Mountain Grasslands and Alpine Tundra

Photo courtesy of WGFD

Table of Contents

Habitat Description

Mountain grasslands are defined as grasslands in montane landscapes typically above 6,500 to 7000 feet in elevation and alpine areas above timberline. These grasslands are frequently referred to as parks or mountain meadows, while alpine areas are referred to as turf fellfield or dwarf-shrubland. Within the mountain grassland, and interspersed with montane and subalpine forest types, are small, but unique tall forb communities. Tall forb communities are typically dominated by wild geranium, nettleleaf, arrowleaf balsamroot, western coneflower, asters, fleabanes, yarrow, some sedges, alpine timothy, mountain brome, and a few plants of mountain big sagebrush, or dwarf willows and snowberry. NatureServe (2010) lists and provides descriptions of the five ecosystems characterizing these habitat types (Table 11).

Within mountain grassland types, species composition varies with elevation, moisture, soil depth, and soil type. Bluebunch wheatgrass, needle-and-thread, Junegrass, Sandberg's bluegrass, and fringed sagebrush are common at lower elevations. As elevation increases, Idaho fescue, bearded wheatgrass, green needlegrass, other needlegrasses, bluegrasses, tufted hairgrass, sedges, lupine, sticky geranium, prairie smoke, hawk's-beard, and pale agoseris become more prevalent (Tweit and Houston 1980, Knight 1994). Wet meadows are found along streams and in areas where snow melt provides abundant moisture. Mountain big sagebrush, mountain silver sagebrush, shrubby cinquefoil, and various dwarf willows are common shrubs in mountain meadows.

The absence of trees in mountain grasslands is often the result of fine textured soils and their moisture-holding characteristics. Such soils are often too wet during the growing season to allow for the establishment of conifer seedlings. On steeper south-facing slopes, fine textured soils can be too dry to support trees. In other locations, soils can be too shallow for trees, or persistent snow drifts can preclude tree growth. Competition from established herbaceous plants as well as cold-air drainage or frost pockets may also restrict tree establishment (Knight 1994). Lastly, disturbances such as forest fires, avalanches, and tree blowdowns can create conditions favorable to the establishment and persistence of mountain grasslands. Clearcut timber harvests often regenerate as mountain grasslands for several years before succeeding back into seedling/sapling stage forests.

Alpine tundra exists at the highest elevations where winds are severe and temperatures too low during the growing season to allow for adequate photosynthesis needed to support larger plants (Knight 1994). This often occurs where either the mean July temperature is lower than 50° F or the mean July maximum temperature is lower than 52° F (Tranquillini 1979, Arno and Hamnerly 1984). In Wyoming, subalpine forests and Krummholz give way to the treeless alpine tundra at elevations ranging from about 11,480 feet in the Medicine Bow Mountains in the south to about 9,840 feet in the Beartooth Mountains in the north (Nicholoff 2003). Alpine soils can be very dry as a result of severe cold, persistent strong winds, intense ultraviolet radiation, low vapor pressure at high altitudes, and reflective solar radiation from snowbanks. These effects can impair photosynthesis and limit growth of woody vegetation (Knight 1994).

Alpine tundra is more diverse than the lower elevation mountain grasslands. Common species include sheep fescue, spike trisetum, kobresia, tufted hair grass, alpine bluegrass, alpine avens, dwarf willows, and numerous cushion plants and sedges. Alpine plants tend to have much more root and rhizome biomass than shoots, leaves, and flowers. This feature not only aids in water and nutrient absorption, but also plays a very important role in over-winter carbohydrate storage (Nicholoff 2003). Reproduction in alpine plants is largely vegetative due to difficulties of seedling establishment in such a harsh environment.

Alpine vegetation generally occurs in a mosaic of small patches with widely differing environmental conditions. Changes in

topography of as little as one foot or less may mean the difference between a windswept area and an area of protective snow accumulation, which can have a dramatic effect on the composition and productivity of the local plant community (Nicholoff 2003). Recovery after disturbance in alpine tundra is long, due to a very short, cold growing season and extremely slow soil formation.

The majority of mountain grasslands in Wyoming are under federal management. Roughly 98% of alpine tundra is publicly owned, and 72% is in wilderness areas (Nicholoff 2003). Important human uses of the mountain grassland and alpine tundra habitats include livestock grazing, recreational hiking, hunting, fishing, photography, rock climbing, camping, off-road vehicle travel, skiing, horse-packing, and mining. Mountain grasslands and alpine tundra also play important roles in water collection and storage, mostly through snow accumulation and melting, which is slowly released into Wyoming's streams and rivers throughout the summer in the form of runoff.

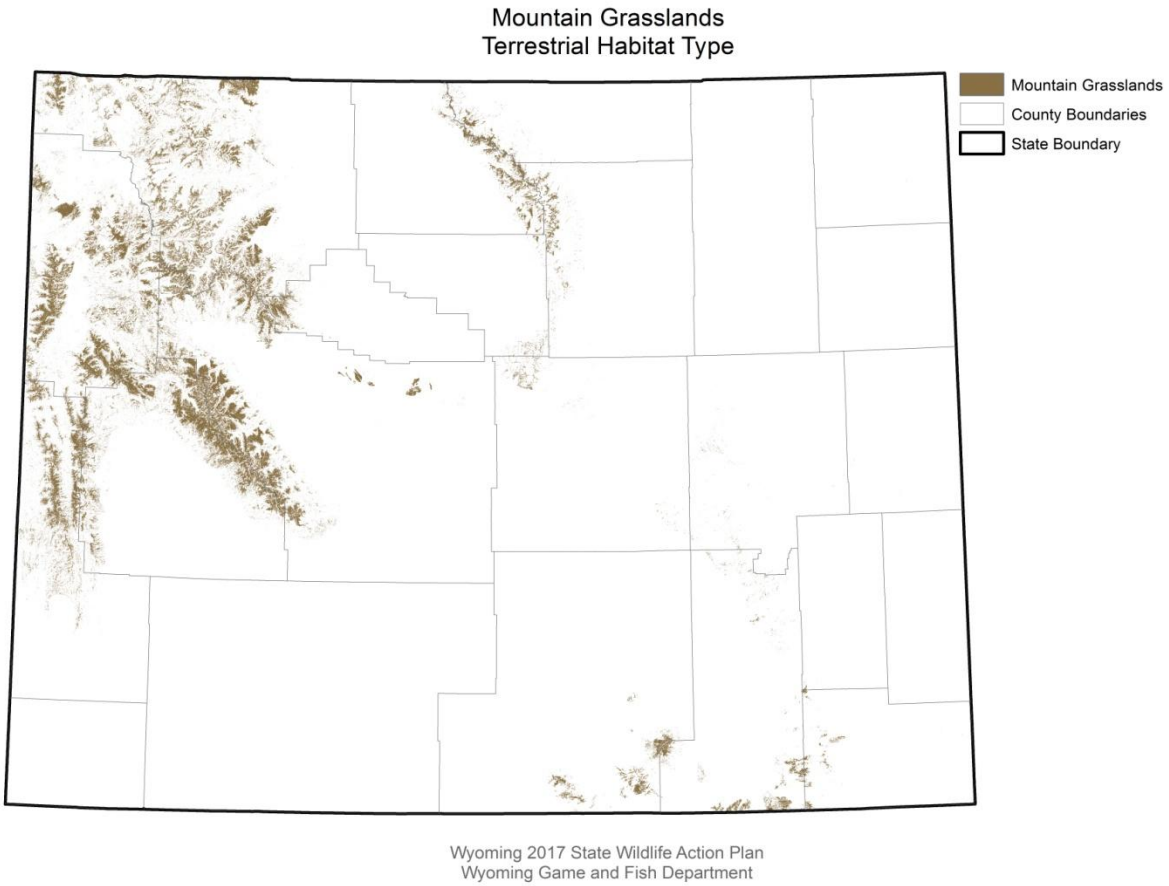


FIGURE 11. Wyoming Mountain Grasslands and Alpine Tundra

TABLE 11. Wyoming Mountain Grasslands and Alpine Tundra NatureServe Ecological Systems[1]

1. Northern Rocky Mountain Subalpine-Upper Montane Grassland
2. Rocky Mountain Alpine Turf
3. Rocky Mountain Alpine Dwarf-Shrubland
4. Rocky Mountain Subalpine-Montane Mesic Meadow
5. Southern Rocky Mountain Montane-Subalpine Grassland
6. Harvested forest-grass regeneration

[1] Descriptions of NatureServe Ecological Systems which make up this habitat type can be found at: NatureServe Explorer: an online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, VA. http://www.natureserve.org/explorer.

TABLE 12. Wyoming Mountain Grasslands and Alpine Tundra Species of Greatest Conservation Need

Mammals
American Pika
Bighorn Sheep
Dwarf Shrew
Moose
Preble's Shrew
Water Vole
Wolverine
Uinta Chipmunk

Birds
American Pipit
Calliope Hummingbird
Black Rosy-finch
Brown-capped Rosy-finch

Reptiles
Northern Rubber Boa
Red-sided Gartersnake
Smooth Greensnake
Valley Gartersnake

Amphibians
Columbia Spotted Frog
Wood Frog
Western Toad

Mountain Grasslands and Alpine Tundra Wildlife

Abiotic conditions in alpine habitats can be both harsh and highly variable. Consequently, animals that live in these environments use several unique adaptations in order to survive. These include food caching, diet-switching, subterranean habitat use, torpor and hibernation. Wildlife in mountain grasslands and alpine tundra is often limited in the winter by deep snowpack. Many species, including big game and passerine birds, migrate to lower elevations and latitudes in the winter, occupying this habitat type only in the spring, summer, and fall.

Mountain grasslands and herblands can be characterized as patches of high primary productivity (i.e., forbs and grasses) embedded within a generally low-productive understory contained within the forest matrix. This combination provides critical forage patches in close proximity to tree cover. For example, mountain grasslands and herblands provide important summer forage for elk, mule deer, moose, and bighorn sheep. Mountain goats, which are not native to Wyoming, use this habitat year round. Small mammals found in mountain grasslands and alpine tundra include water vole, montane vole, long-tailed vole, short-tailed weasel, and yellow-bellied marmot. The northern pocket gophers plays a keystone role in this environment through constant soil disturbance and root herbivory, which facilitates nutrient cycling, air and water penetration into the soil, and creates a fine-grained patchwork of understory plant communities in various stages of vegetational succession. In addition to plants, mountain grasslands and herblands are an important source of insects, which further contribute to the forage base for vertebrate wildlife and provide means for pollination and reproduction by vegetation.

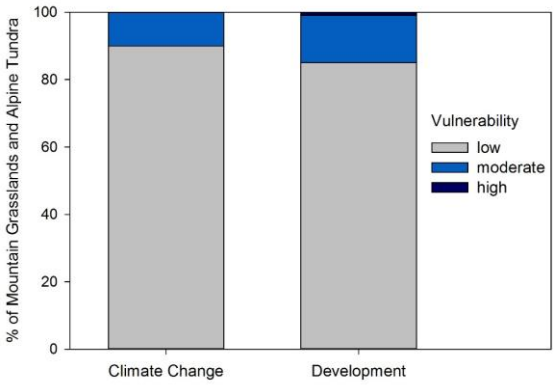
Due to the severe climate, few vertebrate species, including birds, are able to breed in the alpine tundra. Although the avifauna of the alpine tundra is small compared to those of other habitats, these species (e.g., brown-capped rosy-finch, black rosy-finch, and American pipit) are typically specialized and endemic, and are not found in other habitats during the breeding season. Both rosy-finch species are SGCN and breed above timberline in barren, rocky, or grassy areas, including cirques, talus slopes, and alpine areas that have cliffs, snowfields, or glaciers nearby. The American pipit is a well known breeder in arctic and alpine tundra, using coastal beaches and marshes, stubble fields, recently plowed fields, mudflats, and river courses during migration and winter. Mountain(Subalpine) grasslands and herblands below the tundra zone support a more diverse avifauna, with many tree-nesting species using adjacent grasslands as foraging patches.

Considerable data gaps exist for many of the SGCN mammals found in these habitats. However, some key habitat components can be

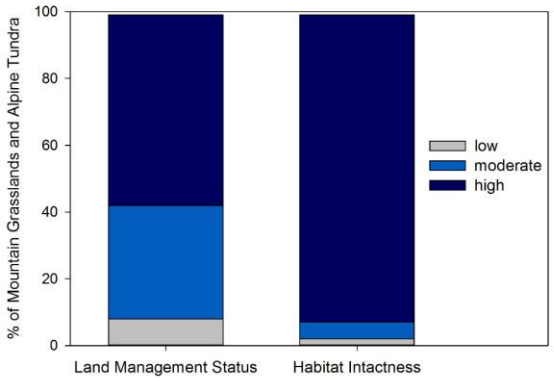
identified, such as high structural diversity of alpine meadows, high diversity of invertebrates, and proximity of habitat to water, which increase the value of these habitats for these mammals. Many alpine animals also rely on access to microrefuges, such as rock crevices or grass cover, which can provide immediate reprieve from extreme conditions (Rull 2009 and Shi et al. 2015). The American pika and the wolverine are Wyoming SGCNs that are found in the mountain grasslands and alpine tundra habitat type. They have been petitioned for protection under the Endangered Species Act, most recently regarding concerns that they may be negatively impacted by climate change.

Mountain Grasslands and Alpine Tundra Habitat Threats

Figure 12. Mountain Grasslands and Alpine Tundra Vulnerability Analysis



The colored bars show the proportion of the habitat type that was identified as having low, moderate, or high vulnerability to climate change or development, based on classification of scores ranging from 0 to 1 into the following categories: low (<0.34), moderate (0.34-0.66), and high (>0.66). Rankings for climate change or development vulnerability were based on the land area of the habitat type classified as having high vulnerability: low (<10%), moderate (10-33%) or high (>33%). Vulnerability was calculated as exposure minus resilience. Development vulnerability includes existing and projected residential, oil and gas, and wind energy development. Further details are provided in the Leading Challenges section of this report and in Pocewicz et al. (2014).



The colored bars show the proportion of the habitat type that was identified as having low, moderate, or high land management status or habitat intactness. For land management status, high corresponds to the percent of the habitat occurring in GAP status 1 or 2, moderate to the percent occurring in GAP status 2b or 3, and low to the percent occurring in GAP status 4. Rankings for land management status were based on the land area of the habitat type classified as having high status or legal protection: low (<10%), moderate (10-33%), or high (>33%). For habitat intactness, scores ranging from 0 to 1 were assigned to categories as follows: low (<0.34), moderate (0.34-0.66), and high (>0.66). Rankings for intactness were based on the land area of the habitat type classified as having high intactness: low (<25%), moderate (25-75%), or high (>75%).

Human disturbances have been of relatively low intensity and localized in the alpine zones because a majority of this habitat type is within designated wilderness. However, any disturbance above treeline may have lasting effects because of harsh growing conditions and low productivity. Because of their generally easier access and higher productivity, montane grasslands and herblands have received greater human-related impacts.

Invasive plants – High

The potential for invasive plant spread in the mountain herblands and grasslands has dramatically increased since the 1960s. This is particularly evident in drier montane habitats dominated by bluebunch wheatgrass and Idaho fescue. Spotted knapweed, leafy spurge, cheatgrass, yellow toadflax, Dalmatian toadflax, orange hawk's-beard, oxeye daisy, and nonnative thistles pose a serious threat to plant diversity and land productivity. In tall forb communities, mule ear and tarweed can increase under improper grazing conditions. Alpine tundra and subalpine areas tend to be more resistant to noxious weed invasion due to harsh growing conditions and fewer vectors.

Lower elevation montane habitats may become threatened by cheatgrass and other invasive species, which are more tolerant to changing climate conditions and varying levels of soil moisture, that currently occur below the subalpine zone.

Climate change – High

Mountain systems are highly sensitive to climate change (Pauli et al. 1996, Gottfried et al. 2012 and Oyler et al. 2015). In the alpine zone, climatologists have recorded increases in spring and winter temperatures (Mote and Redmond 2012), a decline in the ration of precipitation falling as snow (Knowles et al. 2006), and decrease in snow cover (Walther et al. 2002). In Wyoming, the greatest increases in annual temperature during the past 50 years have occurred at high elevations in the Wind River, Gros Ventre, Absaroka, Wyoming, and Salt ranges (Girvetz et al. 2009). There are concerns over long-term persistence of alpine and subalpine habitats under climate warming scenarios. Rising global temperatures may lead to drier environmental conditions in these habitats which could cause shifts in species composition and the loss of high elevation wet meadows, which function as important natural water storage features and hydrological flow regulators. Warming surface temperatures are expected to be most pronounced at high elevations and latitudes. Changes in species diversity may be most apparent in alpine landscapes as warmer conditions encourage lower elevation species to expand their range upward in elevation and northward in latitude (Walther et al. 2002 and Thuiller et al. 2005). The redistribution of vegetation into alpine tundra will depend on a variety of factors, including temperature extremes and water limitations. Subalpine conifers have been documented as infilling these areas—a trend that is suspected to be related to changing climate conditions (Joyce et al. 2007).

Changing dynamics of animal communities linked to changing climate conditions have also been observed and documented in areas of high elevation and/or latitude (Parmesan 2006). Terrestrial species that are associated with alpine tundra and mountain grasslands may be impacted by warmer temperatures, changing precipitation patterns, and mountain snow runoff, which will likely influence climate-sensitive behaviors, animal abundance, and species diversity. These changes may result in functionally fragmented habitats and lead to isolated populations. Similarly, high elevation fisheries may be impacted by changing climate conditions that lead to alterations in water temperature, chemistry, or quality and quantity (see Wyoming Leading Wildlife Conservation Challenges – Climate Change).

Overgrazing by ungulates - Moderate

At proper stocking levels, grazing regimes can be compatible with montane and subalpine habitat function. Alpine habitats are less compatible with livestock grazing practices due to the short snow-free season, low productivity, and slow ecosystem recovery after disturbance. Improper grazing practices can eliminate

vegetation, cause soil erosion and compaction, encourage invasion of invasive plants, change vegetation composition, and reduce the availability of cool microclimates that are important to the occurrence of some mountain amphibians and invertebrate species. Historic grazing within tall forb communities has led to loss of soil, stream sedimentation, and changes in plant species in many areas in western Wyoming; and may require decades of rest and management to reverse these trends.

The degraded condition of some subalpine and alpine areas in the West has been the result of uncontrolled grazing, mainly by domestic sheep, which occurred in the late 19th and early 20th centuries (Winward 1998, Belsky and Blumenthal 1997). Early grazing operations herded sheep in tightly grouped bands, continuously bedded them in the same location for several nights, and drove them to and from water. These practices reduced forage through trampling and overgrazing, especially near water, and damaged soil through excessive trailing and compaction. Alpine ranges are still grazed by domestic sheep, but in some instances the intensity is much lower.

Recreational livestock use (i.e., pack stock) can also have detrimental localized effects through soil compaction and overgrazing. Wild ungulates also graze alpine habitats, and overgrazing is not uncommon in localized areas.

Recreation –Moderate
Recreational activities such as camping, hiking, biking, horse-packing, and off-road travel can degrade mountain grasslands and alpine tundra. Recreationists may trample plants, compact the soil, increase soil erosion, and contribute to the establishment of invasive plant species. Human activities may also disturb animals, including birds, especially during breeding season (Nicholoff 2003). Recreational activities appear to be most detrimental when concentrated and repeated on the same ground, such as is found near trails, trailheads, and developed campsites, and they have less effect when dispersed. Road development in mountain landscapes brings more people, livestock, exotic plant species, generalized disturbance, and pollution into the ecosystem. Motorized vehicles, including ATVs and snowmobiles, can have significant impacts on wildlife and plant communities.

Current Mountain Grasslands and Alpine Tundra Conservation Initiatives

Land exchanges and purchases have occurred on some mountain grassland habitats in Wyoming to consolidate land and facilitate more efficient land management for both private landowners and public agencies, or to protect in-holdings or adjacent lands with high ecological and/or recreational value.

The Nature Conservancy (TNC) works in several areas of Wyoming where mountain grassland and alpine meadow landscapes are prevalent. The organization works with private landowners and public land managers to protect the integrity of these areas where important plant and animal alpine species are found. TNC has used conservation easements, land exchanges, and grazing and invasive plant management techniques to conserve high elevation landscapes and species, including the American pika and bighorn sheep, in the Absaroka, Bighorn, and Wind River Mountains.

As part of a larger effort to reduce invasive species, certified weed-free hay is required for livestock producers and recreational horseback riders using many federal lands, including National Parks and U.S. Forest Service lands. Early Detection and Rapid Response strategies to prevent the establishment of invasive species are being developed for both public and private lands.

Additionally, the PlayCleanGo campaign was initiated by Weed and Pest Districts across the state. The concept of cleaning gear, before and after recreating to prevent the spread of weed seeds has gained many partners across the state.

The Wyoming Natural Resources Conservation Service (NRCS) is working with the Wyoming Association of Conservation Districts (WACD) to use Light Detection and Ranging (LiDAR) technology to acquire statewide elevational data that will benefit Wyoming's natural resource managers. LiDAR has the potential to provide state resource managers with high resolution Digital Elevation Models (DEMs) that cover large areas with highly accurate data. This effort will have many positive implications for effectively modeling and monitoring state hydrology, vegetation, soil, and other surface features, which could be particularly useful as changing climate conditions alter high elevation landscapes.

NRCS, Bridger Teton National Forest and Wyoming Game and Fish Department have been collaborating to develop an Ecological Site Description for Tall Forb Communities (Loamy Vertic, 20"+ precipitation). This will include plant community phases, species lists, soils data, production tables, state and transitional models, and other climatic references to help managers make better decisions for this community in the future.

Recommended Mountain Grasslands and Alpine Tundra Conservation Actions

Grazing plans for mountain grasslands and alpine tundra should be developed and evaluated on a case-by-case basis to address specific site conditions.
Leaving 70–80% residual herbaceous for major species is recommended for alpine tundra grazing strategies (Nicholoff 2003). The fall date of removing livestock from alpine areas should be carefully monitored. Monitoring helps to avoid trampling damage to soil that has been moistened by snow, but is not yet solidly frozen; damage to preformed flower buds, which could influence plant growth the following growing season; and livestock losses to early fall snowstorms. Big game grazing impacts should be considered when setting herd population objective levels.

Appropriate grazing guidelines that will allow restoration of tall forb communities should be established. An initial attempt to establish grazing guidelines for tall forb communities through species composition of five key plant species and ground cover has been made (O'Brien et al. 2003). This work needs to be refined to include additional species and focus on species composition by occurrence versus canopy cover. Tall forb sites with low amounts of remnant species may restore themselves, providing grazing management is such that seedlings can be sustained. Where no remnant desirable species remain, artificial reintroduction of native forb species will be required (Winward 1998).

Use minimum impact fire suppression tactics in mountain grasslands and alpine tundra.
Although fire is an important successional influence in montane and subalpine elevations, it is not usually as influential as in the alpine zone. In general, alpine communities are usually too wet to burn, or the plants are too widely spaced to carry a fire. Wildfire management at montane and subalpine elevations, however, can have profound effects on non-forested habitat. Some fires should be allowed to burn unless they pose a significant risk to human lives or structures. When fighting fires the use of fire retardants, fire/dozer lines, and other tactics which may damage fragile vegetation and soils should be limited.

Create recreation plans for mountain grasslands habitats.
Consider potential disturbances to wildlife and plant communities when planning or locating trails, camping sites, picnic areas, and other sites of concentrated human activity within subalpine habitat and alpine tundra. In recreational use plans for alpine habitats, considerable attention should be given to the kinds of vegetation and soils present and their susceptibility to change and destruction. Buffer zones should be established between roads and recreational

facilities. Road networks in general are the main vector of disturbance into these habitats; thus, travel plans and road maintenance/retirement plans will figure largely in their future distribution and quality.

Rehabilitate degraded sites, including heavily-used recreation sites.
Where possible, restore disturbed sites to native plant communities. Revegetation minimizes erosion and associated reduced water quality and aids in reestablishing native plant communities. Seed mixes should reflect local plan diversity. Local seed stock is preferred and nonnative plants should be avoided. Revegetate alpine disturbances in the fall. Most high-elevation areas remain inaccessible in the spring until large snowdrifts melt. By the time access and site conditions are suitable, the optimum conditions for seed germination and seedling development may be passed (Nicholoff 2003). Fall revegetation ensures that seeds and amendments will be in place when conditions are ideal for germination the following spring as snowmelt occurs (Nicholoff 2003).

Mountain Grasslands and Alpine Tundra Monitoring Activities

Continue monitoring mountain grasslands and alpine tundra SGCN in order to detect population trends or changes in distribution that may reflect habitat problems.
Implement mountain grasslands and alpine tundra monitoring programs to establish baseline data and identify changes in habitat quality (both positive and negative) over time. This information should be used to guide future monitoring and research, as well as to identify and address habitat conservation needs. Important information gaps include the ability of montane SGCN to adjust to climate change, and whether modification in behavior and habitat use will allow SGCN to keep pace with changing conditions.

Continue to monitor the distribution and condition of mountain grasslands and alpine tundra through remote sensing and ground surveys.
Remote sensing is useful in tracking the size and distribution of this habitat in Wyoming. Information gathered would be helpful in determining the cumulative impacts of activities and events such as road and trail building, effects of adjacent forest fires and beetle outbreaks, and the possible effects of climate change.

Monitor the effects of individual grazing strategies in mountain grasslands and alpine tundra to check progress toward established objectives.
Record how key alpine plant species and the overall alpine tundra and mountain grassland ecosystems respond to grazing management (Nicholoff 2003). Collecting basic range analysis data is essential to be able to evaluate the effects of natural and human activities on habitat conditions over time. Annual photographs taken from the same point are helpful (Nicholoff 2003).

In cooperation with research entities and the Wyoming State Climatologist, monitor the effects of climate change.
Changing climate conditions, including warming temperatures and changing precipitation patterns, may cause observable impacts to high elevation and high latitude landscapes. These impacts will affect both the terrestrial and aquatic species that inhabit alpine tundra and montane grassland habitat. Efforts should be made to monitor changes in seasonal temperatures, temperature extremes, season length, precipitation variability, and snow pack.

Monitor the effects of human recreation on wildlife behavior and population dynamics and stability of alpine grassland habitat.

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