Mountain Grasslands and Alpine Tundra

Photo courtesy of WGFD

Table of Contents

Habitat Description

For Wyoming's 2010 State Wildlife Action Plan (SWAP) 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, with 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.

Most 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.

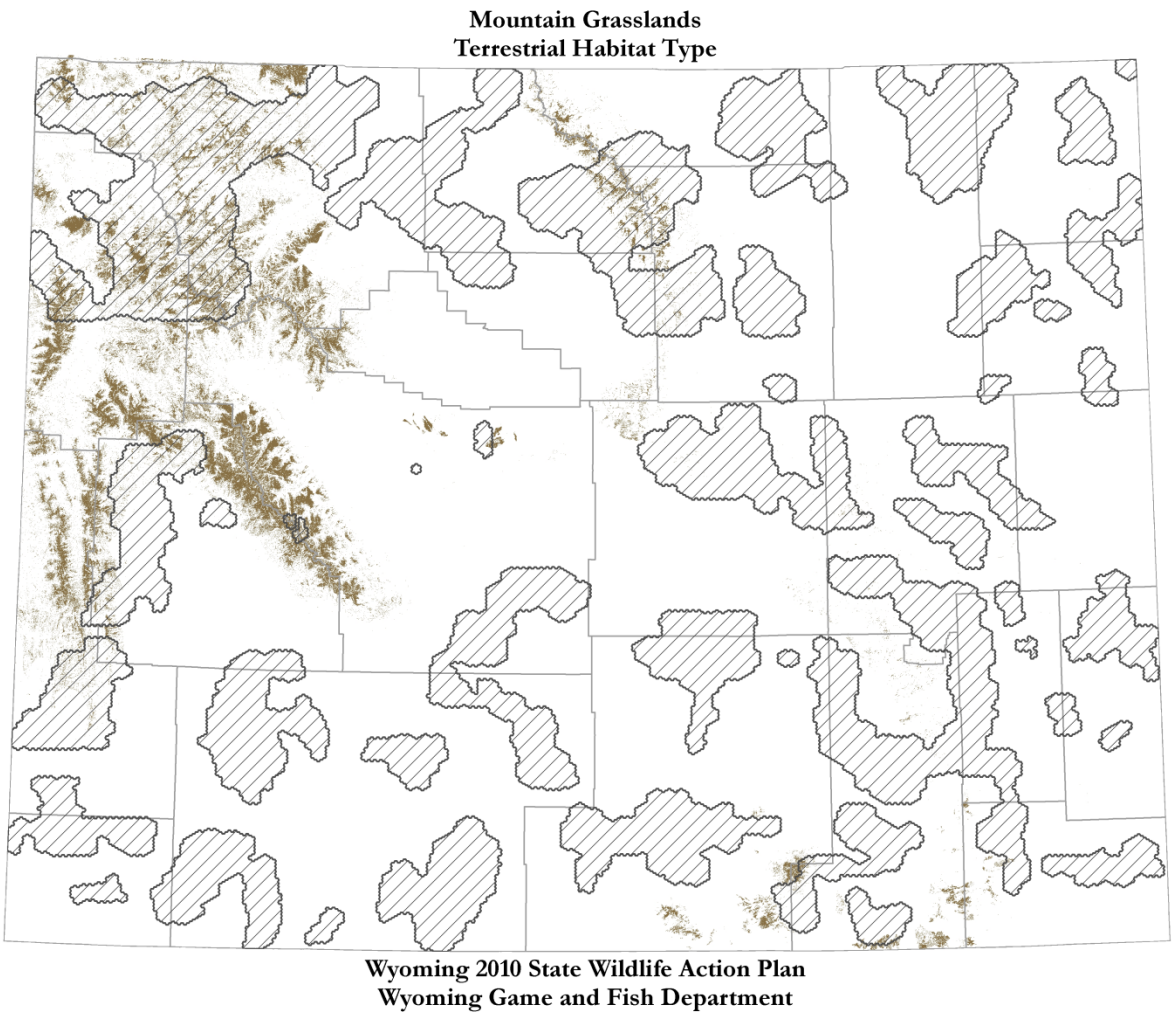

FIGURE 6. Wyoming Mountain Grasslands and Alpine Tundra and SWAP SGCN Priority Areas (cross-hatched areas)

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
Vagrant Shrew
Water Vole
Uinta Chipmunk
Yellow-pine Chipmunk

Birds
Black Rosy-finch
Brown-capped Rosy-finch

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

Amphibians
Columbia Spotted Frog
Wood Frog

Mountain Grasslands and Alpine Tundra Wildlife

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 can be characterized as patches of high primary productivity (i.e., forbs and grasses) embedded within a generally low-productive forest matrix. This combination provides critical forage patches in close proximity to tree cover. For example, mountain grasslands provide important summer forage for elk, mule deer, 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 are an important source of insects, which further contribute to the forage base for vertebrate wildlife.

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 grasslands 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 grasslands, high diversity in invertebrates, and proximity of grasslands to water, which increase the value of these habitats for these mammals. The American pika is a Wyoming SGCN that is found in the mountain grasslands and alpine tundra habitat type. It has been petitioned several times for protection under the Endangered Species Act, most recently regarding concerns that it may be negatively impacted by climate change.

Mountain Grasslands and Alpine Tundra Habitat Threats

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, the lower elevation mountain grasslands have received greater human-related impacts.

Invasive plants – High
The potential for invasive plant spread in the mountain grasslands has dramatically increased since the 1960s. This is particularly evident in drier grasslands 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. Alpine tundra areas tend to be more resistant to noxious weed invasion due to harsh growing conditions and fewer vectors.

Climate change – Moderate
There are concerns over long-term persistence of alpine and subalpine meadows under climate warming scenarios. Rising global temperatures may lead to drier environmental conditions in mountain meadows and alpine tundra plant communities, 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). 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). Lower elevation mountain grasslands 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.

Changing dynamics of animal communities linked to changing climate conditions have also been observed and documented in areas of high elevation and/or latitude. 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 could affect climate-sensitive behaviors, abundance, and diversity, and potentially cause habitat fragmentation 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 alpine tundra/grassland maintenance and improvement despite the short snow-free season, low productivity, and slow ecosystem recovery after disturbance. However, improper grazing practices can eliminate vegetation, cause soil erosion and compaction, encourage invasion of noxious plants, and change vegetation composition. Grazing within associated tall forb communities has led to loss of soil, stream sedimentation, and changes in plant species; and may require decades of rest and management to reverse these trends.

The degraded condition of some alpine areas in the West is 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.

Some cattle grazing still occurs in alpine habitat due to the conversion of domestic sheep allotments to cattle allotments. 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.

The WGFD sets big game herd unit population objectives based on a variety of factors including habitat condition within the herd unit, hunter demand, landowner input, and biological potential. These considerations result in mixed opinions as to what the objective should be. All objectives are taken to the public for review and approved by the Wyoming Game and Fish Commission. Although the WGFD collects habitat data across the state, seldom is it specific enough to tie the habitat condition directly back to a specific number of animals. Such data is useful; however, in understanding whether big game populations are within the limits of what the habitat can support. The WGFD strives to have populations that are in balance with the majority of the habitats within the herd unit.

Recreation – Low to 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 alpine plants species are found and high elevation terrestrial and aquatic animals inhabit seasonally or year round. 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.

Teton County Weed and Pest and Grand Teton National Park have worked cooperatively on the Snake River Project, which is aimed at controlling and ultimately eliminating noxious weed infestations along the Snake River, which rises in the Rocky Mountains in western Wyoming. The project emphasizes weed control, community involvement, and education to control the spread of noxious weeds such as spotted knapweed and Canada thistle. The project has utilized biological controls and mechanical controls (community weed-pulling events). Although higher elevation areas may not be heavily impacted by these noxious weeds, the proactive nature of the project is essential to the preservation of the integrity of mountain and alpine landscapes in this region.

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.

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 to avoid trampling damage to soil that has been moistened by snow but is not yet solidly frozen; to avoid damage to preformed flower buds, which could influence plant growth the following growing season; and to avoid 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 at lower elevations, it is not usually as influential 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 lower elevations, however, can have profound effects on mountain grasslands. 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 lines, and other tactics which may damage fragile vegetation and soils should be limited. Forest and fire managers should consider the long-term impacts of existing clearcuts succeeding into forest. There may be some situations in which new clearcuts are not planned and wildfire, or prescribed fire, would be needed to maintain important mountain grasslands.

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 mountain grasslands 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.

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. Special attention should be given to monitoring mountain grasslands and alpine tundra habitats in SWAP SGCN priority areas (Figure 6).

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, and precipitation variability.

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