# 13.3.6. Ecology of Montane Wetlands

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Most waterfowl managers envision typical waterfowl habitat as the undulating or flat terrain characteristic of the prairie pothole region of the north-central United States or the aspen parklands of Canada. However, several other habitats in North America provide valuable resources for breeding and migrating waterfowl. Among these is the Rocky Mountain region of the western United States, which stretches in a band 100–500 miles (160–800 km) wide and 1,240 miles (1,984 km) long from south-central New Mexico to northern Montana (Figure).

Some Rocky Mountain wetland complexes contain waterfowl breeding densities that equal or exceed those of prairie breeding habitat, and also serve as important staging, migratory, and wintering areas. To aid waterfowl management endeavors in this region, this leaflet summarizes aspects of wetland ecology and waterfowl biology in montane habitats. Although emphasis is placed on the Rocky Mountain region, many of the wetland characteristics and waterfowl relationships in this area are similar or identical to those found in other montane regions of the United States.

## Comparisons with Prairie Wetlands

As in other regions, waterfowl that breed in montane habitats require suitable upland nesting areas coupled with a diverse wetland community, from which they obtain aquatic invertebrates, plant foods, and isolation from territorial birds of the same species. These wetland complexes also attract spring and fall migrants and, in some instances, wintering waterfowl.

Montane waterfowl habitats have several attributes that set them apart from their grassland counterparts. First, montane wetland communities are relatively intact compared with the widespread wetland degradation typical of the northern Great Plains. This more nearly pristine condition reflects the rugged topography and generally poor soils of the region, which favor ranching, timber harvest, and mining rather than farming. Additionally, some areas are afforded legal protection as wilderness areas or research natural areas. Second, except where locally affected by mining operations and ski areas, for example, upland plant communities are still dominated by native plant species despite some grazing and timber harvest. Third, although the magnitude of the snowpack and rainfall varies annually, precipitation is almost always sufficient to provide adequate spring water for ducks and geese. Thus, montane wetlands are relatively stable compared with those in the prairie states.

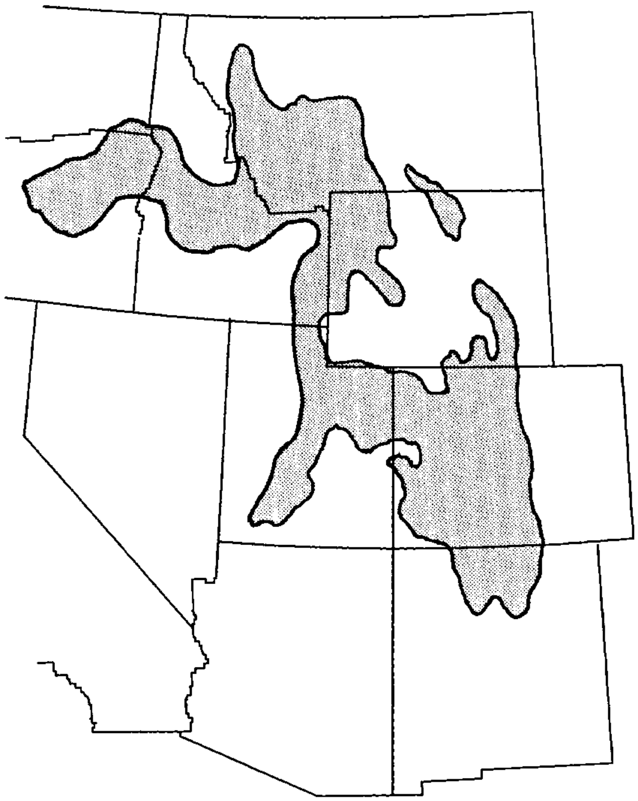

**Figure.** Distribution of montane wetlands (*shading*) in the Rocky Mountain region of western United States.

The geology and topography of montane regions create a greater diversity of wetland types than may be found in the prairies. Rocks weather slowly, and annual primary production decreases with elevation, so wetland succession proceeds much more slowly in montane wetlands than in low-elevation ponds. Elevational gradients interacting with precipitation patterns and growing season affect soil type, nutrient cycling, water chemistry, and associated plant and animal communities. Most high-elevation wetlands are slightly acidic to circumneutral and contain relatively small amounts of dissolved nutrients compared with typical prairie wetlands. Accordingly, only some types of montane wetlands are frequented by waterfowl, unlike their wide use of most prairie ponds. Recognition of the wetland types inhabited by waterfowl and an understanding of basic wetland function is therefore important to the success of any waterfowl management initiative in montane habitats.

## Montane Wetlands Important to Waterfowl

### *Intermountain Basin Wetlands*

The intermountain basins or "parks" of the western United States contain the most important habitats for montane waterfowl. The flat or rolling topography typical of mountain parks, which originated from tectonic and volcanic events during the formation of mountain ranges, is underlain by deep layers of alluvial material eroded from the surrounding mountains and transported to nearby basins by wind and water. Although relatively few in number—33 parks have been identified in the Rocky Mountain region—intermountain basins are often several hundred square miles in area. Many parks are considered cool deserts because of the low precipitation created by the rain shadow from surrounding mountains. The average frost-free period may be less than 2 months. Despite low seasonal temperatures, ratios of precipitation to evaporation are usually less than 1, causing the development of pedocal soils. Where alkali deposits occur in poorly drained areas, salt-tolerant plants such as black greasewood and saltgrasses are common. Less saline areas typically contain wheatgrasses, bluegrasses, sedges and rushes, or shrubs such as sagebrush and rabbitbrush. Ranching and hay cultivation are the most common land uses, but some grain crops and cold-weather vegetables are grown in more temperate parks.

Many intermountain basins contain few wetlands; some, such as the 5,000-square-mile (12,950-$km^2$) San Luis Valley in south-central Colorado, possess abundant wetlands. Wetlands are formed by spring runoff, which creates sheet water and recharges the persistently high water tables, and by artesian flows and impoundments. Lakes and reservoirs provide important migratory staging and molting habitats, and lake margins attract breeding waterfowl. Rivers and old oxbows are also frequented by waterfowl. Dissolved nutrients and high amounts of organic matter create some wetlands that rival prairie potholes in their fertility. High densities of aquatic invertebrates such as freshwater shrimp and the larvae of dragonflies, midges, flies, and mosquitos are common in intermountain basin wetlands.

### *Beaver Ponds*

Beaver ponds most commonly occur in mid-elevation, montane valleys where slope is less than 15%. Because beaver ponds are often clustered in flowages along suitable lengths of streams and rivers, they provide a valuable wetland community well suited to the needs of breeding waterfowl. Densities of 3 to 6 ponds per mile (5–10 ponds per kilometer) of stream are common, increasing to as many as 26 ponds per mile (42 ponds per kilometer) in excellent habitat with high beaver populations. Wetlands created by beaver possess relatively stable water levels maintained by precipitation and runoff. However, beaver flowages themselves may be somewhat ephemeral in nature, and usually are abandoned within 10–30 years, after beaver deplete their food resources. Floods sometimes destroy beaver dams that are constructed in narrow valleys or on major streams or rivers.

Beaver ponds act as nutrient sinks by trapping sediments and organic matter that otherwise would be carried downstream. This function enhances wetland fertility and the plant and aquatic invertebrate communities exploited by waterfowl. Invertebrates typical of running water systems are replaced by pond organisms such as snails, freshwater shrimp, and the larvae and immature stages of caddisflies, dragonflies, flies, and mosquitos. Structural cover provided by flooded willows, alders, sedges, burreeds, and other emergents affords ideal habitat for waterfowl breeding pairs and broods.

### *Glacial Ponds*

Glacial ponds include (1) small wetlands formed behind lateral and terminal moraines, and (2) kettle ponds created by the same glacial process that found the prairie potholes—large chunks of ice embedded in glacial outwash melt after a glacier retreats, forming depressions that later fill with water. Glacial wetlands most commonly occur in mountainous terrain. Often, these ponds are dependent solely on spring runoff and summer precipitation for water. Therefore, water levels recede during summer, while density and abundance of herbaceous, emergent vegetation increases. Despite dynamic water level fluctuation, natural succession is slow; peat accumulations indicate that some glacial ponds have persisted as wetlands for more than 7,000 years.

Northern mannagrass, sedges, and reedgrasses are common emergent plants in glacial ponds, as are submersed species such as pondweeds, watermilfoils, and cowlilies. Glacial ponds are often surrounded by forested uplands and rocky moraines. These physical features and the relatively small size of glacial ponds may restrict the types of waterfowl using them to dabbling duck species that can take off in confined areas. The shallow water depths typical of kettle ponds often are unsuitable for sustaining fish populations, which might otherwise compete with waterfowl for aquatic invertebrate foods. The absence of fish and the abundant underwater substrate provided by herbaceous vegetation promote a rich invertebrate fauna dominated by larvae or immature stages of caddisflies, dragonflies, beetles, and mosquitos.

## Ecological Relations

Elevational changes result in ecosystem regions or life zones characterized by differences in precipitation, humidity, temperature, growing season, wind, exposure, and soil conditions. The four life zones recognized in the Rocky Mountain region—Lower Montane, Upper Montane, Subalpine, and Alpine—possess unique flora and fauna. Only the wetlands found in the first three zones are used extensively by waterfowl. Alpine wetlands receive occasional use by migrating and postbreeding waterfowl, but the duration of the ice-free period and growing season is too brief to enable waterfowl to breed.

Montane habitats separated by relatively small distances often vary markedly in annual precipitation. Much of this variation is attributable to altitude and slope. Western slopes usually receive more snowfall than eastern slopes or areas in the rain shadow of surrounding mountains. For example, portions of the San Luis Valley in south-central Colorado (8,200 feet or 2,500 m elevation) receive less than 7 inches (18 cm) of moisture per year, whereas the nearby western slopes of the San Juan Mountains at the same elevation receive over 40 inches (102 cm) per year. Accordingly, west- and north-facing slopes usually support different plant communities than southern and eastern slopes.

Snowmelt begins in late April and May in Lower and Upper Montane zones but occurs 3 to 4 weeks later in Subalpine areas. The shade provided by a forest canopy further delays snowmelt, thus providing wetlands in forested areas a more constant supply of water. However, the flora and fauna in such wetlands may develop more slowly than in ponds in open terrain. This delayed development is a result of the constant supply of cold snowmelt water, as well as shading from the forest canopy, which reduces sunlight penetration.

The effects of precipitation patterns and snowmelt on floristic and faunal development have important implications for breeding waterfowl. In prairie habitats, breeding waterfowl often use wetlands of different water permanencies to optimize their exploitation of aquatic invertebrates. Temporary prairie wetlands are heavily used in early spring because their invertebrate faunas develop quickly in the warm, shallow water. More permanent wetlands, in which development of invertebrates is delayed, receive increasing use in the spring and summer. In montane habitats, however, this temporal pattern of use in relation to water permanency is superimposed on a spatial component that includes exposure and time of runoff. Small, shallow snowmelt ponds, which are the counterparts of temporary ponds in the prairies, usually lack invertebrate faunas of value to waterfowl. Instead, the shallow margins of permanent wetlands are the areas in which the invertebrate fauna is richest in early spring.

The timing of snowmelt runoff is also critical to understanding waterfowl exploitation of montane habitats. Many species (e.g., mallards and green-winged teal) begin nesting long before runoff begins to fill wetlands in most intermountain basins. The early application of water in such areas by pumping or by releasing water from reservoirs is vital in providing habitat to attract and hold breeding pairs and for promoting development of aquatic invertebrates needed by prelaying female ducks. At higher elevations, where natural kettle ponds, lakes, and beaver flowages have retained water through winter into early spring, runoff often increases water levels through late spring and into early summer, increasing the amount of wetland habitat through the middle of the nesting period.

Nutrient availability is important in regulating wetland primary productivity, which in turn affects periphyton, invertebrate, and waterfowl abundance. Surface runoff is far more important than groundwater flow or direct precipitation in determining water level dynamics and nutrient input to montane wetlands. Thin, coarse soils on granite bedrock tend to be acidic and low in nutrients, whereas soils near limestone and shale outcroppings are more finely textured, higher in nutrients, and buffered by calcium carbonate. Wetlands fed by runoff from the latter soils tend to receive higher nutrient loads from runoff, and therefore have higher productivity than wetlands associated with granitic soils. Some common wetland plants such as alders and rushes host nitrogen-fixing bacteria that incorporate atmospheric nitrogen into wetlands, providing a supplemental source of nutrients. Waterfowl and beaver are the primary animal groups to import nutrients to montane wetlands, although defecation by large herbivores such as moose, elk, mule deer, bighorn sheep, cattle, and domestic sheep may also be important.

## Waterfowl Resources

Waterfowl populations in montane habitats have not been well studied. Most research has been conducted at mid-latitude habitats between 7,000 and 10,000 feet (2,100–3,000 m) elevation. Despite the relatively harsh climate and infertility of montane wetlands, waterfowl are surprisingly abundant in these areas. Generally, peak waterfowl populations occur during spring and fall migration periods, particularly in intermountain basins. As prairie-nesting species migrate northward in spring, resident birds establish territories in preparation for breeding. In beaver pond and glacial wetland habitats, numbers of waterfowl decline as females proceed with incubation and males seek larger wetlands during the time of molting. Often, a molt migration occurs from higher elevation forested habitats to large lakes and reservoirs in intermountain basins. During fall, postfledging young birds also move toward lower-elevation staging areas in mountain parks. Most mid-latitude montane wetlands freeze during October, greatly reducing the amount of available wetland habitat. Some wetland areas, however, such as the San Luis Valley of south-central Colorado, retain open water reaches as a result of warmer flows from springs and artesian wells. Major river systems also afford winter habitat, particularly if cereal grain crops or other foods are located nearby.

Species composition of the waterfowl community varies seasonally and in relation to habitat type (Table 1). Mallards and green-winged teal are usually the most common nesting species in both intermountain parks and higher-elevation

Table 1. *Relative species abundance in different montane wetlands during spring and fall migration (*M *or* m*), breeding (*B *or* b*), and wintering (*W *or* w*) periods. Uppercase letters denote greater relative abundance than lowercase letters.*

| Species | Montane wetland type: Intermountain basin | Beaver pond | Glacial wetland |
|---|---|---|---|
| American wigeon | M,B | b | b |
| Barrow's goldeneye | m | m,b | m,b |
| Blue-winged teal | m,b | — | — |
| Bufflehead | m,b | m,b | m,b |
| Canada goose | M,B,w | b | — |
| Cinnamon teal | m,B | — | — |
| Common merganser | m | m,b | m,b |
| Gadwall | M,B | b | b |
| Green-winged teal | M,B,w | m,B | m,b |
| Lesser scaup | M,B | — | — |
| Mallard | M,B,w | m,B | m,B |
| Northern pintail | M,B,w | — | — |
| Northern shoveler | M,B | — | — |
| Redhead | M,B | — | — |
| Ring-necked duck | m,b | M,B | M,B |
| Ruddy duck | m,b | — | — |
| Trumpeter swan | b[a] | — | — |

[a] Primarily riverine habitats.

Montane and Subalpine zones. Gadwalls, northern pintails, American wigeon, cinnamon teal, northern shovelers, redheads, lesser scaup, and Canada geese are other common breeders in intermountain basins. Trumpeter swans are important year-round residents in the northern Rockies. In beaver and glacial ponds of the Upper Montane and Subalpine zones, ring-necked ducks, Barrow's goldeneyes, buffleheads, and gadwalls are common. The peak of nest initiation for early-nesting ducks (mallards and green-winged teal) varies from early May to early June, depending on snow conditions and wetland availability. Late-nesting species such as ring-necked ducks begin nesting nearly a month later than early-nesting species.

Breeding densities vary greatly among montane habitats (Table 2), largely as a function of wetland density and availability of open water to attract and hold spring migrants. Wetlands larger than 1 acre (0.405 ha) receive most of the use by breeding ducks, although much smaller wetlands are also frequented. Considerably larger wetlands are needed to attract molting birds and fall migrants. Some intensively managed habitats achieve remarkably high breeding densities. For example, the 22-square-mile (57-$km^2$) Monte Vista National Wildlife Refuge in the San Luis Valley of Colorado averaged 277 duck nests per square mile (107 duck nests per square kilometer) during a 27-year period, and some individual wetland units exceeded 3,000 nests per square mile (1,158 nests

Table 2. *Waterfowl breeding pair densities in montane habitats. Habitat type denotes either forested montane (*FM*) or intermountain basin (*IB*) study sites.*

| Density | | Area sampled | | Elevation | | |
|---|---|---|---|---|---|---|
| pairs/$mi^2$ | pairs/$km^2$ | $mi^2$ | $km^2$ | feet | m | Location (habitat type) |
| 1.6 | 0.62 | 36 | 93.2 | 7,500–10,000 | 2,285–3,047 | Uinta Mountains, Utah (FM) |
| 1.6 | 0.62 | 18 | 46.6 | 9,000–10,000 | 2,742–3,047 | White River Plateau, Colo. (FM) |
| 4.1 | 1.58 | 685 | 1,774.0 | 8,000–10,000 | 2,437–3,047 | San Juan Mountains, Colo. (FM) |
| 21.8 | 8.42 | 7 | 18.1 | 8,500–9,500 | 2,590–2,894 | Park Range, Colo. (FM) |
| 0.5 | 0.19 | 900 | 2,331.0 | 8,400–9,900 | 2,559–3,016 | South Park, Colo. (IB) |
| 5.2 | 2.01 | 5,000 | 12,950.0 | 7,400–8,000 | 2,255–2,437 | San Luis Valley, Colo. (IB) |
| 27.2 | 10.50 | 598 | 1,549.0 | 8,000–9,000 | 2,437–3,047 | North Park, Colo. (IB) |

per square kilometer) in some years. This compares favorably to nesting densities in the best prairie habitat, where, except in island nesting situations, 400–700 duck nests per square mile (150–270 duck nests per square kilometer) are typical. Moreover, nest success averaged 50%, a rate about four times as high as that in much of the northern Great Plains. The unfragmented habitat and balanced predator communities typical of many montane areas undoubtedly contribute to these high nest success rates. The combination of high nest success and potentially high breeding densities underscores the pronounced management potential of some montane habitats.

## Waterfowl Habitat Management

Most waterfowl habitat management is directed at correcting problems caused by humans. Montane wetlands management is no exception, although the causes of habitat deficiencies are often different than those found in prairie habitats. In Upper Montane and Subalpine zones, logging activities may cause disturbance, reduce the amount of available nesting cover surrounding wetlands, and cause erosion and sediment deposition in ponds. Reseeding and stabilizing uplands may be necessary to promote the timely regrowth of grasses and forbs. Disturbance from recreationists can also become a problem in popular areas, and seasonal restrictions on activities in buffer zones surrounding wetlands may be necessary. Grazing by domestic livestock and native ungulates can have locally severe effects on riparian vegetation and surrounding uplands. Eliminating grazing, reducing stocking rates, and fencing portions of wetlands can reverse the habitat degradation. Mining activities often physically alter or destroy wetlands, and can create acid runoff that drastically alters water chemistry and devastates invertebrate communities. Reclamation of wetlands despoiled by mining activities, although technically possible, is often difficult and costly. Beaver, which create beneficial wetland habitat, can also become a nuisance if populations grow beyond carrying capacity and begin to degrade streamside vegetation. Control by trapping or transplanting may be warranted in such instances. Agricultural practices have affected plant communities and wetland abundance in several intermountain basins, as they have in the prairie states. In these instances, the conventional waterfowl management practices developed in the prairies can be successfully employed to improve waterfowl habitat.

Some human activities have caused irreversible damage to waterfowl habitat. Among these are residential developments along riparian corridors, and dams and water diversions that have either flooded former shallow wetland habitat or dewatered once productive wetlands. Fortunately, however, many montane habitats, particularly those in the Upper Montane and Subalpine zones, have been insulated sufficiently from human activities that no management activities are warranted. In these pristine habitats, actions are best directed toward habitat preservation rather than improvement. By conducting a biological reconnaissance of waterfowl populations and identifying limiting factors before initiating management actions, managers can avoid trying to fix something that isn't broken.

## Selected Reading


Frary, L. G. 1954. Waterfowl production on the White River Plateau, Colorado. M.S. thesis, Colorado State University, Fort Collins. 93 pp.

Hopper, R. M. 1968. Wetlands of Colorado. Colorado Department of Game, Fish and Parks Technical Publication 22. 88 pp.

Peterson, S. R., and J. B. Low. 1977. Waterfowl use of Uinta Mountain wetlands in Utah. Journal of Wildlife Management 41:112–117.

Rutherford, W. H., and C. R. Hayes. 1976. Stratification as a means for improving waterfowl surveys. Wildlife Society Bulletin 4:74–78.

Szymczak, M. R. 1986. Characteristics of duck populations in the intermountain parks of Colorado. Colorado Division of Wildlife Technical Publication 35. 88 pp.

Windell, J. T., B. E. Willard, D. J. Cooper, S. Q. Foster, C. F. Knud-Hansen, L. P. Rink, and G. N. Kiladis. 1986. An ecological characterization of Rocky Mountain montane and subalpine wetlands. U.S. Fish and Wildlife Service Biological Report 86(11). 298 pp.

## **Appendix.** Common and Scientific Names of Plants and Animals Named in Text.

| | |
|---|---|
| **Birds** | |
| Northern pintail | *Anas acuta* |
| American wigeon | *Anas americana* |
| Northern shoveler | *Anas clypeata* |
| Green-winged teal | *Anas crecca* |
| Cinnamon teal | *Anas cyanoptera* |
| Blue-winged teal | *Anas discors* |
| Mallard | *Anas platyrhynchos* |
| Gadwall | *Anas strepera* |
| Lesser scaup | *Aythya affinis* |
| Redhead | *Aythya americana* |
| Ring-necked duck | *Aythya collaris* |
| Canada goose | *Branta canadensis* |
| Bufflehead | *Bucephala albeola* |
| Barrow's goldeneye | *Bucephala islandica* |
| Trumpeter swan | *Cygnus buccinator* |
| Ruddy duck | *Oxyura jamaicensis* |
| **Mammals** | |
| Moose | *Alces alces* |
| Beaver | *Castor canadensis* |
| Elk | *Cervus elaphus* |
| Mule deer | *Odocoileus hemionus* |
| Bighorn sheep | *Ovis canadensis* |
| **Invertebrates (orders)** | |
| Freshwater shrimp | Decapoda |
| Beetles | Coleoptera |
| Flies | Diptera |
| Midges | Diptera |
| Mosquitos | Diptera |
| Dragonflies | Odonata |
| Caddisflies | Trichoptera |
| **Plants** | |
| Wheatgrass | *Agropyron* spp. |
| Alder | *Alnus* spp. |
| Sagebrush | *Artemisia* spp. |
| Sedge | *Carex* spp. |
| Rabbitbrush | *Chrysothamnus* spp. |
| Saltgrass | *Distichlis* spp. |
| Northern mannagrass | *Glyceria borealis* |
| Rush | *Juncus* spp. |
| Watermilfoil | *Myriophyllum* spp. |
| Cowlily | *Nuphar* spp. |
| Pondweed | *Potamogeton* spp. |
| Bluegrass | *Poa* spp. |
| Willow | *Salix* spp. |
| Greasewood | *Sarcobatus vermiculatus* |
| Burreed | *Sparganium* spp. |

**Note: Use of trade names does not imply U.S. Government endorsement of commercial products.**

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