadows are important wildlife habitat and are frequented by grizzly bears, which feed on rodent and ungulate prey species, plant roots and leafy vegetation. Moisture for these wet meadow community types comes from groundwater, stream discharge, overland flow, overbank flow, and precipitation. Salinity and alkalinity are generally low due to the frequent flushing of moisture through the meadow. Depending on the slope, topography, hydrology, soils and substrate, intermittent, ephemeral, or permanent pools may be present. Standing water may be present during some or all of the growing season, with water tables typically remaining at or near the soil surface.

The wet meadows of the Blackfeet reservation support a wide variety of wildlife, waterfowl and other birds. Grizzly bears, black bears, moose, elk, deer, coyote, grey wolf, mountain lion and other species are frequently seen within wet meadows. Numerous bird Species of Concern, such as Clark's nutcracker, American bittern, black crown night heron, black-necked stilt, Great blue heron, ferruginous hawk, Great grey owl, black rosy finch, grey crowned rosy finch, peregrine falcon and La Conte's sparrow have been observed in the reservation wet meadows. Dozens of additional, more common species of water birds, songbirds and predatory birds occur within wet meadows on the Reservation; many of which nest and rear young, while the remainder use these areas during spring and fall migrations. Rare amphibians such as western toad and northern leopard frog are found within these wetlands.

(Figure 7: Wet meadow adjoining nearby marsh, Frog flats, East Glacier, Blackfeet Reservation)

Western North American Marsh

Natural marshes occur in and adjacent to ponds and prairie potholes, as fringes around lakes or oxbows, and along slow-flowing streams and rivers as riverine marshes. Water chemistry may include some alkaline or semi-alkaline sites, but the alkalinity is highly variable even within the same complex of wetlands. Marshes have distinctive soils that are typically mineral, but can also accumulate organic material. Soils have characteristics that result from long periods of anaerobic conditions – gleyed soils, high organic content, and redoximorphic features.

Wetland marshes are classified as either seasonal or semi-permanent based on the dominant vegetation found in the deepest portion of the wetland (Stewart and Kantrud 1972). Vegetation communities that occur in these marsh systems are indicative of their hydroperiod, where some basins dry to bare soil after seasonal flooding while others will have a variety of wetland types in a zoned pattern dependent on seasonal water table depths and salt concentrations. A central shallow marsh zone that is dominated by graminoids and sedges characterizes seasonal marshes, while semi-permanent wetlands that are continually inundated with water depths up to 2 m (6.5 feet) will have a deeper, central marsh zone (Figure 8).

(Figure 8: Frog Flats Marsh, East Glacier, Blackfeet Reservation)

Typically, riverine marshes subjected to unaltered, seasonal water flow and annual flooding are characterized by zonal vegetation determined by water depth. Riverine marshes can be influenced by beaver activity and human-caused influences that can change the structure and species richness of these plant communities. Beaver activity can increase species richness and diversify community structure by altering water flow, depth, and organic matter and sediment accumulation (Figure 9). Riverine marshes are frequently used as travel corridors and feeding areas for native mammals and birds; including grizzly bears.

(Figure 9: Riverine marsh developed by beaver activity, Middle Fork Milk River, Blackfeet Reservation)

The marshes of the Blackfeet reservation support a wide variety of wildlife, waterfowl and other birds. Grizzly bears, black bears, moose, elk, deer, coyote, grey wolf, mountain lion and other species are frequently seen within marshes. Numerous water bird Species of Concern, such as white pelican, loon, common tern, black tern, Forester's tern, American bittern, black crown night heron, black-necked stilt, Great blue heron, Clark's grebe, horned grebe, Franklin's gull, Trumpeter swan, white faced ibis, peregrine falcon and La Conte's sparrow have been observed in the reservation marshes. Dozens of additional, more common species of water birds, songbirds and predatory birds occur within marshes on the Reservation; many of which nest and rear young, while the remainder use these areas during spring and fall migrations.

Rare amphibians such as western toad and northern leopard frog are found within these wetlands. The Plains spadefoot is likely present on the eastern edge of the reservation. Common amphibians include tiger salamander, long toed salamander and western chorus frog.

Rocky Mountain Kettle Pond

Kettle ponds are very similar to glacial prairie potholes, however, they occur within mountain elevations and are surrounded by coniferous and aspen forests. Examples of kettle ponds occur on Looking Glass Ridge, near Spot Mountain boundary, Red Blanket Hill and other locations within the mountains and foothills of the Reservation. Kettle ponds are fluvioglacial landforms occurring as the result of blocks of ice calving from the front of a receding glacier and becoming partially to wholly buried by glacial outwash.

Kettle ponds can also occur in ridge shaped deposits of loose glacial till. Kettle ponds receive its water from precipitation, the groundwater table, or a combination of the two, or underground rivers and streams. Water depth is variable, supporting submergent and emergent wetland vegetation. Most examples on the Reservation are surrounded by coniferous or aspen forests (Figure 10).

(Figure 10: Kettle Pond, top right, surrounded by aspen forest and mesic meadow, Heart Butte Road, Blackfeet Reservation)

On the Blackfeet Reservation, black cottonwood (*Populus balsamnifera*), river birch (*Betula occidentalis*) and alder (*Alnus species*) can form significant cover adjacent to these ponds. The submergent and emergent communities within these ponds are variable. Along the drawdown margin, Northwest Territory sedge (*Carex utriculata*), water sedge (*Carex aquatilis*), Nebraska sedge (*Carex nebrascensis*) and common spikerush (*Eleocharis palustris*) are common. In deeper, open water, plant communities are often dominated by wapato (*Sagittaria latifolia*), pondweed (*Potamogeton* species and *Stuckenia pectinata*), mare's tail (*Hippuris vulgaris*) and water starwort (*Callitriche* species).

This wetland ecosystem system is important breeding, foraging and nesting habitat for migratory waterfowl, including wood ducks, as well as many other upland nesting songbird species. Black bears, coyote, grey wolf, moose, elk, deer and grizzly bears have been observed using these ponds on the reservation. Columbia spotted frog prefers these forested wetland habitats.

Rocky Mountain Wooded Vernal Pools

These wooded vernal pools are small shallow circum-neutral freshwater wetlands of glacial origin that partially or totally dry up as the growing season progresses. Vernal ponds usually fill with water over the fall, winter and early spring, but then at least partially dry up towards the end of the growing season. Depending on annual patterns of temperature and precipitation, the drying of the pond may be complete or partial by the fall. These sites are usually shallow and less than 1 m in depth, but can be as much as 2 m deep. The pool substrate is a poorly drained, often clayey layer with shallow organic sediments. The freshwater ponds have pH ranges from 6.2 to 7.8 with most measurements between 6.5 and 7.5, i.e., relatively neutral.

These ponds in Montana were thought to be isolated, but it has been shown that in high water years the ponds spill over, and there is an exchange of surface water between ponds. Wooded ponds have a ring of trees surrounding the ponds that provide shade and influence their hydrology. On the Blackfeet Reservation, these ponds can be surrounded by coniferous trees or aspen forests. Black cottonwood (*Populus balsamnifera*), river birch (*Betula occidentalis*) and alder (*Alnus species*) can form significant cover adjacent to these ponds. The submergent and emergent communities within these ponds are variable. Along the drawdown margin, Northwest Territory sedge (*Carex utriculata*), water sedge (*Carex aquatilis*), Nebraska sedge (*Carex nebrascensis*) and common spikerush (*Eleocharis palustris*) are common. In deeper, open water, plant communities are often dominated by wapato (*Sagittaria latifolia*), pondweed (*Potamogeton* species and *Stuckenia pectinata*), mare's tail (*Hippuris vulgaris*) and water starwort (*Callitriche* species).

This wetland ecosystem system is important breeding, foraging and nesting habitat for migratory waterfowl, including wood ducks, as well as many other upland nesting songbird species. Black bears, coyote, grey wolf, moose, elk, deer and grizzly bears have been observed using these ponds on the reservation. Columbia spotted frog prefers these forested wetland habitats.

Rocky Mountain Alpine to Montane Springs

These highly localized ecosystems that include alpine wet cliff faces and narrow chutes below mountain summits with perennial water sources (seeps and groundwater fed springs) forming small, pocketed wetlands. They occur on steep slopes ranging from 55% to overhanging cliffs (angle >90 degrees). Alpine springs, seeps and wet cliffs are hydrologically supported by groundwater discharge, from permanent snowfields or glaciers (Figure 14). They are typically isolated from other wetland systems because they usually flow a short distance before infiltrating back into the ground. However, spring heads on steep slopes represent headwater location for several perennial streams, as well as those that are intermittent, where groundwater flows underground for short distances and re-surfaces on steep to moderately steep slopes and hills. Air temperatures are cooler and humidity levels are higher than the surrounding environment. They tend to occur at all exposures of alpine to mountain elevation cliff

faces, walls or narrow chutes below mountain summits and can occur at all aspects. They are usually shaded for at least part of the day.

Alpine springs are frequently hot spots of plant diversity, providing habitats for uncommon, endemic or peripheral subalpine to alpine wetland species that do not occur in other wetland systems. Moss cover is usually high around spring heads. Plants in the Saxifragaceae are commonly found associated with springs at all elevations (Figure 11). The floristic inventory of the reservation's springs at all elevations has yet to be inventoried and documented.

(Figure 11: Example of alpine spring, near Siyeh Pass, Glacier National Park)

Soil development is minimal on wet cliffs, however organic matter accumulates in cracks, crevices and rock ledges. On mountain and hillside terraces, there can be a deeper peat layer. Alterations in hydrology will directly impact this ecosystem and the species that occur within it.

Montane elevational springs are important sources of drinking water to many rural residents in and around the reservation. Several mountain spring heads originate off Looking Glass Hill and Ridge that serve as a local drinking water supply. Spring water ecosystems are tied to climate, groundwater discharge, and water quality. Impacts to these parameters, as well as their natural variability, will have a corresponding effect on

spring dependent or spring dependent biota. Springs are also found at lower elevations of the Reservation and at least one spring cluster feed a unique spring- fed prairie fen wetland. These lower elevational springs on the Great Plains are associated with ancient glacial lakes that formed when the Saint Mary and Two Medicine Glacier began receding and melting during the late Pleistocene. Springs, whether they are located at high or lower elevations, represent the headwater source of groundwater discharge of the reservation's riparian and wetland systems. Long-term drought, groundwater withdrawal at local and regional levels, and local diversions at or near the orifice are common impacts on water quantity at spring sites throughout the Western United States.

Northern Rocky Mountain Alpine to Subalpine Riparian System

Alpine to subalpine riparian systems represent headwaters of streams near or at groundwater and snow fed spring heads. This system occurs at high elevations above and near treeline in the mountains, at the head of wide, glaciated valleys on snowmelt-fed swales (Figure 15), as well as in narrow valleys with sinuous streams and wet floodplains associated with beaver ponds. This system is confined to narrow riparian zones along upper reaches of streams to elongated openings in higher elevation forests and shrublands. Microtopography is usually hummocky to undulating. Slopes range from 2-4 percent. Soils are wet to saturated at the surface by flowing groundwater for most or all of the growing season. Soils are poorly to very poorly drained due to accumulation of organic material.

Vegetation is classified as seasonally or permanently flooded cold-deciduous shrublands that are dominated by dwarf, subalpine willow (*Salix)* species. This plant community is largely confined to these higher elevations and cold, thin, peat-based soils that remain highly oxygenated due to continuous runoff. This riparian system grades into forested or woodland riparian system dominated by coniferous species below treeline. Examples of this system occur near Chief Mountain, Sherburne Peak and Divide mountains, as well as within the higher elevations of Glacier National Park and Badger Two Medicine Wilderness area.

Vegetation in these high elevation riparian areas contains dwarf willow shrub communities, which often form dense cover over the streams and embankments. At the highest elevations on the Reservation, these willow communities include undergreen willow (*Salix commutata*), plane leaf willow (*Salix planifolia*), and short fruited willow (*Salix brachycarpa*). The understory and associated herbaceous layer contains a mixture of subalpine to alpine sedges, grasses and forbs. These high elevation riparian systems are important to mountain wildlife such as grizzly bears, black bears, wolverines, deer, elk, mountain lions, fisher, Rocky Mountain goats, Rocky Mountain sheep as well as pika, marmots and many other smaller rodents, raptors and birds.

Northern Rocky Mountain Lower Montane to Subalpine Riparian System

This riparian woodland and forested ecosystem is comprised of seasonally flooded forests and woodlands found at montane to subalpine elevations on the western edge of the Blackfeet Reservation, within headwaters originating on the reservation boundary at

Chief Mountain and Sherburne Peak, as well as within the boundaries of Glacier National Park and the Badger-Two Medicine Wilderness area of the Lewis and Clark National Forest. This habitat is defined as narrow streamside forests that line small confined low-order mountain streams and are typically dominated by coniferous tree species (Figure 12). This system is common to the floodplains and terraces of confined V-shaped, narrow valleys and canyons, and less frequently, it occurs in moderate-wide valley bottoms on large floodplains along broad, meandering rivers, and on pond or lake margins. Ground water seepage from snowmelt may create shallow water tables or seeps that vegetation depends on for a portion of the growing season.

Dominant tree species vary across the latitudinal and elevation range. On the Blackfeet Reservation, these riparian areas are typically dominated by subalpine fir (*Abies lasiocarpa*), white spruce (*Picea glauca*) and Engelmann spruce (*Picea engelmannii*), at higher elevations and moister sites, and Douglas-fir (*Pseudotsuga menziesi*) at slightly lower elevations. Some sites support scattered black cottonwood (*Populus balsamnifera*) and/or small stands of aspen (*Populus tremuloides*). In the transitional foothills, this riparian system is often bordered by mature, boreal Great Plains aspen parkland. The understory in this riparian system, along the banks and on gravel bars, contain willow (*Salix* spp.), alder (*Alnus* spp.) and red-osier dogwood (*Cornus sericea*), which contribute to structural diversity and are highly favored wildlife habitat to mammals and birds. Shading created by tree and shrub layers, moderate stream temperatures, are important to native fisheries and provide habitat to amphibians.

Riparian conifer and aspen types like this system contribute to animal and plant diversity because they tend to have a more diverse forest structure than adjacent upland forest habitats, and often contain important cultural food plant species, such as serviceberry *(Amelanchier alnifolia*), chokecherry (*Prunus virgininana*), and medicinal species such as Dawson's angelica (*Angelica dawsonii*), which is only found on the Blackfeet Reservation in subalpine meadows and riparian areas in the Chief Mountain area. Elsewhere, this highly important Blackfeet plant is found only in similar habitats in the northern Rocky Mountains of Montana and adjacent, extreme southwestern Alberta. Other plants valued by Blackfeet traditions are found in this habitat.

Stochastic flood events and variable fluvial conditions are crucial to the development of establishment sites for riparian plants, and exert a primary control on plant succession. In areas with steep gradients, high-energy flows precipitated by snowmelt, rain-on-snow events or convective thunderstorms lead to floods, which in turn scour and transport coarse sediments. The scouring out and downstream accumulation constantly creates and destroys sites for the establishment of vegetation. Gravel bars are created at or near the surface of the river, where vegetation colonizes. As the gravel and point bars extend, mixed vegetation bands grow up, representing different stages of succession. The vegetation traps even more sediment, so that over time the size and height of the gravel bar increases. As gravel bar height increases, backwater channels can establish. These channels hold early runoff for an extended time, and are also fed by ground water seepage. Further from the channel, groundwater recharge from snowmelt may create shallow water tables or seeps that support vegetation when stream flow is low.

(Figure 12: Saint Mary River between Upper and Lower Saint Mary Lake, Blackfeet Reservation; photographer unknown)

Rocky Mountain Subalpine to Montane Riparian Shrubland

This riparian system is a seasonally flooded shrubland found at montane to subalpine elevations of the Rocky Mountains. Shrubs dominate this system, with total shrub cover ranging from 20 to 100 percent (Figure 13). It occurs as linear bands of shrub vegetation lining streambanks and alluvial terraces in narrow to wide, low-gradient valley bottoms and floodplains with sinuous stream channels. Flooding creates and destroys sites for the establishment of vegetation through the transport and accumulation of coarse sediment . Sediment accumulating in these systems can form gravel bars at or near the surface of the river, creating bands of mixed vegetation that occupy different stages of succession Ground water seepage from snowmelt may create shallow water tables or seeps that vegetation depends on for a portion of the growing season.

This system often occurs as a mosaic of multiple communities that are shrub and herb dominated. The structure of vegetative communities in these systems can vary depending on latitude, elevation and climate. In Montana, these systems are dominated by willows, including Drummond's willow (*Salix drummondiana*), Bebb's willow (*Salix bebbiana*), planeleaf willow (*Salix planifolia* ssp. *planifolia*), undergreen willow (*Salix commutata*), booth willow (*Salix boothi*) and Geyer's willow (*Salix geyeriana*). Typical herbaceous vegetation found in the understory includes beaked sedge (*Carex utriculata*), bluejoint reedgrass (*Calamagrostis canadensis*), and northern reedgrass (*Calamagrostis stricta*).

This riparian ecosystem, is important habitat to moose, as well as other native ungulates and serves as a travel and feeding corridor to black and grizzly bears. Generally, the upland vegetation surrounding these riparian systems are coniferous or aspen forests. Shrubland riparian systems are highly important for bank stabilization, organic inputs to the adjacent stream, shade cover and wildlife habitat values. They also are traditional plant gathering areas for species such as willow, cottonwood, wild mint (*Mentha arvensis*), sweetgrass (*Hierochloe hirta*) and many other Blackfeet cultural significant plant species. Undisturbed examples are highly important as reference for riparian restoration because undisturbed examples are rare elsewhere in the state of Montana.

(Figure 13: Subalpine to Montane Riparian Shrubland and Forest, Two Medicine River, Blackfeet Reservation)

Northwestern Great Plains Riparian System

This system is associated with perennial to intermittent or ephemeral streams throughout the northwestern Great Plains. On the Blackfeet Reservation, this system occurs along smaller tributaries of the Missouri River, as well as tributaries to the large floodplain rivers that feed them (Figure 13). It is well represented in areas on the western edge of the Reservation. This system is found on alluvial soils in highly variable landscape settings, from confined, deep cut ravines to wide, braided streambeds. Channel migration occurs in less-confined areas, but within a more narrow range than would occur in broad, alluvial floodplains.

The primary inputs of water to these systems include groundwater discharge, overland flow, and subsurface interflow from the adjacent upland. In the Northwestern Great

Plains, the water source is primarily local precipitation and groundwater inflow; in systems receiving flow from mountain ranges, snowmelt and summer thunderstorms provide a significant portion of flows. The boundaries of these riparian areas extend beyond the limits of flooding into streamside vegetation. They are important links between terrestrial and aquatic ecosystems, acting as ecotones between upland and wetland, connecting ecological processes and plant communities.

Fluvial processes play a key role in the dynamics of Northwestern Great Plains streams. The nature of these processes is often indicated by channel morphology. Meandering channels generally have a shallow gradient, low flow variability, and sediment loads dominated by silt and finer particles, while braided channels are characterized by a steep gradient, high flow variability, and a sediment load dominated by sand and coarser particles. Flooding is the key ecosystem process. It creates suitable sites for seed germination and seedling establishment, and controls vegetation succession.

Communities within this system range from riparian forests and shrublands to wet meadows and gravel/sand flats. Dominant species are similar to those found in the Northwestern Great Plains Floodplain System. Vegetation may be a mosaic of communities that are not always tree or shrub dominated. At lower elevations, forested communities may form galleries dominated by black cottonwood (*Populus balsamifera ssp. trichocarpa*). This species tends to be prevalent at higher elevations and near the Rocky Mountain Front.

Great Plains Riparian Floodplain System

These are the big perennial rivers of the reservation (Figure 14), with hydrologic dynamics largely driven by large amounts of snowmelt and rainfall originating in their headwater watersheds, rather than local precipitation events. In the undisturbed state, periodic flooding of the fluvial and alluvial soils and channel migration create depressions and backwaters that support a mosaic of wetland and riparian vegetation, whose composition and structure is sustained, altered and redistributed by hydrology.

The overstory dominant species is black cottonwood (*Populus balsamifera ssp. trichocarpa*) with narrowleaf cottonwood *(Populus angustifolia)* and eastern cottonwood (*Populus deltoides)* occurring as co-dominants in the riparian/floodplain interface near edge of the Reservation. In relatively undisturbed stands, willow (*Salix* species), red-osier dogwood (*Cornus sericea*), and common chokecherry (*Prunus virginiana*) form a thick, multi-layered shrub understory, with a mixture of cool and warm season graminoid species below. These shrub species are important Blackfeet cultural plants.


(Figure 14: Cottonwood forests along Great Plains Riparian Floodplain, Two Medicine River, Blackfeet Reservation)

Cottonwoods and willows are the dominant tree species in the Northwestern Great Plains Floodplain Systems, creating a highly productive and important habitat type for birds, mammals and fish. This system is specifically adapted to infrequent large flooding events that promote dispersion and colonization of newly formed alluvial bars. Along the Two Medicine, Milk and Saint Mary rivers, the cottonwood gallery forests are important to the water quality, provide habitat for plains animals, birds, fish and serve as travel corridors for many other species, including grizzly bears. These cottonwood forests are in better ecological condition than in most other areas of the state because of the lack of development in the adjacent buffer and lack of the invasive tree species, Russian olive (*Elaeagnus angustifolia*) (Vance 2012). The understory structural diversity remains high, which supports numerous bird and animal species; including several Species of Concern. Shade and downed logs and debris provide fish habitat.

This ecosystem type is incredibly important for attenuating floodwater surface velocity and flow. These Great Plains riparian forests are endangered throughout the Great Plains region, due to development, invasive species and dams further downstream. Thus, the cottonwood forests of the Blackfeet reservation are a highly significant ecological resource that provides critical riparian functions, wildlife habitat and corridors, as well as important native fish habitat.

Elsewhere in Montana, Northwestern Great Plains floodplain systems have been substantially impacted by the development of both groundwater and surface water for

irrigation, isolating rivers from their adjacent floodplains. Unless water management can restore periodic flooding, floodplains and riparian areas may become dominated by late-seral communities, and nutrient cycles may be disrupted without floodwaters depositing organic material. Aggressive non-native Russian olive (*Elaeagnus angustifolia*) has drastically altered ecological processes. This species replaces native cottonwood and willow stands where natural flow regimes have been altered. It is especially problematic along the Milk and Marias rivers just to the east of the Blackfeet Reservation, and as well as other major river systems throughout the state.

Greasewood Flats

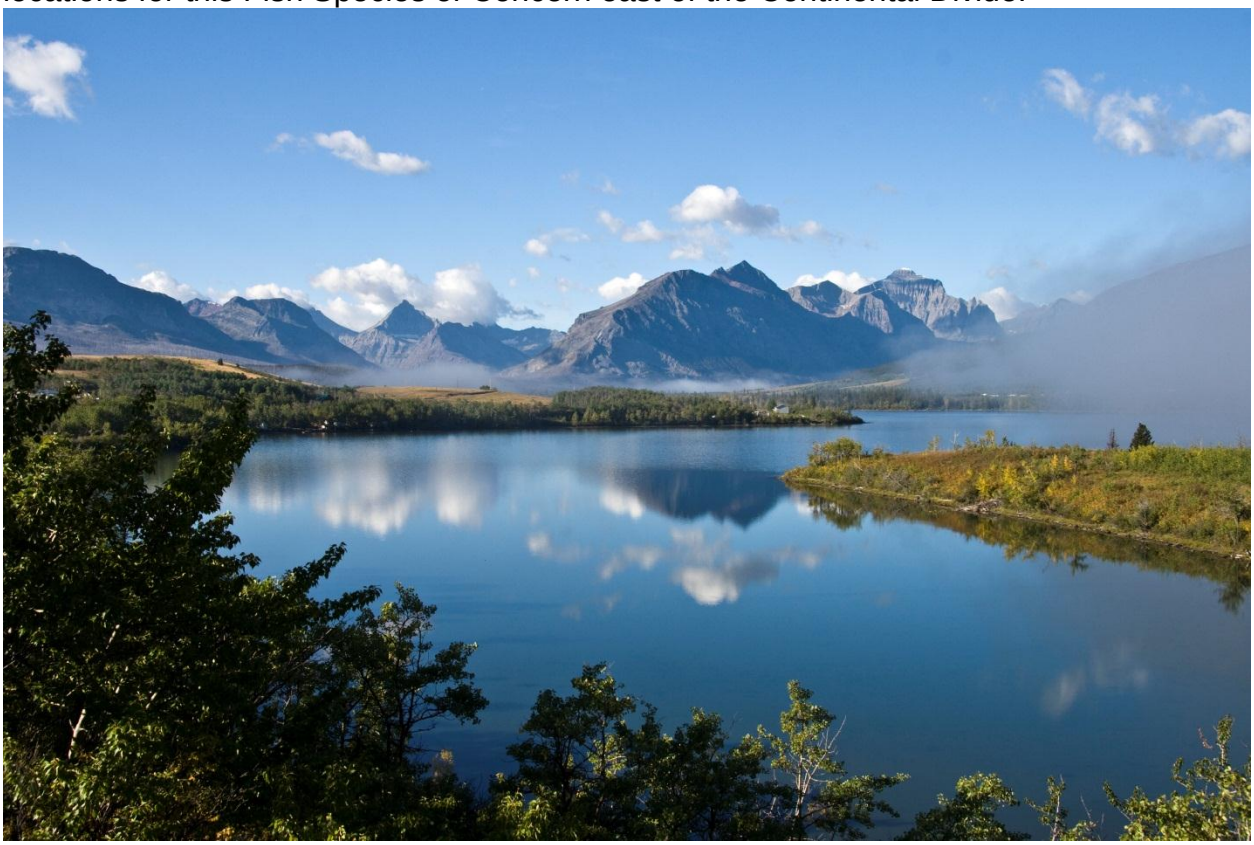
The Greasewood Flats ecosystem occurs on nearly level, older alluvial terraces on broad or narrow floodplains (Figure 16). It may also occur on broad expanses along lake shores and depressional wetland complexes. Soils are saline or alkaline underlying a shallow water table. Flooding occurs intermittently; however, this ecological system remains dry during most of the year and during most growing seasons. The water table remains high enough to maintain vegetation, despite salt accumulations. Greasewood Flats occur where overland water flow or soils or a combination of both allow for greater than normal moisture regime. High water tables are common, typically within 25-30 cm (10-12 inches) of the soil surface. Soils are very fine textured, poorly drained alkaline or saline clays or silts. This ecosystem represents the driest extreme of classified wetland ecosystem types. During some years or unusual precipitation or flooding events, this ecosystem can have surface water present for up to 2 months or longer due to the fine, poorly drained soils. Greasewood flat ecosystems are found in the central and eastern portions of the Reservation on relatively level topography associated with creeks and floodplains. Greasewood (*Sarcobatus vermiculatus*) is the dominant shrub in this wetland system. Other species that are present include saltbush (*Atriplex* species), silver sage (*Artemisia cana*), rabbitbrush (*Chrysothamnus* and *Ericameria* species), old man sage (*Artemisia ludoviciana*), woman's sage (*Artemisia frigida*) and winterfat (*Krascheninnikovia lanata*).

Lakes

Lake ecosystems are prime examples of lentic ecosystems (Figure 15). The general distinction between pools/ponds and lakes is vague, generally, ponds and pools have their entire bottom surfaces exposed to light, while lakes do not. In addition, some lakes become seasonally stratified. Ponds and pools have two regions: the pelagic open water zone, and the benthic zone, which comprises the bottom and shore regions. Since lakes have deep bottom regions not exposed to light, these systems have an additional zone, the profundal. These three areas can have very different abiotic conditions and, hence, host species that are specifically adapted to live there. Ice-formed lakes are created when glaciers recede, leaving behind large depressions in the landscape shape that are then filled with water. Oxbow lakes are fluvial in origin, resulting when a meandering river bend is pinched off from the main channel.

Lake ecology is highly complex and the result of interplay between abiotic factors such as dissolved oxygen, water depth, water chemistry, temperature and biotic factors that

form intricate food webs. The Blackfeet Reservation contains dozens of large lakes that provide year-round fishing tourism income. Reservation lakes such as Lower Saint Mary and Duck Lake are important habitat for species such as bull trout, and are the only locations for this Fish Species of Concern east of the Continental Divide.



(Figure 15: Lower Saint Mary Lake, Blackfeet Indian Reservation. Photographer unknown)

Upland Ecosystems of the Blackfeet Reservation

FORESTS AND SHRUBLANDS

The forests of the Blackfeet Reservation form a critically important link along the western third of the Reservation, to the ecosystems of Glacier National Park and the Badger Two Medicine Wilderness area within the Lewis and Clark National Forest. Unlike any other area within the state of Montana, a significant portion of the Reservation's forest cover is comprised of deciduous forest. Significantly, this is the largest, most intact example of this forest ecosystem type within the state and southern Canada.

The coniferous forests types of the Reservation reflect a largely dry, cold, Continental climate. Recent fire history includes two large fire events during 2006 and 2007. The Red Eagle Fire of 2006 was started by humans in Glacier National Park on July 29, 2006 and burned a significant proportion of the Divide Mountain watershed's forests.

The 2007 fire event started in the Lewis and Clark National Forest and burned major portions of the South Fork of the Two Medicine River watershed's forests. Recent drought, fire severity, and large insect outbreaks, have contributed to major, recent changes to the Reservation's coniferous forest resources.

Northwestern Great Plains Boreal Aspen Parkland

This system ranges from the North Dakota/Manitoba border west to central Alberta and is considered part of the boreal-mixed grass prairie grassland transition region. This aspen forest system is the southernmost extension of the Canadian boreal aspen parkland and borders the Rocky Mountain Front in northwestern portion of the state on the Blackfoot Reservation (Figure 16). It occurs in the foothills and extends out into the extreme western edge of the northwestern Great Plains. Much of this region is covered with undulating to kettled glacial till. The climate in this region is subjected to long severe winters, high winds, and warm, dry summers. High winds characterize the shape and height of the aspen stands, which are characteristic and distinct from other aspen stands in the state of Montana. Because most of this ecosystem (90%) has been converted to farmland and rangeland within southern Canada, the size, extent, and good to excellent ecological condition of this forest type on the Blackfeet Reservation, is a highly significant cultural, biological and ecological resource.

(Figure 16: Northwestern Great Plains Boreal Aspen Parkland, Lake Creek Drainage, Blackfeet Reservation. Photo by Steven Gnam)

Aspen (*Populus tremuloides*) dominates this system. The most common overstory associate is black cottonwood (*Populus balsamifera)* with an understory of mixed grass species and shrubs. Occurrences in good to excellent condition have very high forb diversity. More poorly drained sites may contain willow (*Salix* species), red stem dogwood (*Cornus sericea*) and sedges (*Carex* species). Fire constitutes the most important dynamic in this system and prevents boreal conifer species such as white spruce (*Picea glauca),* lodgepole pine (*Pinus contorta*) and Douglas-fir (*Pseudotsuga menziesii)* from becoming too established in this forest ecosystem. Common shrubs include Rocky Mountain maple (*Acer glabrum*), serviceberry (*Amelanchier alnifolia*), creeping Oregon grape (*Mahonia repens*), chokecherry (*Prunus virginiana*), Woods rose (*Rosa woodsii*), and Canadian buffaloberry (*Shepherida canadensis*), birch-leaf spiraea (*Spiraea betulifolia*), upland mountain willow (*Salix scouleriana*), and snowberry (*Symphoricarpos* species).

The understory is typically forb rich, often supporting up to 70 species in occurrences in good to excellent condition (Cooper and Heidel, 1997). Common understory forbs include yarrow (*Achillea millefolium)*, mountain Indian paintbrush (*Castilleja miniata*), arnica (*Arnica* species), Engelmann aster (*Eucephalus engelmannii*), larkspur *(Delphinium* species), aspen daisy (*Erigeron speciosus*,), silky lupine (*Lupinus sericeus*), cream pea (*Lathyrus ochroleucus*), yampah (*Perideridia gairdnerii*), nine leaf biscuitroot (*Lomatium triternatum*), stinging nettle (*Urtica dioica*) and western valerian (*Valeriana occidentalis*) and many-flowered stickseed (*Hackelia floribunda*). Common fireweed (*Chamerion angustifolium*) becomes more common in disturbed stands.

Mesic occurrences support other species such as glacier lily (*Erthyronium grandiflorum*), Richardson's geranium (*Geranium richardsonii*), common cow parsnip (*Heracleum maximum*), sharptooth angelica (*Angelia arguta*), western sweet cicely (*Osmorhiza occidentalis*), baneberry (*Actaea rubra*), streambank groundsel (*Senecio pseudoaureus*), green false hellebore (*Veratrum viride*), Canadian violet (*Viola canadensis*), fairybells (*Disporum hookeri*), feathery solomon's seal (*Mainthemum racemosa*), western meadow rue (*Thalictrum occidentale*), and large leaved avens (*Geum macrophyllum*). Ferns and scouring rush (*Equisetum* species) are common. Many of these species are Blackfeet cultural plants used for food, medicine and utilitarian and traditional games purposes. Sweetroot (*Osmorhiza occidentalis*) is largely confined to this ecosystem on the Blackfeet Reservation; and constitutes the *Populus tremuliodes/ Osmorhiza occidentalis* community type common around the East Glacier area (Cooper and Heidel 1997)(Figure 17).

This ecosystem type contains more cultural plants than any other upland habitat. Blackfeet cultural plants found in aspen parkland include sweetroot (*Osmorhiza occidentalis)*, wild strawberry (*Fragaria virginiana)*, false hellebore (*Veratrum viride),* violet (*Viola species),* horsetail (*Equisetum species),* western valerian *(Valeriana occidentalis),* larkspur (*Delphinium bicolor),* wild mint *(Mentha arvensis),* redoiser dogwood *(Cornus sericea),* prairie windflower (*Anemone multifida),* American licorice (*Glycyrrhiza lepidota),* penstemon (*Penstemon species),* yampah (*Perideridia gairdnerii),* wild onion (*Allium species),* rose (*Rosa species),* willow *(Salix species),*

fleabane (*Erigeron philadelphicus*), creeping Oregon grape (*Mahonia repens),* Indian paintbrush (*Castilleja species),* arrowleaf balsamroot (*Balsamhorhiza sagittata*), common juniper (*Juniperus communis*), prairie crocus (*Pulsatilla patens),* alumroot (*Huechera cylindrica*), prairie smoke (*Geum triflorum),* willowleaf dock (*Rumex salicifolius*), subalpine fir (*Abies lasiocarpa),* stoneseed (*Lithospermum ruderale),* Indian blanketflower (*Gaillarida aristata),* baneberry (*Actaea rubra),* sticky geranium (*Geranium viscosissimum),* horsemint (*Mondara fistulosa),* wintergreen (*Pyrola species),* fireweed *(Chamerian angustifolium),* western meadow rue (*Thalictrum occidentale), crazyweed (Oxtropis species),*selfheal (*Prunella vulgaris),*yarrow (*Achillea millefolium),* twisted stalk *(Disporum trachycaulum),* shooting star (*Dodecatheon pulchellum),* camas (*Camassia quamash),* gooseberry *(Ribes species),* black cottonwood (*Populus balsamnifera),* beargrass (*Xerophyllum tenax),* goldenrod (*Solidago species),* man's sage (*Artemisia ludoviciana*), black twinberry (*Lonicera involucrata),* nineleaf biscuitroot (*Lomatium triternatum),* sacred turnip (*Lomatium dissectum),* white flowered biscuitroot (*Lomatium macrocarpum),*selaginella (*Selaginella densa),* kinnickinick (*Arctostaphylos uva-ursi), prairie buckwheat (Eriogonum umbellatum),* thimbleberry (*Rubus parviflorus),* shrubby cinquefoil (*Dasiphora fruticosa*), Canada milkvetch (*Astragulus canadensis),* elk thistle *(Cirsium undulatum*), musineon (*Musineon divaricatum),* sulfur buckwheat (*Eriogonum flavum),* thinleaf alder (*Alnus incana),* river birch (*Betula occidentalis),* lodgepole pine *(Pinus contorta*), creeping juniper (*Juniperus horizontalis),* buffalo bean (*Thermopsis rhombifolia),* silky lupine (*Lupinus sericeus),* Rocky Mountain maple (*Acer glabrum),* pineapple weed (*Matricaria discoidea),* Douglas-fir (*Pseudotsuga menziesii),* western clematis (*Clematis occidentalis*), edible valerian (*Valeriana edulis),* sitka valerian (*Valeriana sitchensis*), and aspen (*Populus tremuloides)* (McClintock 1910; Hellson and Gadd 1974; Johnston 1987; Moerman 1998; Barney and Peacock 2001).

(Figure 17: *Populus tremuliodes/Osmorhiza occidentalis* (sweetroot) community type, near East Glacier Park, Blackfeet Reservation)

The Northwestern Great Plains Boreal Aspen parkland of the Blackfeet Reservation is critically important wildlife habitat for numerous species of mammals and birds. Grizzly and black bears use this ecosystem during spring months, summer and fall months for feeding, cover, and rearing of young. Many key forage species for bears (*Osmorhiza occidentalis, Heracleum maximum, Erythronium grandiflorum, Claytonia parviflora, Angelica arguta, Amelanchier alnifolia, Prunus virginiana*, among others), occur in abundance within these aspen forests. Lynx, mountain lions, wolves, fishers, pine marten, wolverine, coyote, elk, moose and deer, as well as snowshoe hare, chipmunks, tree and ground squirrels are found in these aspen parklands. Bird Species of Concern include great grey owls, northern hawk owl, flammulated owl, northern goshawk, peregrine falcon, bald and golden eagles, boreal chickadee, veery, evening grosbeak, brown creeper, Cassin's finch, Lewis woodpecker, pileated woodpecker and black backed woodpecker. Dozens of more common species of neotropical migratory songbirds this habitat for nesting and rearing of young, as well as more common species of owls, raptors and other birds. Year-round residents include ruffed grouse, chickadees, pine siskins, nuthatches and owls such as pygmy owl,

Wetlands are very common within aspen parklands, including lakes, riparian zones, marshes, wooded kettle ponds and vernal pools. These wetlands attract additional bird species, shore birds and waterfowl as well as containing invertebrate and amphibian Species of Concern such as the western toad. Glacial erosion has contributed to such features by creating depressions in which standing water can collect. In the larger depressions, permanent lakes or ponds of water remain.

Aspen parkland is important and threatened habitat in central and southern Alberta. In Canada, it is estimated that less than 10 percent of the natural habitat in this region remains intact. Of the 90 percent disturbed, most has been converted to agricultural cropland (WWF 2012). In those parts of the southern Alberta where aspen parkland cover was historically more widespread, forest harvesting continues in the remaining farm woodlots. Mortality due to biotic vectors is furthering the rapid disappearance of this ecosystem in central and southern Alberta (Hogg et al 2002). Consequently, the Blackfeet aspen parkland remains the best condition, intact expanse of this threatened forest type in North America. Its ecological, cultural and biological diversity and significance cannot be over-emphasized (Figure 18).


(Figure 18: Northwestern Great Plains Boreal Aspen Parkland, Blackfeet Reservation).

Rocky Mountain Montane Douglas-Fir Forest and Woodland

In Montana, this Douglas-fir (*Pseudtotsuga menziesii*) forest ecosystem system occurs east side of the Continental Divide. This forest system is associated with a dry to submesic Continental climate regime with annual precipitation ranging from 20 to 40 inches, with a maximum in winter or late spring. Winter snowpacks typically melt off in early spring at lower elevations. Elevations range from valley bottoms to 6,000 feet in northern Montana. It occurs on north facing aspects and south facing aspects. On the Blackfeet Reservation, it forms open transitional woodland within fescue grasslands in the Duck Lake area

This forest ecosystem experiences up to 500 year fire disturbance interval. Locally, in the Two Medicine Valley on the Boundary of Glacier National Park and the Blackfeet Reservation, are stands of Douglas-fir that exceed 1,500 years in age. They occur on steep, south facing slope on Spot Mountain (Pederson 2004) (Figure 19). Individual trees within these forests can attain great age (839-1,000+ years) (Pederson 2004; 2012). Individual trees on Two Medicine Ridge near Looking Glass Road, as well as near Mad Wolf Mountain and near Chief Mountain may well be as old as sampled trees on Spot Mountain.

(Figure 19: 839-1,000 year old *Pseudotsuga menziesii* (Douglas-fir) on Spot Mountain, Glacier National Park near Reservation boundary. Photo courtesy of Greg Pederson, USGS)

Typically, these forests occur from lower montane to lower subalpine environments and are prevalent on calcareous substrates. The *Pseudotsuga/ Calamogrostis rubescens* type is the most ubiquitous association found in this system in Montana. The *Pseudotsuga/Arctostaphylos uva-ursi* sommunity type is common on the coldest, driest sites on the reservation. Spruce (*Picea engelmannii or Picea glauca)* can occur in some stands within the upper montane zone. Some individuals of western larch (*Larix occidentalis*) can be found in some stands in the Two Medicine area. It can intergrade with whitebark pine (*Pinus albicaulis*) forests in the lower reaches of the subalpine zone on the western reservation boundary and often borders aspen parkland (Figure 20).

Understory shrubs also include common juniper (*Juniperus communis*), birchleaf spiraea (*Spiraea betulifolia),* common snowberry (*Symphoricarpos albus)*, and creeping Oregon grape (*Mahonia repens).* Dwarf huckleberry (*Vaccinium caespitosum)* and tall huckleberry (V*accinium membranaceum)* are found on colder, mesic sites. Canadian buffaloberry (*Shepherdia canadensis)* is an indicator shrub of this forest type. Dry and cold Douglas-fir forests often contain kinnickinnick (*Arctostaphylos uva-ursi*) as the dominant in the understory; an important Blackfeet cultural plant.

Common graminoids include pinegrass (*Calamagrostis rubescens)* and Ross sedge *(Carex rossii).* Bluebunch wheatgrass (*Pseudoroegneria spicata*) is often common on some sites adjacent to upper elevation subalpine to montane grasslands. Common

forbs include yarrow (*Achillea millefolium)*, lanceleaf arnica (*Arnica latifolia)*, pussytoes (*Antennaria racemosa)*, wild strawberry (*Fragaria virginiana)*, twinflower (*Linnaea borealis)*, and beargrass (*Xerophyllum tenax)*. On mesic sites, saprophytic species such as coralroot orchids (*Corallorhiza* species) and pinedrops (*Pterospora andromedea)* are sometimes found in the understory. Other orchid species such as northern fairyslipper (*Calypso bulbosa)* and twayblade (*Listera* species) can also occur in cold, sub-mesic sites.

(Figure 20: Douglas-fir forest belt bordering aspen parkland, Blackfeet Reservation)

Douglas-fir forests are widely used by both common and Species of Concern such as grizzly and black bears, lynx, mountain lions, wolves, fishers, pine marten, wolverine, coyote, elk, moose and deer, as well as chipmunks, tree and ground squirrels. Bird Species of Concern include great grey owls, northern hawk owl, flammulated owl, northern goshawk, peregrine falcon, boreal chickadee, veery, evening grosbeak, varied thrush, brown creeper, Cassin's finch, Clark's nutcracker, Lewis woodpecker, pileated woodpecker and black backed woodpecker.

Northern Rocky Mountain Mesic Spruce-Subalpine Fir Forest

Spruce (*Picea engelmannii or Picea glauca)* and subalpine fir (*Abies lasiocarpa)* forests comprise a substantial part of the montane and lower subalpine forests of the Montana Rocky Mountains. Spruce associated with subalpine fir occurs as either a climax co-dominant or as a persistent, long-lived seral species in most upper elevation habitat

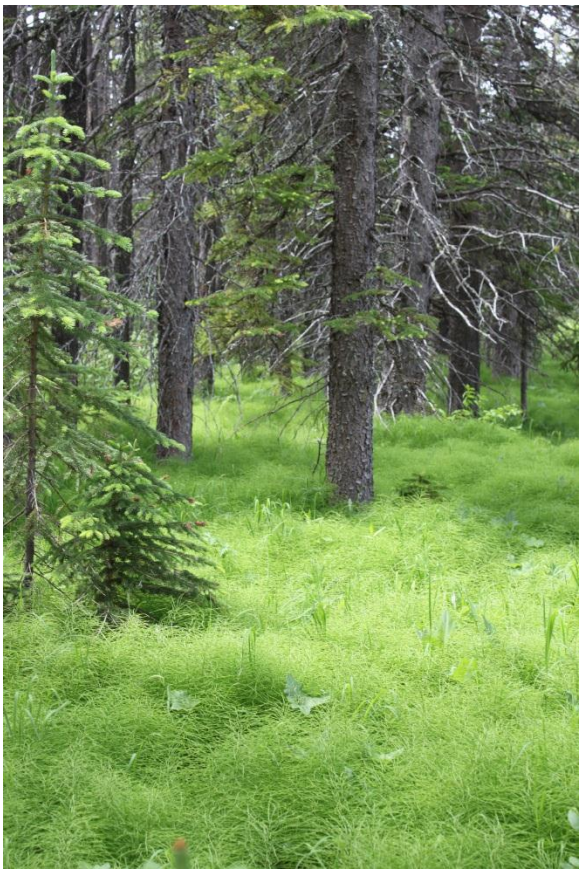
types. These forest can be dry in some expressions or mesic to wet where they occur associated with forested wetlands and riparian areas. These forests range from 5,200 to 6,500 feet east of the Continental Divide. They represent the montane and lower elevation range of subalpine forests in an area. These forests are found on gentle to very steep mountain slopes, high-elevation ridgetops and upper slopes, plateau-like surfaces, basins, alluvial terraces, well-drained benches, and inactive stream terraces.

Tree canopy characteristics are relatively uniform, with *Picea* and *Abies* dominating either mixed or alone. On the Blackfeet Reservation, Englemann spruce (*Picea engelmannii)* hybridizes with its boreal counterpart, white spruce (*Picea glauca)*. *Picea* is more tolerant of extreme environmental conditions than *Abies*, and is usually more dominant in the drier and wettest habitats within this system.

The understory often support diverse stands of Blackfeet cultural plants that bear fruit such as dwarf huckleberry (*Vaccinium caespitosum*), tall huckleberry (*Vaccinium membranaceum*) and grouse whortleberry (*Vaccinium scoparium).* Other shrubs include service berry (*Amelanchier alnifolia*), black twinberry (*Lonicera involucrata),* gooseberries (*Ribes* species), thimbleberrry (*Rubus parviflorus),* willow (*Salix brachycarpa* and *Salix glauca*), among others. The dominant subalpine fir, known as sweet pine to Blackfeet tribal members, is an important plant used for incense (McClintock 1910; Johnston 1987; Hellson and Gadd 1974; Moerman 1998; Barney and Peacock 2000).

The herbaceous layer is typically diverse. Hitchcock's woodrush (*Luzula glabrata var. hitchcockii),* bluejoint (*Calamagrostis canadensis*), and pinegrass (*Calamogrostis rubescens)* are the most commonly associated graminoids. On moist sites with seeps or adjacent to running water, a lush herbaceous understory is present. Forb species include Blackfeet cultural plants such as Dawson's angelica (*Angelica dawsonii),* Sitka valerian *(Valeriana sitchensis)*, false hellebore (*Veratrum viride)* and beargrass (*Xerophyllum tenax).*

Ferns and fern allies such as horsetail (*Equisetum* species*),* oak fern (*Gymnocarpium dryopteris)* and ladyfern *(Athyrium filix-femina)* form dense cover in wet *Picea* habitats on flat sites with poor drainage. Moss cover is often high within these forests. Wet spruce forests often occur as a narrow band adjacent to fens (Figure 21). On the Blackfeet Reservation, these wet spruce forests contain Plant Species of Concern such as frog orchid (*Ameorchis rotundifolia*), sparrows egg ladyslipper orchid (*Cypripedium passerinum*) and yellow ladyslipper orchid (*Cypripedium parviflorum*).


(Figure 21: Wet *Picea/Equisetum arvense* community type bordering a fen wetland, near Middle Fork Milk River, Blackfeet Reservation)

These upper elevational forests are widely used by grizzly and black bears, lynx, mountain lions, grey wolves, coyote, red fox, fishers, elk, moose and deer, as well as chipmunks, tree and ground squirrels. Bird Species of Concern include Varied thrush, Clark's nutcracker, boreal chickadee, northern goshawk, black backed woodpecker, pileated woodpecker, Lewis woodpecker, Great grey owl, evening grosbeak, flammulated owl, as well as many more common species.

Northern Rocky Mountain Dry Spruce-Subalpine Fir Forest

Spruce (*Picea engelmannii or Picea glauca)* and subalpine fir (*Abies lasiocarpa)* forests comprise a substantial part of the montane and lower subalpine forests of the Montana Rocky Mountains. Spruce associated with subalpine fir occurs as either a climax co-dominant or as a persistent, long-lived seral species in most upper elevation habitat types. These dry spruce-fir forests range from 5,200 to 6,500 feet east of the Continental Divide. They represent the montane and lower elevation range of subalpine forests in this area. These forests are found on gentle to very steep mountain slopes, high-elevation ridgetops and upper slopes as well as plateau-like surfaces.

Drier expressions of these forests form a belt at mid to high elevations east of the Divide. Soils are derived a variety of parent materials, but are usually acidic. Soils are

usually rocky or gravelly with good aeration and drainage. Occurrences are typically found in locations with cold-air drainage or ponding, or where snowpacks linger late into the summer, such as north-facing slopes and high-elevation ravines (Figure 22). They can extend down in elevation below the subalpine zone in places where cold-air ponding occurs, especially on north and east aspects.

Tree canopy characteristics are relatively uniform, with *Picea* and *Abies* dominating either mixed or alone. On the Blackfeet Reservation, Englemann spruce (*Picea engelmannii)* hybridizes with its boreal counterpart, white spruce (*Picea glauca)*. *Picea* is more tolerant of extreme environmental conditions than *Abies*, and is usually more dominant in the drier habitats within this system.

The understory often support diverse stands of Blackfeet cultural plants that bear fruit such as dwarf huckleberry (*Vaccinium caespitosum),* tall huckleberry *(Vaccinium membranaceum)* and grouse whortleberry (*Vaccinium scoparium).* Other shrubs include service berry (*Amelanchier alnifolia*), black twinberry (*Lonicera involucrata),* Cascade mountain ash (*Sorbus scopulina),* gooseberries (*Ribes* species), and thimbleberrry (*Rubus parviflorus),* as well as sweet pine (*Abies lasiocarpa*), among others. Mesic, high elevation meadows are often found interspersed within this forest type, especially at higher elevations. One extremely important Blackfeet cultural plant (*Angelica dawsonii*) is found in association with these mountain meadows near Chief Mountain, and is largely the only locale for this plant on the Reservation. It also occurs within Glacier National Park. Thus, protection of this forest near and adjacent to Chief Mountain is of paramount cultural importance.


(Figure 22: Subalpine fir-Spruce Dry Forest, Two Medicine Ridge, Blackfeet Reservation)

These upper elevational forests are widely used by grizzly and black bears, lynx, mountain lions, grey wolves, coyote, red fox, fishers, elk, moose and deer, as well as chipmunks, tree and ground squirrels. Bird Species of Concern include Varied thrush, Clark's nutcracker, boreal chickadee, northern goshawk, black backed woodpecker, pileated woodpecker, Great grey owl, evening grosbeak, flammulated owl, as well as many more common species.

Northern Rocky Mountain Lodgepole Pine Forest

This forest system is widespread in upper montane to subalpine elevations of the Montana Rocky Mountains. These are subalpine forests where the dominance of *Pinus contorta* is related to fire history and topo-edaphic conditions. Forests occur on steep slopes, ridges, toe slopes and valley bottoms on all aspects. Fire is frequent and stand replacing fires are common. Following stand-replacing fires, *Pinus contorta* will rapidly colonize and develop into dense, even-aged stands. Most forests occur as early- to mid-successional forests that persist from 150 to 400 years in subalpine forests (Figure 23).

This forest ecosystem generally occurs on dry to intermediate sites with a wide seasonal range of temperatures and long precipitation-free periods in summer. Snowfall is heavy and supplies the major portion of soil water used for growth in early summer. Vigorous stands occur where the precipitation exceeds 21 inches. Soils supporting

these forests are typically well-drained, gravelly, coarse-textured, acidic, and rarely formed from calcareous parent materials. These forests are especially well developed on the broad ridges and high valleys near and east of the Continental Divide. Succession proceeds at different rates, moving relatively fast on low-elevation mesic sites and particularly slow in high-elevation forests such as those along the Continental Divide on the Blackfeet Reservation.

These forests are dominated by lodgepole pine (*Pinus contorta)* with shrub, grass, or barren understories. Sometimes there are intermingled mixed conifer/aspen (*Populus tremuloides)* stands, with the latter occurring with inclusions of deeper, typically fine-textured soils. Douglas-fir (*Pseudotsuga menziesii)* commonly occurs in *Pinus contorta* subalpine forests east of the Continental Divide on the Blackfeet Reservation. Occasionally, individual trees of western larch (*Larix occidentalis*) are found within these forests in the Two Medicine area. The shrub layer may be conspicuous to absent; common species include kinnickinnick (*Arctostaphylos uva-ursi*), snowbrush *(Ceanothus velutinus),* twinflower (*Linnaea borealis*), creeping Oregon grape (*Mahonia repens),* birchleaf spiraea (*Spiraea betulifolia),* Canadian buffaloberry (*Shepherdia canadensis,)* huckleberry (*Vaccinium species*), snowberry (*Symphoricarpos albus*), and gooseberries (*Ribes* species). Many of the dominant understory species, as well as lodgepole pine, are Blackfeet cultural plants.

(Figure 23: Rocky Mountain Lodgepole pine forest; photographer unknown)

Herbaceous layers are generally sparse, but can be moderately dense, and are typically dominated by perennial graminoids such as Nelson's needlegrass (*Achnatherum nelsonii),* pinegrass (*Calamagrostis rubescens*), and Geyer's sedge (*Carex geyeri).* Common forbs include yarrow (*Achillea millefolium)*, arnica (*Arnica latifolia),* and beargrass (*Xerophyllum tenax)*. Saprophytic species such as coralroot orchids

(*Corallorhiza* species), pinesap (*Moneses uniflora)*, Indian pipe (*Monotropa)* and pinedrops (*Pterospora andromeda)* are sometimes found in the understory. Pale corydalis (*Corydalis sempervirens*), a Species of Concern, has been found in post-burn lodgepole forests on the Blackfeet Reservation. The dominant species, lodgepole pine, is used for teepee poles and a source of firewood for tribal members.

Lodgepole forests are widely used by both common and Species of Concern such as grizzly and black bears, lynx, mountain lions, wolves, fishers, pine marten, wolverine, coyote, elk, moose and deer, as well as chipmunks, tree and ground squirrels. Bird Species of Concern include great grey owls, northern hawk owl, flammulated owl, northern goshawk, peregrine falcon, boreal chickadee, evening grosbeak, varied thrush, brown creeper, Cassin's finch, Clark's nutcracker, Lewis woodpecker, pileated woodpecker, black backed woodpecker, among others.

Northern Rocky Mountain Subalpine Woodland and Parkland

This system includes all subalpine and treeline forest associations of the Montana Rocky Mountains and island ranges and is characteristically a high-elevation mosaic of stunted tree clumps, open woodlands, and herb- or dwarf-shrub-dominated openings, occurring above closed forest ecosystems and below alpine communities. It includes open areas with stands of whitebark pine (*Pinus albicaulis*) occurring most commonly on south, east and west facing aspects. Subalpine fir (*Abies lasiocarpa*) is the co-dominant in these systems and is often the most prevalent tree species (Figure 24). Engelmann spruce (*Picea engelmannii*) is usually associated with subalpine fir and occurs as either a climax co-dominant or as a persistent, long-lived seral species in most upper elevations. Examples of this ecosystem are found at near treeline on Chief Mountain, Divide, Sherburne Peak, Two Medicine Ridge, and higher elevations of the Badger Two Medicine and mountains bordering the Reservation near Heart Butte and Swift Dam.

The climate is typically very cold in winter and dry in summer. This system occurs up to 6,500 to 7,200 ft in northwestern Montana. Landforms include ridgetops, mountain slopes, glacial trough walls and moraines, talus slopes, landslides and rockslides, and cirque headwalls and basins. Snow accumulation is high in basins but, ridegtops have little snow accumulation because of high winds and sublimation. In this harsh, often wind-swept environment, trees are often stunted and flagged from damage associated with wind and blowing snow and ice crystals, especially at the upper elevations of the type. Near its upper elevational limits, these forests and parklands are bordered by alpine meadows. On especially dry sites east of the Continental Divide, these forests are sometimes bordered by subalpine grasslands. Soils are derived a variety of parent materials, but are usually acidic. Soils are usually rocky or gravelly with good aeration and drainage. Organic matter and duff accumulation varies depending on terrain. These forests and parklands are diverse in composition and structure due to widely diverse high elevation terrain, and extreme climatic conditions. At the upper elevations of tree growth, stands and krummolz mats can persist for hundreds of years.

(Figure 24: Whitebark pine and subalpine fir woodland and krummolz, Head of Two Medicine Valley, Glacier National Park, photographer unknown)

Major disturbances in this system include fire, avalanches and biotic vectors. Historically, stand-replacing fires occurred infrequently in this system, at least where open woodlands were present that limited fire severity and spread (Arno, 1980). These tree species are very susceptible to fire. Whitebark pine and subalpine fir have some tolerance to low and medium severity fire if old individual trees have developed thick bark. Lightning damage to individual trees is common, but sparse canopies and rocky terrain limited the spread of fire. More recently, stand replacing fires caused by lightning strikes are becoming more common, especially in areas of steep terrain. In precipitous mountain areas that receive heavy snowfall, avalanches are common and can remove swathes of subalpine forest.

Insects and diseases can play a major role in the successional direction these forests. Whitebark pine, now considered a Species of Concern, is affected by white pine blister rust and mountain pine beetle. Due to its marked decline, subalpine fir (*Abies lasiocarpa*) is becoming more prevalent in these forests. This is due to the extremely high blister rust mortality, especially in northwestern Montana where the moister, Pacific maritime climate at high elevations is more conducive to infection than in the southern mountain ranges of Montana. Throughout Montana, both subalpine fir and spruce are affected by spruce bud worm attacks and large stands of these subalpine forests can be killed following several years of drought or unusually mild winters.

This woodland ecosystem is used by many common and Species of Concern including wolverine, grizzly bears, black bears, Rocky Mountain sheep, Rocky Mountain goats, elk, snowshoe hare, lynx, mountain lion, deer, wolves, pine marten, grey wolf, fisher, and several species of squirrels. Bird Species of Concern such as Golden eagles, great

grey owls, northern hawk owl, peregrine falcon, as well as other more common raptors, use this high elevation woodland for hunting and nesting on the Reservation, within Glacier National Park and the Lewis and Clark National Forest. Other Species of Concern include boreal chickadee, evening grosbeak, Cassin's finch, Clark's nutcracker and ptarmigan. Grey and black crowned rosy finches are frequently found in these upper elevation forests during spring, summer and fall months.

Northern Rocky Mountain Limber Pine-Juniper Woodland

This ecological system occurs in foothill and lower montane zones in the northern Rocky Mountains in Montana and on escarpments and to the western Great Plain grasslands on the Blackfeet Reservation (Figure 25). This woodland ecosystem is especially well represented in the Mitten Lake area and south of Heart Butte to Swift Dam on the reservation, Small patches occur near East Glacier Park on ridge tops. In Montana, elevation ranges from 4,000 to 7,500 feet. At higher elevations, it is limited to the most xeric aspects on rock outcrops, and at lower elevations to the relatively mesic, north aspects. Fire is infrequent and spotty because rocky substrates prevent a continuous vegetation canopy needed for spread. This system occurs on dry, rocky sites that are typified by extreme winter weather and droughty summer conditions. Because these sites are so marginal for tree growth, mortality from abiotic and biotic stresses may be high in some areas.

This woodland ecosystem occurs generally below continuous forests of Douglas-fir (*Pseudotsuga menziesii*) or lodgepole pine (*Pinus contorta*) in the foothills and can occur in large stands well within the zone of continuous forests in the northern Rocky Mountains. East of the Continental Divide, limber pine (*Pinus flexilis*) can occur at the upper elevational limits of tree line with whitebark pine (*Pinus albicaulis*). This climate is typified by a relatively small amount of precipitation, with the wettest months during the growing season, very low humidity, and wide annual and diurnal temperature ranges. Winter conditions may be very cold, but relatively dry, and often include rapid fluctuations in temperature associated with Chinook winds.

In Montana, limber pine (*Pinus flexilis*) grows mainly on calcareous substrates. Soils have a high rock component (typically over 50% cover) and are coarse- to fine-textured, often gravelly and calcareous. This system is found on gently rolling terrain to cliffs. It is most often found on rocky ridges and steep rocky slopes and can survive in extremely windswept areas at both lower and upper tree line. Slopes are typically moderately steep to steep (Pfister et al, 1977).


(Figure 25: Limber pine woodland, Blackfeet Reservation)

On the Blackfeet Reservation, vegetation is characterized by an open-tree canopy or patchy woodland that is dominated by limber pine (*Pinus flexilis*), common juniper (*Juniperus communis*) and creeping juniper (Juniperus horizontalis). Some individuals of Rocky Mountain juniper (*Juniperus scopulorum*), Douglas-fir (*Pseudotsuga menziesii*) and lodgepole pine (*Pinus contorta*) can occur in these woodlands. A sparse to moderately dense short-shrub layer is usually present. Within north-central and northwestern Montana, the most common shrubs include bearberry (*Arctostaphylos uva-ursi*), creeping juniper (*Juniperus horizontalis*), shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*), and Canadian buffaloberry (*Shepherdia canadensis*).

Herbaceous layers are generally sparse, but range to moderately dense, and are typically dominated by perennial graminoids such as blue grama (*Bouteloua gracilis*), Idaho fescue (*Festuca idahoensis*), rough fescue (*Festuca campestris*), Poverty oatgrass (*Danthonia intermedia*), needle and thread (*Hesperostipa comata),* prairie junegrass (*Koeleria macrantha*), Indian ricegrass (*Oryzopsis hymenoides*), Sandberg's bluegrass (*Poa secunda*), or blue bunch wheatgrass (*Pseudoroegneria spicata*). Common forbs include yarrow (*Achillea millefolium*), woman's sage (*Artemisia frigida*), arrowleaf balsamroot (*Balsamorhiza sagittata*), prairie smoke (*Geum triflorum*), dotted gayfeather (*Liatris punctata)*, stone seed (*Lithospermum ruderale*), silver lupine (*Lupinus argenteus*), pricklypear (*Opuntia* species), crazyweed (*Oxytropis* species), and cushion plants such as draba (*Draba* species), phlox (*Phlox* species), Rocky Mountain douglasia (*Douglasia montana*) and Howard's alpine forget-me-not (*Eritrichium howardii*).

Seeds of limber pine are a food source for bears and birds. Good examples of this woodland ecosystem are found from East Glacier Park south to Swift Dam at the south end of the Reservation. At this time, these woodlands appear to be in better condition than examples further south along the Rocky Mountain Front. This woodland system occurs on dry, rocky sites that are typified by extreme winter weather and droughty summer conditions that are marginal conditions for tree growth. Consequently, mortality from abiotic and biotic stresses may be high in some areas. Limber pine (*Pinus flexilis*) is highly susceptible to white pine blister rust *(Cronartium ribicola*) and the pine needle pathogen (*Dothistroma septospora*). It is susceptible to infestation by mountain pine beetles, cone beetles, coneworms, and budworms. The most significant damage due to biotic factors appears to occur at locations on the Lewis and Clark National Forest along the northern Rocky Mountain Front south of the Reservation. Large numbers of trees have very thin crowns and poor terminal growth, and severe mortality is occurring in these areas.

Northern Rocky Mountain Montane-Foothill Deciduous Shrubland

This shrubland ecosystem is found in the lower montane and foothill regions of western Montana, and north and east into the northern Rockies. These shrublands typically occur below treeline, within the matrix of surrounding grasslands. They also occur in the Douglas-fir zones, and are sometimes found in the subalpine zone on dry sites. On the Blackfeet Reservation, these shrublands commonly occur within the upper montane and subalpine grasslands and forests along the western boundary of the Reservation. They are usually found on steep slopes of canyons, toeslopes, ridges,and occasionally on valley bottom lands with some soil development. Bittercherry (*Prunus emarginata*), chokecherry (*Prunus virginiana*), rose (*Rosa* species), Rocky Mountain maple (*Acer glabrum*), serviceberry (*Amelanchier alnifolia), C*ascade mountain ash (*Sorbus scopulina)* and common snowberry (*Symphoricarpos albus)* are the most common dominant shrubs. In moist areas, thimbleberry (*Rubus parviflorus),* Douglas hawthorn (*Crataegus douglasii*), gooseberry (*Ribes species*) and Canadian buffaloberry (*Shepherdia canadensis)* can be abundant. All of these species are important Blackfeet cultural plants, as well as being important food sources to native mammals and birds. Grizzly bears are frequently seen on the Reservation feeding in this shrubland system during spring and summer months.

Western Great Plains Wooded Draw and Ravine

This system is typically found associated with permanent or ephemeral streams and small rivers. It may occur on steep northern slopes or within canyon bottoms where soil moisture and topography produce higher moisture levels than are common throughout most of the area. In some areas of the western Great Plains in higher elevation draws and ravines, Rocky Mountain Juniper (*Juniperus scopulorum)* and aspen (*Populus tremuloides*) can occur. On the central and eastern portions of the reservation, chokecherry (*Prunus virginana*) and Douglas hawthorne (*Crataegus douglasii*) are common dominants. These two species are favored food sources for bears, and bears travel onto the plains and use this ecosystem for feeding and resting. In many parts of

Montana, the understory is a dense shrub layer of western snowberry (*Symphoricarpos occidentalis*).

In less disturbed sites, the understory is two-layered, with a shrub layer chokecherry and other *Prunus* species, as well as hawthorne species, silverberry (*Elaeagnus commutata*), gooseberry (*Ribes* species), woods' rose (*Rosa woodsii*), and silver buffaloberry (*Shepherdia argentea*). All of these fruit producing species are important Blackfeet cultural plants, as well as important food sources for mammals and nesting and migratory songbirds. Wooded draws and ravines provide cover and food for bears and other mammals and many bird species, and serve as travel corridors for grizzly bears that travel out onto the plains.

This shrub ecosystem is found in ravines formed by ephemeral and intermittent streams or small rivers, and on toeslopes and north-facing backslopes. Generally, these systems are less than 50 meters wide, although the linear extent may be considerable. Soils are usually deep and loamy. Flooding is very short in duration when it occurs, as water is rapidly channeled downslope. Wooded draws and ravines are best developed under conditions that favor snow trapment, development of deeper soils, and concentration of moisture. These conditions are typical of ravines formed by ephemeral and intermittent streams or small rivers, and on toeslopes and north-facing backslopes. Uplands are generally mixed grass prairies and shrublands.

Western Great Plains Silver Sagebrush Shrub-Steppe

This ecosystem, which generally occurs in small patches (less than 1 hectare), occurs in the northwestern Great Plains. On the Blackfeet Reservation, it is found on benches to gently inclined slopes (30% maximum recorded) in the vicinity of breaklands along major rivers. Similar habitats (old river terraces, badlands, ravine sideslopes and valley walls) support its occurrence in Alberta. Sites occur on various parent materials, but mostly well-drained, often sandy, glacial drift and sandy alluvium. Silver sagebrush (*Artemisia cana*) is the dominant shrub with canopy coverage up to 50%, but averaging around 25 percent. Woman's sage (*Artemisia frigida)*, needle and thread (*Hesperostipa comata*), blue grama (*Bouteloua gracilis*) and prairie junegrass (*Koeleria macrantha*) are common associated species. This system represents the driest environment capable of supporting silver sagebrush. Additional inventory work on wildlife use and plant species is needed locally.

GRASSLANDS

Grassland conservation within the Blackfeet Reservation is of critical importance to the integrity and health of the landscape, cultural and tradition of the Blackfeet people, livestock production, as well as representing a highly significant conservation opportunity within an ecosystem that is imperiled throughout the rest of its historical range.

The grassland ecosystem is also an essential part of traditional and contemporary Blackfeet culture and lifestyle. Historically, Blackfeet people maintained the health and integrity of the prairie landscape by burning practices. Today, the prairies have provided local residents their livelihood and cultural tradition (e.g., traditional plant gathering, ceremony, hunting and fishing, horseback riding, as well as other recreational opportunities). The Blackfeet Reservation represents an unprecedented opportunity to reintroduce a free ranging bison herd, and integral portion of the ecosystem and of which, has long been absent for the landscape. The prairie landscape of the Blackfeet Reservation also contains aesthetic value and provides many tourism opportunities for visitors and residents, which benefits local communities.

Northern Rocky Mountain Subalpine, Montane and Valley Fescue Grassland

East of the Continental Divide, this grassland ecosystem is well represented on high exposed ridges on the Blackfeet Indian Reservation from the Alberta border and along the eastern edge of Glacier National Park in the Belly River, Many Glacier, Saint Mary and Two Medicine valleys, the South Fork of Two Medicine and south along the Rocky Mountain Front to Heart Butte and within foothills of the Badger Two-Medicine Wilderness area; extending east across the central portion of the Reservation at lower elevations.

Rough fescue (*Festuca campestris*) and Idaho fescue (*Festuca idahoensis*) are the dominants of this grassland system. This system grades into Northern Rocky Mountain Alpine Fellfield and Alpine turf systems at its upper limit and into mixed grass prairie at lower elevations on the plains near the eastern third of the Reservation. In northwestern Montana, this ecosystem forms within upper elevation Douglas-fir (*Pseudotsuga menziesii*), lodgepole pine (*Pinus contorta*), whitebark pine (*Pinus albicaulis*) and aspen (*Populus tremuloides*) parkland forests. Immediately east of the Continental Divide, this system is found on high ridges (5,200 feet or higher) bordering the northwestern Great Plains and on steep mountain slopes and benches above 5,200 feet along the western boundary of the Reservation. Out on the plains, fescue grassland is found at elevations to 4,000 feet. Young soils are derived from recent glacial and alluvial material but tend to be deeper than soils in adjacent forest communities.

In Montana, this system generally occurs as two plant community associations: 1) Rough fescue-Idaho fescue association that occurs on the moister sites, such as the north and east-facing slopes and benches in the mountains and swales on the plains and 2) Idaho Fescue-bluebunch wheatgrass that occurs on the drier sites, such ridges, hilltops and south and west facing slopes and benches (Figure 26). Plant community composition is variable depending on elevation. At lower elevations and on the driest sites that are in pristine condition, lichen cover can high on the ground surface.

On pristine, moist sites, rough fescue (*Festuca campestris*) can form a nearly continuous cover and is interspersed with Idaho fescue (*Festuca idahoensis*) and the rhizomatous ecotype of bluebunch wheatgrass (*Pseudogeneria spicata*). Rough fescue is the principal winter forage of bison and is recognized within local Blackfeet as the

most important grass for bison. Other graminoids include western needlegrass (*Achnatherum occidentale*), Richardson's needlegrass (*Achnatherum richardsonii*), oatgrass (*Danthonia* species), prairie junegrass (*Koeleria macrantha*), Sandberg's bluegrass (*Poa secunda*), basin wildrye (*Leymus cinereus*), slender wheatgrass (*Elymus trachycaulus*), needle and thread (*Hesperostipa comata*), Hood's sedge (*Carex hoodii*), obtuse sedge (*Carex obtusata*), and single spike sedge (*Carex scirpoidea)*. At higher subalpine elevations, alpine timothy (*Phleum alpinum*) and spike trisetum (*Trisetum spicatum*) become common. Drier sites support the same graminoid species with Idaho fescue being the dominant species and rough fescue being absent or with very low frequency.

(Figure 26: Rough fescue-Idaho fescue Montane Grassland, near South Fork of Two Medicine River, Blackfeet Reservation)

This grassland ecosystem supports a forb-rich community that is variable, depending on grazing disturbance and elevation. Species found in this system at upper montane elevations include arrowleaf balsamroot (*Balsamorhiza sagittata*), yarrow (*Achillea millefolium*), silky lupine (*Lupinus sericeus*), sticky geranium (*Geranium viscossisimum*), nine-leaf biscuiroot (*Lomatium triternatum*), prairie cinquefoil (*Potentilla gracilis*), sulphur penstemon (*Penstemon confertus*), yellow bells (*Fritillaria pudica*), wild strawberry (*Fragaria virginiana*),Indian paintbrush (*Castilleja* species), boreal bedstraw (*Galium boreale*), stoneseed (*Lithospermum ruderale*), buckwheat (*Eriogonum* species), prairie smoke (*Geum triflorum*), prairie arnica (*Arnica sororia*), woman's sage (*Artemisia frigida*), man's sage (*Artemisia ludoviciana*), prairie alumroot (*Huechera parviflora*),

prairie crocus (*Pulsatilla patens*), early biscuitroot (*Lomatium macrocarpum*) and many others. Shrub species may be scattered, including shrubby cinquefoil (*Dasiphora fruticosa*), woods rose (*Rosa woodsii*), snowberry (*Symphoricarpos species*), kinnickinick (*Arctostaphylos uva-ursi*), Canada buffaloberry (*Shepherdia canadensis*), and common juniper (*Juniperus communis*). Serviceberry (*Amelanchier alnifolia*), and common chokecherry (*Prunus virginiana*) often occur as patches on north facing slopes where snow persists longer into the growing season. All of the aforementioned species are important Blackfeet cultural plants (McClintock 1910; Johnson 1987; Hellson and Gadd 1974; Moerman 1998; Barney and Peacock 2001). On cool slopes and swales with greater precipitation catchment, camas (*Camassia quamash*) can be abundant.

(Figure 27: Rough fescue-Idaho fescue Grassland near Two Medicine Valley, Blackfeet Reservation)

Northern Rocky Mountain endemic species include Rocky Mountain douglasia (*Douglasia montana*), shining penstemon (*Penstemon nitidus*), Alberta penstemon (*Penstemon albertinus*), Parry's townsendia (*Townsendia parryi*) and alpine buckwheat (*Eriogonum androsaceum*) are common in the higher elevation, drier, rocky sites of this ecosystem. At least three Plant Species of Concern are associated with this grassland ecosystem: upward-lobed moonwort (*Botrychium ascendens*), peculiar moonwort (*Botrychium paradoxum*), and linear leaf moonwort (*Botrychium lineare*). At least one plant community type, *Festuca campestris-Arctostaphylos uva-ursi*, found as a component of this ecosystem, is found only on the Blackfeet Indian Reservation and adjacent Glacier National Park grasslands. It is well represented in the Two Medicine Ridge area at upper montane to subalpine elevations.

Shrubs may increase following heavy grazing and/or with fire suppression. Microphytic crust is very important in this ecological system and is damaged with heavy grazing practices. Rough fescue (*Festuca campestris*) is highly palatable throughout the grazing season. Summer overgrazing for 2 to 3 years can result in rough fescue loss. Although a light stocking rate for 32 years did not affect range condition, a modest increase in stocking rate led to a marked decline in range condition. Livestock grazing decreases cover of rough fescue especially during summer months (Willms and Rhode 1998). Oatgrass (*Danthonia* species) tends to replace rough fescue under moderate or heavy grazing pressure.

This is especially important winter range habitat for the reservation's elk population, as well as many other mammals and upland birds. Swift fox, badger, coyote and red fox frequently raise their young in this grassland. Grizzly bears use this ecosystem during spring, summer and fall months, as many favored roots, berries, and forage are found within this ecosystem. The tribal bison head is managed within this grassland type on the Reservation, near East Glacier. At higher elevations near the Park boundary, Rocky Mountain sheep, mountain lion, deer, as well as wolverine, grizzly bears and grey wolves use this ecosystem. Bird Species of Concern on the Reservation's fescue grasslands include golden eagle, peregrine falcon, great grey owl and northern hawk owl, ferruginous hawk, in addition to many common bird species.

Good to excellent condition examples of this important grassland ecosystem can be found near Houseman Hill, near East Glacier Park, near Badger Two Medicine Wilderness Area (Figure 28), Two Medicine Ridge, and near the Canadian border. Good examples are also found within the Tribe's Wildlife Management Areas within the western third of the Reservation, such as the South Fork of the Two Medicine River. These areas are potential areas for the Tribe's ongoing "Iinni" Bison project, which targets reintroduction of free-ranging bison on portions of the Reservation.

(Figure 28: Montane Rough Fescue-Idaho fescue Grassland, Blackfeet Reservation)

Archaeological sites, grave sites, teepee rings, prayer sites and spiritual camps are found within this ecosystem on the Reservation.

In Montana, some noxious, exotic species threaten this mountain and subalpine grassland system through invasion and potential complete replacement of native species. On drier sites within this system, Japanese brome (*Bromus japonicus),* sulfur cinquefoil (*Potentilla recta*), leafy spurge (*Euphorbia esula*), knapweed species, especially spotted knapweed (*Centaurea biebersteinii*), Saint John's wort (*Hypericum perforatum*), and whitetop (*Cardaria draba*) are problematic. Mesic sites within this system are threatened by meadow hawkweed complex (*Hieracium pratense*, *H*. *floribundum*, *H*. *piloselliodes*), orange hawkweed (*Hieracium aurantiacum*), ox-eye daisy (*Leucanthemum vulgare*), tall buttercup (*Ranunculus acris*), and Canada thistle (*Cirsium arvense*).

Fire frequency is presumed to be less than 20 years. Noxious species invasion, fire suppression, heavy cattle grazing and oil and gas development are major threats to this system. Rough fescue (*Festuca campestris*) is easily eliminated by grazing and does not occur in all areas of this system.

Northwestern Great Plains Mixedgrass Prairie

The Northwestern Great Plains Mixedgrass Prairie encompasses much of the eastern two-thirds of Montana. This system extends from northern Nebraska into southern

Canada and westward through the Dakotas to the Rocky Mountain Front in Montana. On the Blackfeet Indian Reservation, this grassland ecosystem is well represented on the eastern third of the reservation. Soil texture (which ultimately effects water available to plants) is the defining environmental descriptor; soils are primarily fine and medium-textured and do not include sands, sandy soils, or sandy loams. In various locales, the topography where this system occurs is broken by many glacial pothole lakes, and this system may be proximate to Great Plains Prairie Pothole and similar depressional wetlands and riparian areas. On the Reservation, fescue grassland grades into mixedgrass prairie, mostly on eastern third of the Reservation (Figure 29).

Graminoids typically comprising the greatest canopy cover include western wheatgrass (*Pascopyrum smithii),* green needlegrass (*Nassella viridula*), blue grama (*Bouteloua gracilis*) and needle and thread (*Hesperostipa comata*). In Montana, and especially on the Blackfeet Reservation, rough fescue (*Festuca campestris)* and Idaho fescue (*Festuca idahoensis)* grade into this ecosystem. Fire and grazing constitute the primary dynamics affecting this system. Drought can also impact this system, in general favoring the shortgrass component at the expense of the mid-grasses. With intensive grazing, cool-season exotics such as Kentucky bluegrass (*Poa pratensis*), smooth brome *(Bromus inermis*), and Japanese brome (*Bromus japonicus*) can increase in dominance; both of the rhizomatous species have been shown to markedly depress species diversity. Typical land uses are range-grazing lands, cultivated wheat and more recently, oil and gas development.

(Figure 29: Mixed grass prairie near Cutbank, Montana; photographer unknown)

Wildlife such as mule deer, sharp tailed grouse, pheasants, and antelope are common on uncultivated acres. Species of Concern such as Swift fox, burrowing owl, golden

eagle and ferruginous hawk are found on the eastern portions of Blackfeet Reservation, where fescue grasslands grade to mixed grass prairie. The black tailed prairie dog, another Species of Concern, may be present in this ecosystem locally. Piping plover is frequently found in this grassland near depressional wetlands and small lakes. The Blackfeet bison herd and Blackfeet Bison Initiative represents a unique opportunity to restore ecosystem integrity of the mixed grass prairie on the Blackfeet Reservation. Because this grassland system is proximal to prairie wetlands, its inclusion in buffers around wetlands during conservation and protection efforts is critical.

Dynamic vegetative communities make up this diverse prairie ecosystem. Vegetation is a mixture of tall and short grasses, generally having an average height 30 cm. Grasses were typically used by large herbivores such as bison, but since the establishment of the Reservation, cattle and sheep have had a tremendous impact on the composition and condition of Reservation grasslands.

Near the Canadian border, this system grades into grasslands dominated by rough fescue (*Festuca campestris)* and Idaho fescue (*Festuca idahoensis*) and contain many of the same species. Needle and thread (*Hesperostipa comata)* becomes a common component with fescues in northern Montana (Menard et. al., 2006). Needle and thread (*Hesperostipa comata)* is also an important component and becomes increasingly so as improper grazing regimes favor it at the expense of (usually) western wheatgrass and other species. Progressively more destructive grazing can result in the loss of western wheatgrass (*Pascopyrum smithii)* from the system followed by drastic reduction in needle and thread (*Hesperostipa comata)* and ultimately, the dominance of blue grama (*Bouteloua gracilis),* Sandberg's bluegrass *(Poa secunda*), and prairie junegrass (*Koeleria macrantha*).

Many of the common forbs within this system include Blackfeet cultural plants such as yarrow (*Achillea millefolium)*, prairie windflower (*Anemone multifida*), onion (Allium species), scarlet globemallow (*Sphaeralcea coccinea*), gumweed (*Grindelia squarrosa*), textile onion (*Allium textile*), western sagewort, (*Artemisia ludoviciana*), boreal sagewort (*Artemisia frigida*), fuzzy beardtongue (*Penstemon eriantherus*), shining penstemon (*Penstemon nitidus*), prairie cinquefoil *(Potentilla gracilis*), Missouri goldenrod (*Solidago missouriensis*), dalea (*Dalea* species), among others (McClintock 1910; Hellson and Gadd 1974; Johnson 1987; Moerman 1998; Barney and Peacock 2001).

Prolonged drought reduces the density and cover if short grasses by as much as 80 percent and the bunchgrasses and native forbs to almost zero (Albertson, 1937). During prolonged drought, native forbs are rapidly replaced by non-native invasive forbs. During the severe droughts of the 1930's and 1950's, basal area of grasses decreased from 80 to less than 10 percent under moderate grazing regimes in 3 to 5 years (Barbour and Billings 2000). Thus, the dynamics of species changes in this system is a function of climate, but the magnitude of these changes is greatly influenced by the intensity of grazing. In the long absence of bison and indigenous burning practices and the conversion to farmland, the mixed grass prairie ecosystem is highly fragmented and altered throughout its historical range.

Northern Rocky Mountain Alpine Turf

In Montana, small turf communities are represented on Divide, Chief Mountain and Sherburne Peaks on the Blackfeet Reservation. This ecosystem is found on gentle to moderate upper slopes, flat ridges, valleys, and basins, and summits where the soil has become relatively stabilized and the water supply persists until fall. It is characterized by a very cold climate, high winds, heavy snow accumulation, and a very short growing season (60 to 90 days). The climate is typically very cold in winter and dry in summer, although snowfall and freezing rain can occur during summer months. Snow accumulation is high in basins but, ridges and summits have little snow accumulation because of high winds and sublimation.

Vegetation in these areas is controlled by snow retention, wind desiccation, and a short growing season. This system is characterized by a dense cover of low-growing, perennial graminoids and forbs (Figure 31). Rhizomatous, sod-forming sedges (*Carex* species) are the dominant graminoids. Alpine grasses such as alpine bluegrass (*Poa alpina*), and alpine timothy (*Phleum alpinum*) are common. Forb diversity is very high and often constitutes 40% or greater of the canopy cover of the turf community. These same species frequently colonize disturbed areas within the turf community such as grizzly bear diggings and ground squirrel burrows.

Common species include arnica (*Arnica* species), alpine pussytoes (*Antennaria* species), daisy (*Erigeron peregrinus)*, sibbaldia (*Sibbaldia procumbens)*, glacier lily (*Erythronium grandiflorum)*, rhexi-leaf paintbrush (*Castilleja rhexifolia)*, and diverse leaf cinquefoil (*Potentilla diversifolia).* Mat forming willows (*Salix species*) less than 2 cm tall are often present within the turf. Arctic dryad (*Dryas octopetala*), shrubby cinquefoil (*Dasiphora fruticosa*) and alpine leguminous species play a key role in the early successional stages of this community. In this harsh, often wind-swept environment, cushion, mat-forming or densely tufted forbs well adapted to temperature extremes, high uv radiation, wind desiccation, and a short growing season. Many cushion species, such as moss campion (*Silene acaulis*) are especially long lived, and can persist within the turf community for decades.

(Figure 30: Northern Rocky Mountain Alpine Turf forming on Divide Mountain, Blackfeet Reservation)

Several northern Rocky Mountain endemic plant species and Species of Concern inhabit alpine turf communities. Alpine turf develops on shallow soils typically with an soil horizon of less than 10 cm. Although alpine dry turf is the matrix of the alpine zone, it typically intermingles with alpine bedrock and scree, snowfields, fell fields and alpine dwarf-shrubland and alpine/subalpine wet meadow systems. Imbedded within this system is a mosaic of alpine plant communities that vary in composition depending on soil development, snow retention, subterranean hydrology and localized topography. Snow bed communities dominated by ericaceous dwarf shrubs and willows often occur in as well as alpine wet to mesic meadows dominated by tufted hairgrass (*Deschampisa cespitosa*).

Alpine turf communities are used by numerous species of mammals and birds, including many Species of Concern. Rocky Mountain sheep, Rocky Mountain goats, elk, mule deer, wolverines, grizzly bears, black bears, fisher, as well as pika, marmots, dwarf shrew, snowshoe hares and ground squirrels are found in alpine turf communities. Golden eagles and ptarmigan use this habitat for nesting and rearing of young. Other Species of Concern, peregrine falcon, black rosy finch and grey crowned rosy finch also

use this habitat during summer months. If snowmelt ponds are present, the rare western toad can be found within this ecosystem.

High elevation sites such as turf communities are important spiritual, archeological and cultural sites. Several sheep hunting sites have been located within this ecosystem in Glacier National Park (Barney et al 2000).

SPARSELY VEGETATED ECOSYSTEMS

Northern Rocky Mountain Alpine Fell-Field

This ecological system is found discontinuously at alpine elevations on the western boundary of the Blackfeet Reservation, bordering Glacier National Park and the Lewis and Clark National Forest. These are wind-scoured fell-fields that are free of snow in the winter, such as ridgetops and exposed saddles, exposing the plants to severe environmental stress. Soils on these windy unproductive sites are shallow, stony, low in organic matter, and poorly developed; wind deflation often results in a gravelly pavement (Figure 31). This system is characterized by a very cold climate during winter, high winds, high uv radiation and high surface temperatures during the day during summer months, and a very short growing season. Fellfields and the associated mountain summits are sacred areas to the Blackfeet people, containing thousands of years old cultural resources, and are used as quest sites by tribal members (Barney 2000).

Ribbons of nitrogen fixing arctic dryad (*Dryas octopetala*), shrubby cinquefoil (*Dasiphora fruticosa*) and alpine leguminous species occur on slopes subject to downward movement due to frost heaving. These ribbons or stair-step vegetation patterns form perpendicular to the slope. Plant cover can be low to moderate (15 to 50%) with exposed, stable scree, boulders constituting the remainder of cover. Most fell-field plants are highly adapted to this xeric environment and occur within these ribbons or as singular plants among the exposed rocks. These species are typically cushioned, matted or succulent, or grow as flat rosettes, often with thick leaf cuticles or are densely covered with hairs. Diverse crustose and foliose lichen cover is high on exposed rocks. Lichen covered rocks are an important Blackfeet cultural and spiritual resource and are left undisturbed by Blackfeet traditionalists wherever they occur.

Other forbs can occur with the arctic dryad mats, singly or in small patches among the exposed rocks. In northwestern Montana, common forbs include yarrow (*Achillea millefolium*), penstemon (*Penstemon* species), phacelia (*Phacelia* species), alpine fireweed (*Chamerion latifolium)*, moss campion (*Silene acaulis*), twinflower sandwort (*Minuartia obtusiloba*), alpine goldenrod (*Solidago multiradiata*), sky pilot (*Polemonium viscosum*), cut-leaf daisy (*Erigeron compositus*), draba (*Draba* species), alpine arnica (*Arnica alpina*), alpine pussytoes (*Antennaria* species), one-stem fleabane (*Erigeron simplex*), sibbaldia (*Sibbaldia procumbens*), diverse leaf cinquefoil (*Potentilla diversifolia*), moss campion (*Silene acaulis*), lousewort (*Pedicularis* species), elegant death camas (*Zigadenus elegans*), alpine bistort (*Polygonum bistortoides*), rock jasmine buckwheat (*Eriogonum androsaceum*), alpine buckwheat (*Eriogonum ovalifolium*),

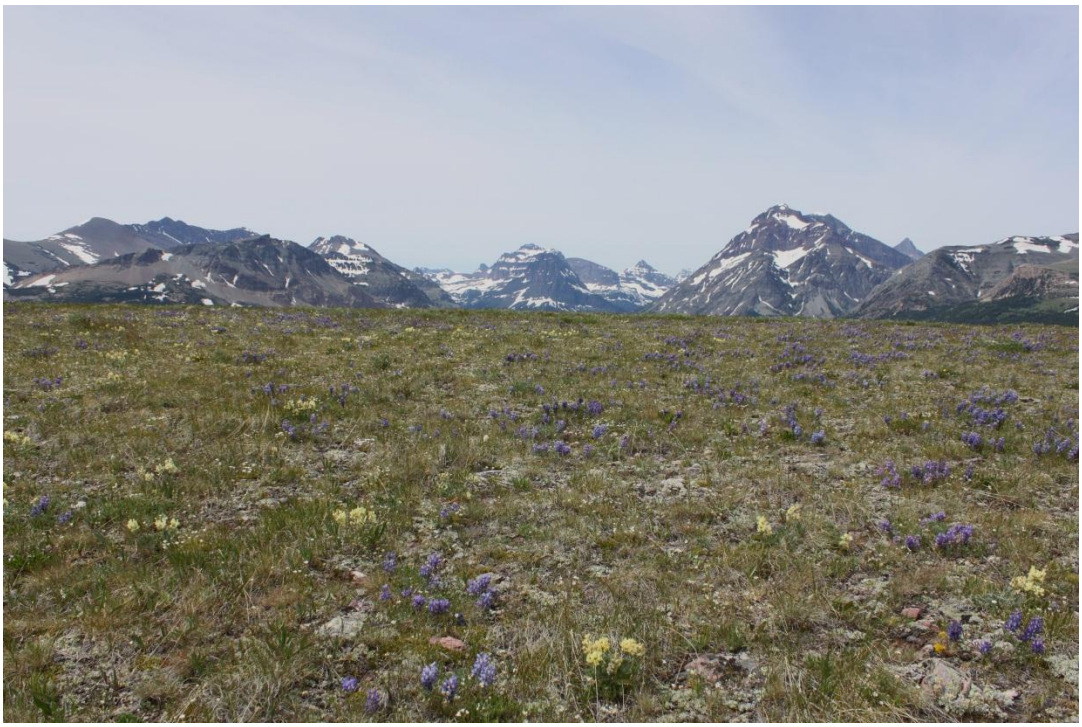
viviparous bistort (*Polygonum viviparum*), alpine forget-me-not (*Myosotis alpestris*) and Siberian aster (*Eurybia merita*).

Northern Rocky Mountain endemics such as limestone columbine (*Aquilegia jonesii*) and Rocky Mountain douglasia (*Douglasia montana*) are locally common in calcareous fell-fields and adjacent scree fields, east of the Continental Divide from Glacier National Park and the Blackfeet Indian Reservation and immediately south along the Rocky Mountain Front. Many of the cushion species are very long lived, well adapted to limited available water during growth and possess a deep, fleshy taproot. These species can persist within this community for decades and potentially can be very old. Mat forming woody species such as arctic willow (*Salix arctica*), snow willow (*Salix nivalis*), rock willow (*Salix vestita*) and in some areas, kinnickninick (*Arctostaphylos uva-ursi*), a Blackfeet cultural plant, is sometimes present among the exposed rocks.

Several northern Rocky Mountain endemic species, Montana Species of Concern, and Potential Species of Concern inhabit alpine fell-field communities. In Montana, some arctic species reach their southernmost range limit within this ecosystem. At least 5 Plant Species of Concern are found in this ecosystem on the Blackfeet Reservation: Rocky Mountain Front fleabane (*Erigeron lackschewitzii*), five-leaf cinquefoil (*Potentilla quinquefolia*), one flowered cinquefoil (*Potentilla uniflora*), viviparous fescue (*Festuca vivipara*), and rock sedge (*Carex petricosa*).

Adjacent to this system is a mosaic of alpine plant communities that vary in composition depending on soil development, snow retention, subterranean hydrology and localized topography. Alpine turf and snow bed communities dominated by ericaceous dwarf shrubs and willows, as well as alpine wet meadows or mesic meadows dominated by tufted hairgrass (*Deschampisa cespitosa*) occur on more level or concave sites with great soil development adjacent to fellfields. Alpine bedrock, talus and unstable scree fields and ice fields occur adjacent to this system around mountain summits.

Ribbons of nitrogen fixing arctic dryad (*Dryas octopetala*), shrubby cinquefoil (*Dasiphora fruticosa*) and alpine leguminous species occur on slopes subject to downward movement due to frost heaving. Common alpine legumes include silver lupine (*Lupinus argenteus*), yellow sweetvetch (*Hedysarum sulphurescens*), alpine milkvetch (*Astragaulus alpinus*), Bourgov's milkvetch (*Astragaulus bourgovii*), boreal crazyweed (*Oxtropis borealis*) and silky crazyweed (*Oxytropis sericea*). These ribbons or stair-step vegetation patterns form perpendicular to the slope. These nitrogen-fixing species accumulate litter within the mats and improve soil fertility, thus facilitating additional species colonization within the mats. Plant cover can be low to moderate (15 to 50%) and is rarely greater than 9 cm high.



(Figure 31: Alpine fellfield on summit of Two Medicine Ridge, Blackfeet Reservation)

Rocky Mountain fellfields are used by numerous species of mammals and birds, including many Species of Concern. Rocky Mountain sheep, Rocky Mountain goats, elk, mule deer, wolverines, grizzly bears, black bears, fisher, as well as pika, marmots, dwarf shrew, snowshoe hares and other species. Golden eagles and ptarmigan use this habitat for nesting and rearing of young. Other species of concern, peregrine falcon, black rosy finch and grey crowned rosy finch also use this habitat during summer months**.**

Lightning strikes can cause fire within these systems, although severity and spread is usually variable. This ecosystem is fragile due to extreme limited growing season and soil development. Species that occur in these systems are generally slow growing and decrease in cover and vigor in areas of trampling or grazing. In some areas, these systems occur in areas of grazing or mining operations. Changing climatic patterns will impact this system and the distribution of peripheral species, northern Rocky Mountain endemics and rare plant, bird and animal species that occur within it.

Northern Rocky Mountain Alpine Scree and Barren Rock

These steep, wind-scoured, loose talus and scree fields and exposed bedrock are often blown free of snow during winter, exposing plants to severe environmental stress. Soil development is very limited, and is usually gravelly and rocky. Soils are derived from a variety of parent materials, and can be acidic or calcareous. Organic matter is usually only found in very limited quantities in pockets among boulders, or in fractures or

leeside of the bedrock slabs. This system is characterized by a very cold climate and high winds during winter, and by high winds, high UV radiation and high surface daytime temperatures during summer months, especially on south and west facing aspects. Unstable scree and talus, isolated boulder pockets and exposed bedrock constitute at least half of the cover (Figure 32).

Plant cover is usually less than 10 percent with exposed, unstable scree, talus and bedrock constituting the remainder of cover. Most scree and bedrock inhabiting plants are highly adapted to this xeric environment and occur as singular plants among the exposed rocks or in bedrock fractures. These species are typically cushioned, matted or succulent, or grow as flat rosettes, often with thick leaf cuticles or a dense cover of hairs. Diverse crustose and foliose lichen cover is high (often greater than 50%) on exposed talus and bedrock. Common lichen genera include *Rhizocarpon*, *Xanthoria*, *Lecidea*, and *Umbilicaria* species. Mosses are typically found in bedrock fractures and leeside of bedrock slabs and chutes below the summits especially on the north and east facing aspects. Lichen covered rocks are considered sacred by Blackfeet traditionalists and are left undisturbed wherever they are found.

Forbs occur singly or in small patches among the exposed talus and scree and in fractures of the bedrock or the leeside of bedrock where organic matter has accumulated. In northwestern Montana, common forbs include yarrow (*Achillea millefolium*), elliptic leaf penstemon (*Penstemon ellipticus*), phacelia (*Phacelia* species), alpine sky pilot (*Polemonium viscosum*), alpine spring beauty (*Claytonia megarhiza*), alpine sandwort (*Minuartia species*), cut-leaf daisy (*Erigeron compositus*), draba (*Draba* spp.), boreal crazyweed (*Oxtropis borealis*), silky crazyweed (*Oxytropis sericea*), wooly groundsel (*Senecio canus*), alpine arnica (*Arnica alpina*), moss campion (*Silene acaulis*), spotted saxifrage (*Saxifraga bronchialis*), alpine buckwheat (*Eriogonum ovalifolium*), alpine forget-me-not (*Myosotis alpestris*) and Siberian aster (*Symphyotrichum sibiricus*). Woody species such as arctic dryad (*Dryas octopetala*), shrubby cinquefoil (*Dasiphora fruticosa*) and rock willow (*Salix vestita*) occur in bedrock fractures or the lee side of bedrock and boulders. Saxifrages and ferns also occur in these protected microsites.

Several northern Rocky Mountain endemic species, Montana species of Concern, and potential species of concern inhabit this system. In Montana, some arctic species reach their southernmost range limit within this system, whereas some middle and southern Rocky Mountain species reach their northernmost range limit. Plant Species of Concern found in scree fields on the Blackfeet reservation include Rocky Mountain Front fleabane (*Erigeron lackschewitzii*), stalked pod crazyweed (*Oxytropis podocarpa*), viviparous fescue (*Festuca vivipara*), and rock sedge (*Carex petricosa*).

Rocky Mountain scree fields and barren rock summits are used by numerous species of mammals and birds, including many Species of Concern. Rocky Mountain sheep, Rocky Mountain goats, elk, mule deer, wolverines, grizzly bears, black bears, fisher, as well as pika, marmots, dwarf shrew, snowshoe hares and other species. Golden eagles and ptarmigan use this habitat for nesting and rearing of young. Other species of

concern, peregrine falcon, black rosy finch and grey crowned rosy finch also use this habitat during summer months**.**

These high mountain ecosystems are sacred sites, quest sites, prayer sites and contain archeological and cultural resources, and are vastly important to continuation and preservation of Blackfeet culture and tradition. Ninastakis, Chief Mountain, is critically important to the practice of Blackfeet religious activities. Furthermore, Ninastakis and the landscape surrounding the mountain, can be nominated as an World Heritage Site under the UNESCO Convention (Barney and Peacock 2001); as it meets all nomination criteria for a World Cultural Site. This would protect the area, surrounding forests and cultural plant resources within this portion of the Reservation, and would eliminate development and activities that threaten this highly important area (Figure 32 and Cover page).

(Figure 32: Ninastakis, Chief Mountain, the Sacred Mountain, representing Alpine Cliff and Scree ecosystem, Blackfeet Reservation)

Northwestern Great Plains Badlands

The Western Great Plains Badlands is found within the mixed grass prairie regions of eastern Montana and the fescue grasslands of the northwestern Great Plains region. It is found on the Blackfeet Reservation along the Two Medicine River Drainage and other areas in the central and eastern portions of the reservation (Figure 34). Distinguished by its easily erodible nature, this ecosystem contains low vegetation cover. Common

species include greasewood (*Sarcobatus vermiculatus*), saltbush (*Atriplex species*) and threadleaf snakweed (*Gutierrezia sarothrae*), a Blackfeet cultural plant. The flora of this ecosystem on the Reservation has not been fully documented or described. Other Blackfeet cultural plants, such as breadroot (*Pediomelum esculentum*), known from the historic range of the Blackfeet people further to the east, may be found in this ecosystem on the reservation. The Cretaceous shale badlands that occur in exposures along the Two Medicine River, where prairie transitions to sparely vegetated badlands, support large populations of scared turnip (*Lomatium dissectum*), one of the most important Blackfeet cultural plants used for medicine.

Sedimentary parent material of exposed rocks and the resultant eroded clay soils is derived from Cretaceous sea beds and is often fossil-rich. Dominant soil types are in the order Entisols. These mineral soils are found primarily on uplands, slopes, and creek bottoms and are easily erodible. Typical land uses are range-grazing lands or for wildlife.

Wildlife such as prairie dogs, deer, grouse, snakes, badger, and antelope are common within the badlands. Species of Concern such as black tailed prairie dogs, swift fox, golden eagle, ferruginous hawk, burrowing owl, loggerhead shrike and greater short horned lizard can be found within this ecosystem on the Blackfeet Reservation. These areas are fossil rich and contain numerous Blackfeet cultural and archaeological sites and resources. Where it borders the Two Medicine River, this ecosystem is part of important buffalo jump sites.

(Figure 33: Great Plains Badlands bordering the Two Medicine River, Blackfeet Reservation. Photographer unknown)

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Glossary of Terms

Aerated ─ the addition of air. Well aerated soil includes a component with large particle size (gravels and coarse sand) that increases the amount of air spaces within the soil.

Aerenchyma ─ refers to specialized tissue in roots, stems, and shoots of wetland plants, consisting of large air chambers and thin walled cells adapted for internal circulation of oxygen.

Alkaline ─ soils or water having a pH greater than 7.0.

Amplitude (ecological) ─ the measure of the width, breadth, or extent of the ability of a species to occupy, persist, and reproduce in an environment.

Annual ─ a plant that completes its life cycle in one growing season or one year; it germinates grows, produces flowers, sets seeds, and then dies.

Anoxic ─ the absence of oxygen which occurs in fully saturated soils.

Anthesis ─ the period of time that a plant is flowering.

Aquatic (plant) ─ a plant that grows partly or wholly in water whether rooted in the mud or floating without anchorage.

Association (plant) ─ a term used in vegetation classification in which the association forms the basic unit based on floristics and field data. Dominant species of the association often form the species of the next and succeeding hierarchical levels, such as alliances, macrogroups and groups, in which similar associations are grouped. Each association has a group of dominant species and a group of high-presence or constant species which give the community or association a cohesive structure. An association implies a community with physiognomic and floristic unity, in which dominant species are those in the upper vegetation layer, and usually has one or two co-dominant species. See community (plant).

Biennial ─ a plant that normally requires two years to complete its life cycle; vegetative growth occurs the first year, with flowering, fruiting, and death occurring the second year.

Boreal ─ refers to the coniferous and deciduous forests of the northernmost regions of the northern hemisphere.

Botanical variety ─ a category in taxonomic hierarchy that is below the species and subspecies level.

Brackish (water) ─ water occurring in wetlands that is highly saline or alkaline.

Calcareous ─ rock, soils, or ground water that are alkaline; usually from limestone bedrock.

Carr ─ a deciduous woodland on a permanently wet, organic soil that is usually dominated by alder (*Alnus*), birch (*Betula*), or willow (*Salix*).

Closed depression ─ a depressional wetland that is distinguished by being completely isolated from both the regional groundwater system and inter-wetland surface drainage. They occur in depressional basins found in flat, enclosed upland areas or on level shallow lake basins. The major sources of input water are precipitation and snow melt, and water loss occurs through evapotranspiration.

Competition-the interaction of two species which compete for space and resources needed for survival and growth.

Community (plant) ─ populations of plant species occurring within a habitat that forms a relatively uniform patch, distinct from neighboring patches of vegetation.

Conifer ─ a general term referring to one of four classes of gymnosperms; a cone-bearing tree or shrub such as pine (*Pinus*), spruce (*Picea*), cedar (*Thuja*), fir (*Abies*), or juniper (*Juniperus*).

Coniferous ─ woodlands or forests that are comprised mainly of conifer species.

Cool-season ─ a plant that initiates growth soon after snowmelt in early spring, flowers in mid to late spring, and often goes dormant by early to mid summer in response to summer drought.

Crown ─ 1. the persistent base of an herbaceous perennial; 2. the foliar part of a tree or shrub; 3. the junction of the stem and root in a plant.

Deciduous ─ refers to plants that drop their leaves at the end of the growing season. Compare evergreen.

Decomposition ─ the process of decomposing organic material in interaction with atmospheric conditions, water, invertebrates and micro-organisms.

Dioecious ─ having male and female flowers on separate plants of the same species; species have imperfect, unisexual flowers; seen in buffaloberry (*Shepherdia*) and all willows (*Salix*), aspen and cottonwoods (*Populus*).

Dispersal ─ the scattering of seeds and fruits following maturation. Main dispersal agents include water, wind, mammals and birds, gravity and force.

Dissemination ─ see dispersal.

Disturbance- change induced to a plant community due to anthropogenic stressors or natural causes**.**

Dormancy (plants) ─ the period of inactivity in which active shoot growth has temporarily ceased due to drought or winter conditions.

Dormancy (seeds) ─ seeds that do not germinate immediately after maturation and dispersal from the mother plant even when appropriate environmental conditions exist. Causes of dormancy are either internal or external, and many species have a combination of dormancy types.

Drawdown ─ the lowering of water level that occurs in wetlands, rivers, and streams.

Ecocline- A gradation from one ecosystem to another when there is no sharp boundary between the two. It is the joint expression of associated community (coenocline) and complex environmental gradients.

Ecological system (ecosystem)─ the biological community and abiotic conditions such as climate, geology, hydrology, soils, landforms, and topography that function together as a unit.

Ecotype ─ individuals within a species that are genetically adapted to a specific environment.

Emergent ─ a plant or vegetation that grows in water but the aerial portions of shoots and leaves remain above water line.

Entisols ─ a soil type of relatively recent origin, that is distinguished by high mineral content and a lack of or very faint soil horizon development.

Establishment ─ the early stage (first few weeks) of seedling growth following germination or planting, in which the seedling produces the primary root, followed by the production of a secondary root mass and the first few leaves.

Evergreen ─ having green leaves throughout winter; not deciduous.

Fen ─ a type of wetland that accumulates peat; less acidic than a bog, and deriving most of its water from groundwater rich in calcium and magnesium.

Floodplain ─ a low level plain adjacent to a river that is formed chiefly of river sediment and is subjected to flooding.

Forb ─ a flowering herbaceous plant species, usually with conspicuous flowers and non-grass-like leaves. Term is usually applied to all herbaceous plants other than grasses, sedges, rushes, bulrushes, reeds, and cattails. Compare with graminoid.

Genotype ─ individuals characterized by a certain genetic constitution. Compare phenotype.

Genus (plural Genera) ─ a taxonomic subdivision between the family and species, which includes one or more closely related species.

Geographically isolated wetland- wetlands occurring in closed basins that are isolated from surface water connectivity.

Germination ─ the process whereby seeds or spores sprout and begin to grow.

Graminoid ─ a herbaceous plant that typically has inconspicuous flowers and grass-like leaves, such as grasses, sedges, rushes, bulrushes, reeds, and cattails. Compare with forb.

Herbaceous (life form) ─ a non-woody plant whose stems and leaves die back to ground level at the end of the growing season; a plant without a persistent above growing woody stem. Compare woody.

Histosols ─ a soil type that forms in wetland environments consisting mostly of organic matter, such as peat based soils or mucks.

Horizon (soil) ─ a layer of the soil that is distinguishable from other layers in the soil profile; typically there is an O horizon on the soil surface, followed by an A horizon that is usually higher in organic matter content and biological activity than the underlying B or C horizons.

Hydric (soils) ─ soils that are saturated, flooded, or ponded long enough during the growing season to develop anoxic conditions in the upper part of the soil profile, thereby influencing the species composition or growth, or both, of plants on those soils.

Hydrology ─ the study of the properties, effects, and distribution of water on soils, underlying parent materials, and the atmosphere.

Hydroperiod ─ the period of time a wetland is covered with water. Hydroperiods can range from regularly flooded to irregularly flooded or exposed.

Hydrophyte ─ a plant species adapted to growing in water either as a free-floated aquatic or rooted in mud as a submergent or emergent.

Inceptisol ─ a soil type of older origin than Entisols, that lack an accumulation of clays, iron and aluminum and are characterized by the presence of a surface horizon rich in organic matter and a cambric subsurface horizon, which is derived from sands or finer particles.

Legume ─ a plant species that is a member of the legume family (*Fabaceae)*.

Leguminous ─ of or pertaining to members of the legume family.

Life history ─ the strategies and mechanisms which a plant uses to optimize growth, occupation of habitat, and reproductive success.

Marsh ─ a herbaceous or forested wetland that is typically found in depressions; often adjacent to ponds, lakes, potholes, and river oxbows and having distinctive mineral soils with high organic matter content. Marshes can be seasonal or semi-permanently flooded, depending on site hydroperiod.

Mesic ─ refers to moist habitats.

Microsite ─ a term used to describe small sites within a plant community that differ from the surrounding environmental conditions of the site by having great shade, wind protection, greater moisture retention, swales or pockets of low lying topography.

Mollisols ─ a soil type that is characterized as being fertile; with a deep, organic matter-rich A horizon, found in steep and grassland environments, that are usually calcareous and base-rich, derived from limestone, loess or sand.

Niche- the occupied position of a species or population within a site relative to other species and populations. Species have physiological and biotic limitations that restrict where they can disperse (dispersal niche) germinate (establishment niche), grow (adult niche), reproduce (reproductive niche) or persist (expressed niche).

Nitrogen-fixing (bacteria) ─ the genera of bacteria that have the ability to fixate atmospheric nitrogen and that form symbiotic relationships with certain plants, thereby supplying them with additional nitrogen.

No-Net-Loss- a national mitigation policy goal aiming to prevent and offset the destruction or degradation of wetlands by compensatory mitigation, creation of artificial wetlands and restoration of and management of existing wetlands.

Non-dormant ─ refers to seeds that do not exhibit seed dormancy at time of maturity and seed dispersal, and will germinate as soon as they contact moist substrates and ambient temperatures. Same as non-orthodox seeds.

Open depression ─ a depressional wetland that is distinguished by having an open basin, larger connection to the surrounding watershed and a connection to groundwater tables.

Organic matter ─ material of organic origin derived from plants and animals that has decomposed to a state that the contributions are no longer recognizable. When organic matter has broken down into a stable humic substance that resists further decomposition, it is called humus.

Overstory ─ the uppermost canopy of vegetation in a plant community.

Oxidation-reduction potential (soils) ─ a quantitative measure of the energy of oxidation. Oxidation is equivalent to a net loss of electrons by the substance being oxidized, and reduction is equivalent to a net gain of electrons by the substance being reduced.**Partthecarpy** ─ the natural or artificial development of fruit without sexual fertilization. See parthenogenesis.

Peat ─ soil material consisting of partially decomposed organic matter; found in wetlands such as fens, forest swamps, and bogs found in temperate and arctic environments. It is formed by the slow decay of successive layers of aquatic and semi-aquatic plants, such as sedges, rushes, wetland grasses, and mosses. One of the principal types of peat is moss peat, derived primarily from sphagnum moss.

Perennial ─ a plant that lives longer than 3 or more years.

pH ─ a measure of the acidity or alkalinity of a water sample, soil sample or solution, where 7 is neutral, >7 is more alkaline, and <7 is more acidic.

Phenology ─ the various biological processes that are correlated with the seasons, such as flowering, fruiting, dormancy, bud break, and root and stem elongation.

Phenotype ─ all characteristics of a plant, as determined by the interaction between genotype and the environment. Compare genotype.

Physiology (plants) ─ the functioning of an organism determined by biochemical processes and cellular and tissue structure and processes.

Playa- a geographically isolated, shallow depressional recharge wetland found in the southern Great Plains region, formed by subsurface material and wind deflation. Similar to closed depressional wetlands in the Prairie Pothole Region.

Pothole ─ a depressional wetland that is distinguished by occurring in depressions carved out by glaciers; closed basins that receive irregular inputs of water from the surroundings and export water as groundwater. Hydrology of potholes is complex and the concentration of dissolved solids results in water that ranges from fresh to extremely saline, with chemical characteristics varying seasonally and annually.

Propagule ─ any plant part (seeds, stems, roots, bulbs, fragments, or turions) that forms a new plant.

Rare (Species or ecosystem)- typically refers to a species' or ecosystem type that is limited in geographic distribution, limited population size, or limited numbers.

Recruitment limitation-describes abiotic factors such as geographic position and distance and biotic factors such as dispersal distance that limits a species ability to recruit into another area. Same as dispersal barrier.

Redox concentrations ─ soft masses of accumulated iron and manganese concentrations found in wetland soils.

Redox depletions ─ characteristic in hydric soils that show where reduction occurs, usually in the form of gleying.

Refugia ─ areas that have escaped recent or past climatic change and serve as a haven for flora and fauna

Rhizomatous ─ producing or having rhizomes.

Rhizome ─ a specialized stem in which the main axis of the plant grows horizontally or vertically at or below the soil surface; can be either thickened or very slender, woody or non-woody.

Riparian ─ the plant community that occurs on the banks of a river or stream.

Safe site- microsite capbale of supporting germination and establishment of propagules. See niche.

Saline depression ─ a depressional wetland that is distinguished by having high salinity attributed to high evaporation and the accumulation of minerals dissolved in the water. Saline depressions are discharge wetlands, where water high in dissolved salts has moved from the regional groundwater system into the depression. During drawdown, salt encrustations form on the soil surface.

Sapling ─ a young tree that is generally at least 2 years old and <10 cm (4 in) in dbh.

Satellite ─ refers to a habitat that occurs in distant proximity to similar habitats; important for the migration or movement of organisms.

Sedimentation- the deposition of soil particles entering a wetland by wind, water or gravitation erosion, causing filling of wetland basins or riparian areas and often forming a distinct layer over wetland soils.

Seed ─ a ripened ovule that consists of an embryo, seed coat, and usually nutritive tissue (endosperm in flowering plants).

Seed Bank- The seeds present on or within the soil of a natural habitat that have the potential to germinate and grow into plants.

Species ─ a group of individuals that usually breed only with one another and exhibit certain characteristics.

Sphagnum ─ any species of the large and widely distributed genus *Sphagnum*, the principal peat constituent in fens and bogs, typically growing in hummocks and floating mats.

Steppe ─ grassland or prairie.

Subalpine ─ growing in the mountains below treeline but above the montane zone.

Submergent ─ a plant or vegetation that is completely submerged below the surface of the water.

Subspecies ─ a category in taxonomic hierarchy that is below the species level.

Succession ─ the gradual process of change in an ecosystem brought about by the progressive replacement of one community by another until a stable climax is established.

Symbiotic (organism) ─ an organism that lives on, or in, the root system of a plant in a mutually beneficial relationship. Refer to *Frankia,* mycorrhiza, *Rhizobium*.

Taxa (taxon singular)- is a distinct entity such as a species, variety, or subspecies.

Texture (soil) ─ a soil property used to describe the relative proportion of different grain sizes of mineral particles in a soil.

Understory ─ the lower levels of canopy of vegetation in a plant community.

Viability ─ the capacity of seeds to germinate.

Wet meadow ─ an herbaceous wetland that is characterized by having a water table at or close to the soil surface for most of the year.

Woody ─ a plant with persistent above ground woody stem(s). Compare herbaceous.

Appendix 1: Species Ranking Definitions

The Montana Natural Heritage Program serves as the states principal source of information for species of concern- plants and animals that are at risk or potentially at risk in Montana. The MNHP Plant Species of Concern Report (2010) identifies 440 vascular Plant Species of Concern (SOC) and an additional 134 Potential Species of Concern (PSOC), based on information sources that include field inventories, publications, reports, herbarium specimens and knowledge of Montana botanists and ecologists. Updated rankings for community types or ecosystems within the state are currently under review and development.

Species of Concern (SOC) are species that rare, threatened, and/or have declining populations and as a result are at risk or potentially at risk of extirpation within Montana. Species of concern include all species, subspecies or varieties that are currently ranked S1, S1S2,S2, S2/S3, SH, or G3. Designation as a Species of Concern is not a statutory or regulatory classification. Instead, these designations provide a basis for resource managers and decision-makers to make proactive decisions regarding species conservation and data collection priorities in order to maintain viable populations and avoid extirpation of species from the state.

Potential Species of Concern (PSOC) includes taxa currently ranked as S3 in the state, except for G3 taxa which are designated as species of concern. Taxa in this designation include species or subspecies which may be rare, have a restricted range in the state or are otherwise vulnerable to extirpation in at least part of their range, but otherwise do not meet the criteria for inclusion as a SOC. An additional designation of "Status Under Review" is used for those taxa for which additional information is needed to accurately assign a status rank or for which conflicting information exists. Taxa with ranks of SR or SU are included into a new "Review" category. The rank definitions variants and qualifiers for Global and State ranking are described below.

Community and Species Rank Definitions

Conservation ranks are assigned to species and communities so that at-risk elements can be prioritized for conservation efforts. The international network of Natural Heritage Programs employs a standardized ranking system to denote global (G -- range-wide) and state status (S) (NatureServe 2010). Ranks range from 1 (critically imperiled) to 5 (demonstrably secure), reflecting the relative degree to which they are "at-risk". Rank definitions are given below along with rank qualifiers. A number of factors are considered in assigning ranks -- the number, size and distribution of known occurrences, short term and long term trends in population size and area and threats to their integrity or existence.

GX/SX Presumed Extirpated-Species or ecosystem is believed to be extirpated from the jurisdiction (i.e., nation or state/province). Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

GH/SH Possibly Extirpated- Known from only historical records but there is potential for rediscovery. There is evidence that the species or ecosystem may no longer be present in the jurisdiction, but not enough to state this with certainty. Examples of such evidence include (1) that a species has not been documented in approximately 20-40 years despite some searching or some evidence of significant habitat loss or degradation; (2) that a species or ecosystem has been searched for unsuccessfully, but not thoroughly enough to presume that it is no longer present in the jurisdiction.

G1/S1 Critically Imperiled-At very high risk of extinction due to extreme rarity (often 5 or fewer populations or occurrences), very steep declines, or other factors.

G2/S2 Imperiled-At high risk of extinction or elimination due to very restricted range, very few populations or occurrences, steep declines, or other factors.

G3/S3 Vulnerable-At moderate risk of extinction or elimination due to a restricted range, relatively few populations or occurrences, recent and widespread declines, or other factors.

G4/S4 Apparently Secure-Uncommon but not rare; some cause for long-term concern due to declines or other factors.

G5/S5 Secure-Common; widespread and abundant.

Variant Qualifiers

G#G# /S#S# Range Rank—A numeric range rank (e.g., G2G3, G1G3) is used to indicate the range of uncertainty about the exact status of a taxon or community type.

GU/SU Unrankable—-Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

GNR/SNR Unranked—Global or state rank not yet assessed.

GNA/SNA Not Applicable—A conservation status rank is not applicable because the species or community type is not a suitable target for conservation activities; ie. non-native species or community types (weeds, anthropogenic communities: farm fields, plantations, etc).

Rank Qualifiers

G? /S? Inexact Rank Qualifiers – Denotes inexact numeric rank.

GQ Questionable Taxonomy- that may reduce conservation status- Distinctiveness of this entity as a taxon or ecosystem type at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or

inclusion of this taxon or type in another taxon or type, with the resulting taxon having a lower-priority (numerically higher) conservation status rank. The “Q” modifier is only used at a global level and not at a national or subnational level.