

141.4 Alpine and Subalpine Grasslands

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These grasslands occupy valleys, slopes, and ridges on usually flat or undulating terrain adjacent to and within subalpine conifer forests. Size of the grassland ranges from a small park-like opening within the forest to extensive landscapes covering several thousand acres (Fig. 57). These grasslands range from the lower edge of the subalpine forest to below and within the alpine tundra; all are at sufficient elevation to experience subalpine conditions. In the Southwest, subalpine grasslands reach their best development between 2500-2600 and 3500 m in the Sangre de Cristo, San Juan, Jemez, and La Plata mountains in Colorado and New Mexico, and in the White Mountains, Lukachukai Mountains, and on the Kaibab Plateau (Buckskin Mountains) in Arizona. Limited areas are also *Rocky Mountain subalpine grassland* in the Sierra Blanca, San Mateo, Magdalena, Cebolleta, Mogollon, Chuska, and other mountains in New Mexico, and in the Pinaleno, Escudilla, and San Francisco mountains in Arizona; there are also some small, high elevation subalpine meadow areas in the Pine Valley Mountains and elsewhere in southern Utah.

Small areas of *Sierran subalpine grassland* are found in the San Gabriel, San Bernardino, and San Jacinto mountains in southern California where they sometimes occur as "snowmelt gullies" (Thorne, 1977). Small meadows also occur in the Sierra San Pedro Mártir in adjacent Baja California Norte. Subalpine grassland communities are absent from the Sierra Madres and other Mexican ranges in the Southwest; they do occupy sizeable areas in the Sierra Madre Oriental (e.g., on Cerro Potosí) and on the high volcanoes of central Mexico. There subalpine and alpine grasslands are represented by "zacatonales" of *Stipa*, *Muhlenbergia*, *Calamagrostis*, and *Festuca* (Flores Mata et al., 1971).

Subalpine grassland soils are variable, and often well drained, and yet they possess properties unsuitable for tree growth. Air temperatures are significantly lower and evaporation rates are significantly higher in the grassland than in the adjacent forest but it is not known whether these microclimatic differences are causes or effects. Particularly at the higher elevations, a near timberline situation of short trees often exists at the grassland-forest border, where 2-m trees at the immediate edge may be the same age as 10-m tall trees only 5 m to 6 m back in the forest.

Precipitation averages from as low as 360 mm, as at Eagle Nest in the Sangre de Cristo Mountains, New Mexico, to 500 mm to 1,150 mm annually, most of which falls as snow. The resulting snowpack commonly covers the ground from October to May and may be of considerable depth. Although subzero air temperatures can be expected during winter months, soil temperatures below the snowpack are at or slightly below freezing. Some plants remain green throughout the winter, while others begin growth before the completion of snowmelt (Turner and Paulsen, 1976). The growing season is brief, often less than 100 days, and occasionally interrupted by nighttime frosts.

Well drained sites are commonly dominated, actually or potentially, by perennial bunchgrasses (*Festuca*, *Agropyron*, *Stipa*, *Poa*, *Muhlenbergia*) with a greater or lesser accompaniment of forbs including species of fleabane or wild-daisy (*Erigeron*), mountain dandelions (*Agoseris*, *Taraxacum*), cinquefoil (*Potentilla*), larkspur (*Delphinium*), aster (*Aster*), yarrow (*Achillea*), vetch (*Vicia*), clover (*Trifolium*), and many others. These high elevation "prairies" are replaced in the



Figure 57. Rocky Mountain subalpine grassland and conifer forest mosaic (=parkland) in the White Mountains on the Apache National Forest in Arizona, ca. 2,896 m elevation. The abundance of bunchgrasses (principally *Festuca arizonica*) mixed with forbs is characteristic, and indicates that this is a subalpine grassland in good condition. The small trees invading the hillsides and the "flagged" trees on the ridge crest are Southwestern White Pine (*Pinus strobiformis*).

moister "ciénega" sites by communities of sedges (*Carex*, *Cyperus*) and rushes (*Juncus*), often in combination with a variety of moisture-dependent forbs and grasses, e.g., Mountain Timothy (*Phleum alpinum*) and Tufted Hairgrass (*Deschampsia caespitosa*). Although both of these communities possess numerous distinctive "indicator" species, there is much intermingling with grasses and forbs equally or more representative of either *montane meadow grassland* below or *alpine tundra* above.

Better water supplies—more snow, rain, springs, and streams—favor the higher subalpine grasslands, which also have lower evapotranspiration rates than the montane mountain grasslands below. As a result many alpine and subalpine grasslands in the Southwest still retain much of their original "wet-meadow" characteristics, while many montane meadows are now distinctly drier.

Few subalpine grasslands are in a climax condition because of grazing or, less commonly, fire. Past and present misuse of subalpine grasslands is prevalent but not always readily apparent because of the abundant herbaceous cover usually present and the variations in plant composition potential between sites (Fig. 58). Generally the less palatable forbs and grasses tend to increase on cattle ranges at the expense of the native bunchgrasses, while secondary grasses can be expected to replace the more valuable forbs where sheep are pastured

(Turner and Paulsen, 1976). At the lower elevations and on drier and poorer ranges, shrubs such as *Artemisia tridentata* may now occur abundantly.

Not considered as subalpine grasslands are those grass-forb and shrub areas recently the site of a major forest disturbance and which are obviously in a successional stage toward subalpine conifer forest. Nonetheless, it should be noted that the grassland edge is often in the process of being invaded by small conifers or thickets of Quaking Aspen (*Populus tremuloides*), so that the extent of subalpine grassland appears in many areas to be decreasing.

Of the vertebrates inhabiting subalpine grasslands in the Southwest, mammals are best represented and may include several species that have adapted to the rigorous winters by hibernating or by feeding underground and/or under snow. These include the Marmot (*Marmota flaviventris*), Gray-collared Chipmunk (*Eutamias cinereicollis*), Least Chipmunk (*Eutamias minimus*), Heather Vole (*Phenacomys intermedius*), Meadow Voles (*Microtus montanus*, *M. longicaudus*, *M. mexicanus*, *M. pennsylvanicus*), Golden-mantled Ground Squirrel (*Spermophilus lateralis*), Deer Mouse (*Peromyscus maniculatus*), Jumping Mouse (*Zapus princeps*), Pocket Gophers (*Thomomys talpoides*, *T. bottae*), several shrews (*Sorex vagrans*, *S. obscurus*, *S. cinereus*, *S. nanus*), and their predators—e.g., the Long-tailed Weasel (*Mustela frenata*), Ermine (*Mustela erminea*),



Figure 58. Subalpine grassland at and above timberline on the San Juan National Forest, Colorado, ca. 3,566 m elevation. The ground cover is mostly of forbs, the taller bunchgrasses having been cropped or removed by livestock. Photograph by David Cook.

Badger (*Taxidea taxus*), and Red Fox (*Vulpes vulpes*). The proclivity of the Grizzly Bear (*Ursus arctos*) for open areas such as subalpine grasslands contributed to its early extirpation from the Southwest. Other large mammals such as the Mule Deer (*Odocoileus hemionus*), Wapiti or Elk (*Cervus elaphus*), Bighorn Sheep (*Ovis canadensis*), and Coyote (*Canis latrans*) are more or less migratory to and from these other high elevation sites, as was the now extirpated Gray Wolf (*Canis lupus*). The insectivorous bats (e.g., *Myotis volans*, *Lasiurus cinereus*) are also of necessity, summer residents only. In the San Juan and Sangre de Cristo mountains in Colorado and extreme northern New Mexico, the White-tailed Jack-rabbit (*Lepus townsendii*) is characteristically a resident of subalpine grassland.

No species of bird is restricted to or is particularly characteristic of subalpine grassland. Avian inhabitants are those species generally found throughout the higher open landscapes of the Southwest—e.g., Raven (*Corvus corax*), Red-

tailed Hawk (*Buteo jamaicensis*), American Kestrel (*Falco sparverius*), Mountain Bluebird (*Sialia currucoides*), Horned Lark (*Eremophila alpestris*), Common Nighthawk (*Chordeiles minor*), and Savannah Sparrow (*Passerculus sandwichensis*). Other species found more or less at or near the forest edge include the Yellow-rumped Warbler (*Dendroica coronata*), Robin (*Turdus migratorius*), and Blue Grouse (*Dendragapus obscurus*).

As expected in boreal biotic communities, relatively few reptilian or amphibian species are present. These few include the Short-horned Lizard (*Phrynosoma douglassi*), Wandering Gartersnake (*Thamnophis elegans*), Gophersnake (*Pituophis melanoleucus*), Western Toad (*Bufo boreas*), Chorus Frog (*Pseudacris triseriata*), Leopard Frog (*Rana pipiens*), and Tiger Salamander (*Ambystoma tigrinum*). Populations of these species in the Southwest approach or exceed 3,050 m elevation, where they can be found in these natural openings in the forest.