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Birds of the Rocky Mountains -- Paul A. Johnsgard

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11-2009

## ***Birds of the Rocky Mountains*—Introduction**

Paul A. Johnsgard

University of Nebraska-Lincoln, pajohnsgard@gmail.com

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*This book is dedicated to my new grandson Scott;  
may he love these mountains as one would a favorite book,  
and may the life therein offer him its manifold lessons.*

# Introduction

The Rocky Mountains represent the longest and in general the highest of the North American mountain ranges, extending for nearly two thousand miles from their origins in Alaska and northwestern Canada southward to their terminus in New Mexico, and forming the continental divide for this entire length. As such, these mountains have provided a convenient corridor for northward and southward movement of both plants and animal life, but on the other hand have produced important barriers to eastern and western plant and animal movements. These effects result not only from their height and physical nature, but also from their manifold effects on such things as precipitation, humidity, temperature, and other important climatic factors affecting plant and animal life.

The bird life of the Rocky Mountains is surprisingly uniform, in spite of their great latitudinal spread and the equally wide altitudinal variations that occur in the region. Thus, a bird-watcher in Banff or Jasper national parks will encounter the vast majority of the same breeding species in the coniferous zones of those areas as one who is observing birds nearly a thousand miles to the south in Rocky Mountain National Park, although particular bird species would occur at considerably different altitudes. This is a result of the horizontal zonation patterns of organisms, which individually distribute themselves along the slopes of mountains within vertical bands that conform to their limits of physiological stress and their biological requirements for food, cover, reproduction sites, and the like. Because of these biotic interactions, complex plant and animal communities have evolved through time. The observant naturalist can soon learn to recognize these communities on the basis of one or two "dominant" plant species that represent biological reflections of the overall physical and biotic environment of that particular altitude and latitude. In earlier biological literature these aggregations of interacting organisms were often called "life zones," based on temperature and moisture characteristics, and were given a variety of names that tended to have geographic connotations. More recently, the life zone concept has been replaced with one based

primarily on the native plant life, inasmuch as it is believed that such plant "communities" provide an immediate biotic index to the climate, as well as to the soil characteristics and to the recent history of the environment, such as disturbance by burning, grazing, and the like. Specifically, a succession of natural plant communities are believed to develop and replace earlier developmental ("seral") stages in a relatively orderly fashion, until a "climax" or essentially permanent and self-regenerating stage is reached. By mapping large regional areas on the basis of actual potential climax plant communities, an insight into their climates, soils, and biotic productivities can be attained. Many such areas, because of periodic or continuous disturbance, probably may never reach this ultimate climax stage, but instead remain in various earlier transitional stages. In the Rocky Mountain region repeated forest fires have caused much of the area to become vegetated by fire-adapted communities, such as lodgepole pine or aspen, for example, and in other areas timbering may have caused regeneration of a second-growth forest that likewise represents a non-climax community type.

Because of both the physical characteristics of the communities (height, density, etc., of the vegetation), and their biological characteristics (food availabilities, presence of competing or otherwise interacting organisms such as predators and prey species), birds and other organisms occur in greatly differing levels of abundance in differing communities. Those plants which exert the greatest ecological effects in a community (the "dominants"), are obviously likely to play important roles in the distribution and abundance of many bird species. However, particular birds may be dependent upon certain non-dominant plants or even other features of the environment. Thus, for example, three-toed woodpeckers favor recently burned forest areas, where an abundance of wood-boring beetles are attracted to dead trees. Indeed, many other species of birds require dead snags, rotted trees, or other relatively uncommon or unique features of a community in order to find all the requirements for performing all of the aspects of their particular ecological "profession," or niche. Thus, ecological communities that have a great diversity of plant life also tend to have a diversity of bird life, for in such communities there are far more opportunities for diverse niches to be supported.

One of the major roles of national parks is to insure the existence of protected examples of all the major habitat types and ecological communities typical of a particular region; in a sense they are natural repositories of ecological diversity. Even though most established national parks are areas of outstanding natural beauty, as indeed was the case with all the national parks included in this book, it was also recognized

by their founders that their natural integrity should remain inviolate forever, and that they should be allowed to continue to support the broadest possible range of plant and animal life. For an ecologist, a national park might be more exciting because it supports a rare species of fern, orchid, or bird, than because it has awesome peaks, high waterfalls, or stunning geysers. Or, it may well be the only place left in that part of North America that has not felt the effects of mining or oil drilling machinery, or heard the sounds of chain saws or timber axe in recorded time. It is in part for this reason, that the parks are the last and best vestiges of a pristine North America, that I have decided to concentrate on them in writing this book. Furthermore, they are visited each year by millions of people wanting information on the distribution, abundance, and identification of birds and other organisms, and to varying degrees they have been studied by biologists sufficiently that relatively complete bird lists are available now for most parks.

I have selected an area of the central and northern Rocky Mountains that includes a total of eight national parks in a relatively confined area, namely between 40° and 52° north latitude, or specifically from northern Colorado to the arctic watershed divide in southern Alberta and adjacent British Columbia. Four Canadian national parks (Banff, Yoho, Kootenay, and Watertown Lakes) and four U.S. parks (Glacier, Yellowstone, Grand Teton, and Rocky Mountain) fall within this area, in addition to a national monument, several national wildlife refuges, and numerous national forests and provincial or state parks.

I have adopted a tri-level approach to the information presented in this book. First, a seasonal abundance and breeding chart for each species is provided in the back matter for each national park mentioned. Secondly, the distributional status for each species is regionally presented in "latilong" form. Latilongs are geographic areas that are defined by quadrants of latitude and longitude, each block measuring approximately 50 × 70 miles (in the area concerned), and provide convenient methods of illustrating bird distributions in areas where more "fine-grained" analyses are impossible. Groups of latilongs were chosen that include all four U.S. national parks, and also include a maximum of typical Rocky Mountain terrain outside the parks. Thirdly, regional distribution maps show each species' apparent breeding or residential distribution (in the case of breeding species) or non-breeding status, within the northern Rocky Mountain regions, here chosen to include all of Montana, Idaho, and Wyoming, and adjacent parts of Colorado and Alberta.

The list of species to be included in this book was developed using information available on all of the included national parks as well as Dinosaur National Monument. All species reliably reported from any

of these areas are included in the book. A few additional species have also been included that have not yet been definitely reported from any of the parks, but which perhaps do occasionally occur, for a total of 354 species.

It might be of interest to compare the species coverage of this book with that of the various states and provinces that are variably encompassed. Idaho has a total avifaunal list of 305 species (Burleigh, 1972), including 197 total known breeders (Idaho Fish and Game Information Leaflet No. 12, undated). This book includes all known Idaho breeders except for the mountain quail (which is local from Latan to Owyhee counties), and the locally introduced (Lemhi County) Gambel's quail. Wyoming has a total list of 377 bird species, of which 227 are considered to be breeders (Oakleaf et al., 1982). This book includes all known Wyoming breeding birds, except for the barn owl (local in southern Wyoming) and the Scott's oriole (local in southwestern Wyoming). Montana has a total list of 378 species, of which 237 are known breeders (Skaar, 1980). This book includes all the state's known native breeders except for the piping plover (local in northeastern Montana). Alberta has a total list of 333 species, and 247 breeding species (Salt and Salt, 1976). This book includes all of the montane breeding avifauna, and 97% of the province's total breeding species. Colorado has a total list of 416 species, and approximately 260 breeding species. This book includes all of the typical montane breeding avifauna, and about 90% of the state's total breeding species.

## Latilong and Abundance Coding

The methods of using latilongs for plotting bird distribution was devised by Skaar for use in Montana, and initially was applied to the area around Bozeman, and later (1975, 1980) to the entire state. Skaar argued that, although the area encompassed by latilong varies with latitude owing to the gradual narrowing of the distances between lines of longitude toward the poles, the encompassed areas of latilongs along the Montana-Canada border are, for example, only 5.4% smaller than ones on the Montana-Wyoming border. Thus, for all practical purposes, those used in this book can be considered approximately equal in size.

Skaar's pioneering work in Montana was followed by similar analyses for Wyoming (Oakleaf et al., 1979, 1982), and for Colorado (Kingery and Graul, 1978; Chase et al., 1982). As a result, most of the Rocky Mountain area south of Canada and under consideration in this book has been subjected to latilong analysis, with the exception only those portions of the Rocky Mountains occurring in eastern Idaho.

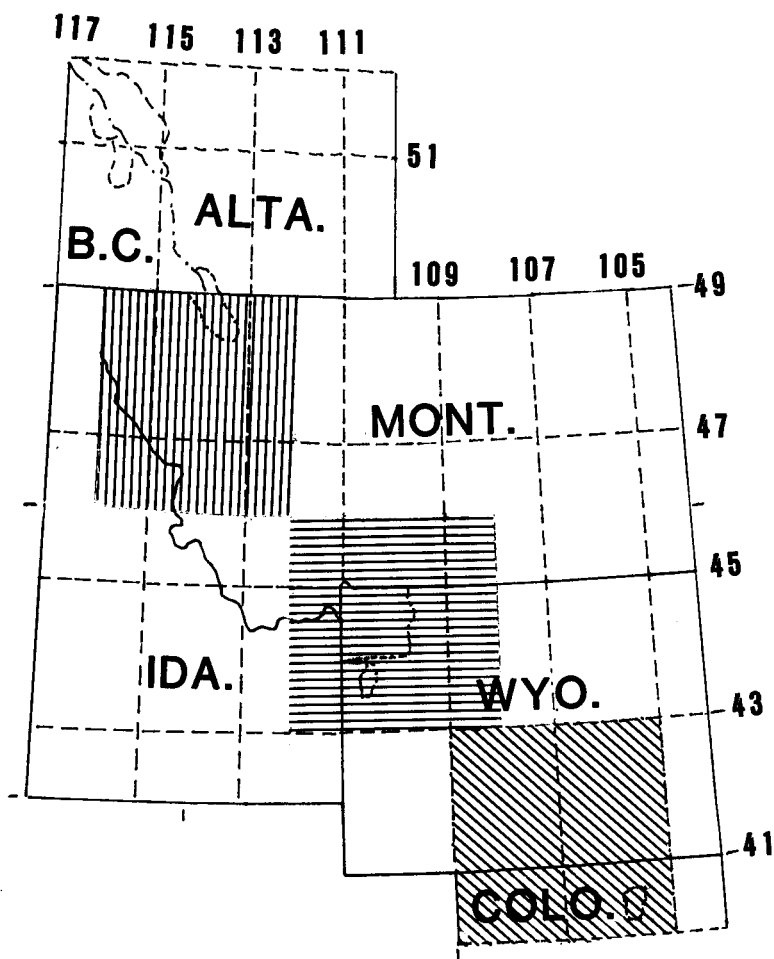


Figure 1. Outline map of region encompassed, showing lines of latitude and longitude, and (shaded) latilong groupings selected for detailed information presentation.

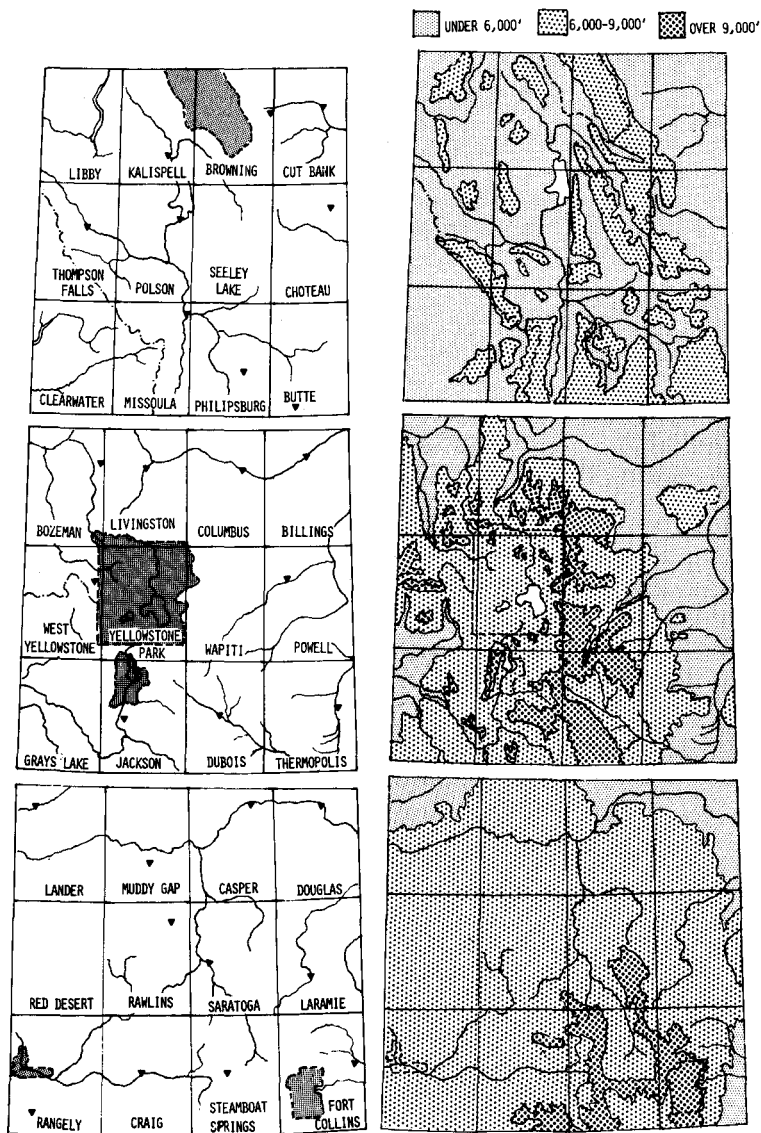


Figure 2. Details of latilong groupings summarized in species accounts, showing (left) latilong names and locations of features for which each latilong is named, and (right) selected contour intervals for areas within latilong groupings.



Because of this available useful data base, I requested and obtained permission from the appropriate authors to extract latilong data from a sample group of latilongs that center on the U.S. national parks and extend diagonally southward from northwestern Montana to northern Colorado along the continental divide. Three quadrants, each measuring four latilongs wide by three latilongs high, or approximately 180–210 miles east–west by 207 miles north–south, were thus selected (Fig. 1). Within these three quadrants, two latilongs fall entirely within the state of Idaho, but otherwise all the latilongs fall partially or entirely within the states of Montana, Wyoming, and Colorado. Names applied to these latter latilongs (Fig. 2) are the same as those used in the previously mentioned studies, while new names were devised for the two strictly Idaho-restricted latilongs. Data for these two latilongs, which I have named Clearwater and Bear Lake, were assembled from various sources, but primarily from information obtained on the birds of Clearwater National Forest and Bear Lake National Wildlife Refuge. In each case, the limits of the national forest and the national wildlife refuge do not entirely correspond with latilong limits, and thus some possibilities for errors of latilong attribution exist.

Unfortunately, no consistent method of coding latilong information has yet been formalized, and the methods used for Wyoming, Montana, and Colorado all differ to some extent from one another. I settled for using a system that is not entirely like any one of the three, but which concentrates on reproductive status (breeding or non-breeding) and seasonal occurrence. The symbols used are as follows:

- R=breeding permanent resident
- r=resident, breeding unproven
- S=breeding summer resident
- s=summer resident, breeding unproven
- M=migrant, excepting wintering visitors
- W=migrants that sometimes or regularly overwinter
- V=vagrant, out of normal range
- X=extirpated from area
- ?=inadequate or conflicting information

Latilong codes in this book thus differ to varying degrees from those found in the individual state references, and in some cases decisions were necessarily made (especially as to “vagrant” vs “migrant” status) of a subjective nature. There are also a few cases in which the status for a given latilong differs from that reported in individual state summaries; this is the result of additional or different information available to me that seemed to warrant making such deviations. A different set of symbols, provided in a chart following the species accounts, has

been used to indicate relative seasonal or overall abundance for each of the national parks. These are as follows:

A=abundant

C=common

U=uncommon

O=occasional

R=rare

V=vagrant (accidental)

?=inadequate information

\*=breeds (or has bred) in area

## Habitats and Ecological Distributions

All bird species, by virtue of variably specialized niche adaptations, are most abundant in or may even be completely restricted to particular habitats. It is thus particularly important that birders pay attention to the habitat in which they are observing birds, for this very often provides important clues as to the species of birds that are most likely to be encountered. Except for such specialized habitats as rocky outcrops, mud flats, and other special substrates, the majority of habitats are most easily described in terms of their dominant plants. Furthermore, as noted earlier, there is a rather remarkable consistency in the vertical stratification or zonation patterns throughout the central and northern Rocky Mountains. Thus, there is a sequence of community types that typically occurs sequentially from the plains and foothills upwards toward the mountain tops. The exact altitudes at which a particular habitat type occurs varies greatly, depending both on latitude and also on such local effects as directional exposure, protection from winds, soil characteristics, and the like. However, as shown in Table 1, most vegetation zones in the Rocky Mountains occur in broad belts ranging in altitudinal width from a few hundred feet to about two thousand feet.

Although many bird watchers may not be interested in making such fine botanical distinctions as separating Douglas fir forest from, for example, Engelmann spruce, subalpine fir forest, in many cases this is not actually necessary for useful habitat identification. For example, many birds seemingly respond to forest habitats in terms of rather broad life-form characteristics (e.g., mature hardwood forest, open woodlands, coniferous forest, timberline thickets, etc.) and thus detailed botanical recognition may not be necessary. Nevertheless, habitats are identified in the text as accurately as possible, and thus some familiarity with the usual vegetational zonation patterns in the Rocky Mountains can be very useful in finding particular birds.

Table 1. *Vertical Distribution of Major Plant Communities in the Central and Northern Rocky Mountains*

Physiography	Vegetation Zones	Traditional "Life-Zones"	Approximate Average Altitude in Feet		
			Colorado	Wyoming, S. Idaho	Montana, S. Alberta
Alpine	Tundra	Arctic-Alpine	11,000-13,000+	10,300-12,000+	6600-8000+
Subalpine (timberline)	Engelmann spruce, Subalpine fir	Hudsonian	10,000-11,000	9500-10,300	6000-6600
Montane	Climax Phase Douglas fir Western redcedar, Western hemlock Ponderosa pine Seral Phase Lodgepole pine Quaking aspen	Canadian	8000-10,000	7500-9500	4500-6000
Foothills and Mesas	Pinyon, Juniper Oak, Mountain mahogany Sagebrush scrub Saltbush, Greasewood	Transition	6000-8000	5500-7500	4000-4500
Plains and Valleys	Shortgrass Plains Riparian Deciduous Forest	Upper Sonoran	under 6000	under 5000	under 4000

For example, in the tundra zone from Colorado north to Jasper National Park, the most typical breeding bird species are the white-tailed ptarmigan and the rosy finch. In the southern Rockies of Colorado, the rosy finch is of the brown-capped race, while in the central Rockies of Wyoming it is of the black-bodied race, and farther north it is the gray-headed form. In the subalpine zone below timberline such species as the Brewer's sparrow, pine siskin, red and white-winged crossbill, and white-crowned sparrow are typical breeding forms, and slightly lower in the montane coniferous forest a great number of breeding species are found. Among those that are particularly associated with the mesic or typical montane forest are the spruce grouse, goshawk, Cooper's hawk, sharp-shinned hawk, great gray owl, boreal owl, pileated woodpecker, three-toed and black-backed woodpeckers, Williamson's sapsucker, gray and Steller's jays, Clark's nutcracker, Wilson's, yellow-rumped, and MacGillivray's warblers, winter wren, golden-crowned and ruby-crowned kinglets, mountain chickadee, red-breasted nuthatch, Townsend's solitaire, varied, hermit, and olive-backed thrushes, mountain bluebird, and dark-eyed junco. In the moister western red cedar, western hemlock forests of northwestern Montana, the chestnut-backed chickadee is especially characteristic, while in the drier and more park-like ponderosa pine forests such species as the blue grouse, band-tailed pigeon, calliope hummingbird, American robin, black-billed magpie, Lewis' woodpecker, and pygmy nuthatch are more likely to be found. The birds of lodgepole pine forests are in general very much like those of the Douglas fir forests and other coniferous montane forest communities, while the aspen forests typically have a somewhat more diversified breeding avifauna, including such species as the ruffed grouse, flammulated owl, pygmy owl, yellow-bellied sapsucker, tree swallow, eastern bluebird, and warbling vireo.

The woodlands of pinyon pine, juniper, oak, and mountain mahogany, which are best developed to the south and west of the region under consideration here, carry into the region a distinctive group of birds such as the common poor-will, saw-whet owl, pinyon jay, gray flycatcher, plain titmouse, blue-gray gnatcatcher, western bluebird, Bewick's wren, black-throated gray warbler, and Grace's warbler. The drier and lower sagebrush scrub and less widespread alkaline-associated saltbush and greasewood communities likewise have a few highly distinctive breeding species, such as sage grouse, mountain plover, sage thrasher, Brewer's sparrow, and sage sparrow. The birds of the shortgrass plains beyond the foothills typically have wide breeding distributions on the Great Plains, while those of riparian deciduous forest usually

have their affinities with the deciduous forest communities that occur widely over eastern North America. For example, the yellow-billed cuckoo, eastern screech-owl, red-headed and red-bellied woodpeckers, least flycatcher, eastern phoebe, blue jay, eastern bluebird, brown thrasher, warbling vireo, red-eyed vireo, chestnut-sided warbler, bay-breasted warbler, indigo bunting, fox sparrow, rufous-sided towhee, orchard oriole, and Baltimore oriole are all likely to be encountered in mature riparian woodlands as well as in deciduous forests much farther to the east.

Even in national parks not all the habitats are pristine; historical and recent forest fires have placed much of the area of Yellowstone Park in various stages of vegetational succession dominated by lodgepole pine, for example, and ranching activities in Grand Teton National Park have influenced grassland and shrub succession in non-forested areas. Browsing of elk has greatly influenced aspen distribution and survival, and damming of streams by beavers has resulted in the formation of unique beaver-pond communities, with an interesting and diverse associated plant, bird, and mammal life. Indeed, such species as the trumpeter swan and sandhill crane are largely dependent upon beaver activity in the Grand Teton-Yellowstone area for the production and maintenance of suitable breeding habitat.

Man's effects on the environment are apparent everywhere throughout the Rocky Mountains, as lumbering, agriculture, mining, energy development, road-building, and other familiar symbols of modern civilization have left their marks on the landscape. In general, the influence of man is to reduce environmental diversity, by eliminating either unwanted ("weeds," "pests," predators, etc.) or "worthless" species, in favor of more economically desirable uses for the land. As a result, some bird species have become extremely rare throughout the region, even in national parks. These include the peregrine falcon (now being reintroduced). This and other species have in some areas been locally extirpated, such as the flammulated owl and the Cassin's kingbird from Rocky Mountain National Park. Others, such as the trumpeter swan and sandhill crane, are gradually responding to protection and management, and are moving back into areas from which they have been absent for many decades. Yet others have benefited greatly from man's activities, and have become extremely abundant in and around human activity centers. These include such introduced species as the house sparrow and European starling, and various native species including the American robin, common grackle, and brown-headed cowbird.

## Climate, Landforms, and Vegetation

The entire area under consideration is characterized by continental climate, with great seasonal and daily changes in temperature, and fairly short and cool summers. Most of the precipitation is orographic in nature; that is, it is related to topography, with the heaviest precipitation levels typically occurring on the western slopes, and the eastern slopes and valleys often showing reduced precipitation or "rain-shadow" effects (Fig. 3). In general, the higher precipitation levels are in the northwestern portion of the area, in northern Idaho and northwestern Montana, where moist winter air from the Pacific Northwest spills inland to produce the lush western red cedar, western hemlock forests of the west-facing slopes. The driest parts of the area are in the Snake River basin of southern Idaho, the Bighorn Basin of Wyoming, and the Red Desert region of southeastern Wyoming, where annual precipitation is sometimes under ten inches.

The landforms of the region are, of course, dominated by mountainous topography (Fig. 4). These consist of three relatively discrete regions: the northern Rockies, extending from Canada south into western Montana and Idaho as far as the Snake River basin; the central Rockies, centering on the Yellowstone Plateau of northwestern Wyoming and adjacent portions of southern Montana and extreme eastern Idaho; and the southern Rockies of Colorado and extreme southern Wyoming. These are generally relatively high mountains, with the highest elevations being 12,294 feet in Alberta, 12,665 feet in Idaho, 12,850 feet in Montana, 13,785 feet in Wyoming, and 14,431 feet in Colorado. The Rocky Mountains form the continental watershed throughout, separating the Great Plains to the east from the Great Basin to the west, and providing the headwaters for such major river systems as the Snake, Colorado, and Missouri. Only in central Wyoming does the continental divide drop below 7,000 feet. There, in the Red Desert area, it separates and encloses the arid and alkaline Great Divide Basin before rising and leaving the state in the Sierra Madre range. Besides the primary Rocky Mountain chain, there are a number of smaller subsidiary ranges, including the Bighorn Mountains of Wyoming, and several smaller groups of mountains in eastern Wyoming and Montana (Fig. 5).

The geologic forces that shaped the area of the northern and central Rocky Mountains are complex, but the mountains are largely the result of folding and thrust-faulting of sedimentary layers starting in late Cretaceous times some seventy million years ago. Lateral pressures on these layers caused folding, buckling, and faulting to occur, with large areas being lifted upwards and subsequently eroded away. After the Cre-

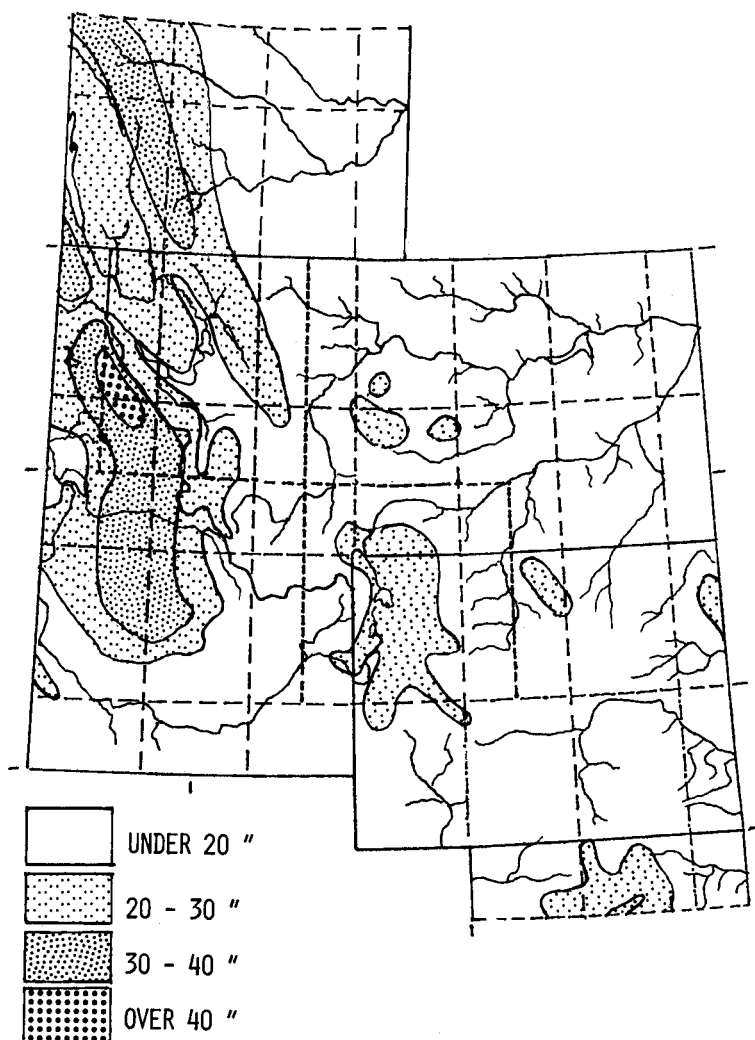


Figure 3. Outline map of region, showing annual precipitation patterns and river drainages.

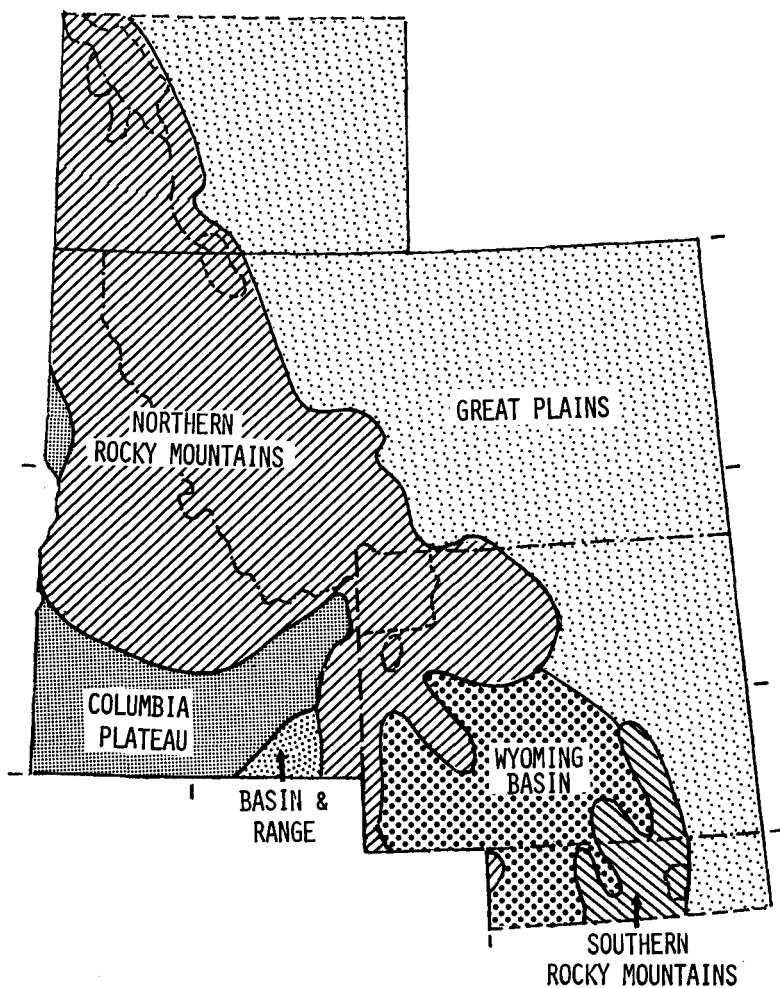


Figure 4. Outline map of region, showing state or provincial boundaries and boundaries of major physiographic features.



taceous layers had been eroded away, progressively earlier layers of Mesozoic and Paleozoic deposits were exposed, until finally the Precambrian core levels were locally exposed. By early Cenozoic times the mountains were perhaps as rugged as the present-day Rockies, but were generally much lower and far more subtropical in climate. Folding and thrust-faulting actions terminated by about the end of the Eocene some sixty million years ago, but during various later parts of the Cenozoic several periods of vulcanism resulted in the deposition of great lava plateaus in the Columbia Plateau, as well as tremendous depositions of wind-blown ash, raising mountain valleys and filling basins. In mid-Cenozoic times the entire Rocky Mountain area began to rise gradually, until the range reached its present-day elevation. This lifting was countered by continued erosion, especially during Pleistocene times, when actions of ice, water, and winds removed several thousands of feet from the exposed strata, and left evidence of such glacial handiwork as U-shaped valleys, cirques, and morainal lakes.

The cold climate of Pleistocene times brought with it a host of northern plant and animal species, which moved variably southward along the Rocky Mountain chain. Subsequently, many of the less mobile species became isolated on high peaks, as the climate ameliorated and a period of drying and warming began. This, of course, was much more true of plant life than of the more mobile animals, but to some degree can also be observed in such locally variable species as the rosy finches, with their distinctive isolated populations from Canada southward. In any case, tundra areas were isolated in post-Pleistocene times and became restricted to the highest mountains, while montane forests and progressively more arid-adapted vegetational communities established varied patterns of geographic distribution reflecting altitude, precipitation, soils, and other environmental factors (Figs. 6-10).

The bird watcher should be aware of the major vegetational zones in the Rocky Mountains, both as a means of predicting the occurrence of particular birds and also as a way of more fully appreciating the complex ecological interactions visible in the region. The major plant communities, and some of their associated botanic characteristics, are as follows:

**ALPINE TUNDRA:** Areas above timberline where trees are absent or confined to exceptionally protected locations, and dominated by perennial herbs and shrubs. Summers are very short, and very few breeding birds occur here.

**SUBALPINE ZONE (timberline zone):** This area of generally low and often twisted trees ("krummholz") is typically dominated by subalpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii*), although

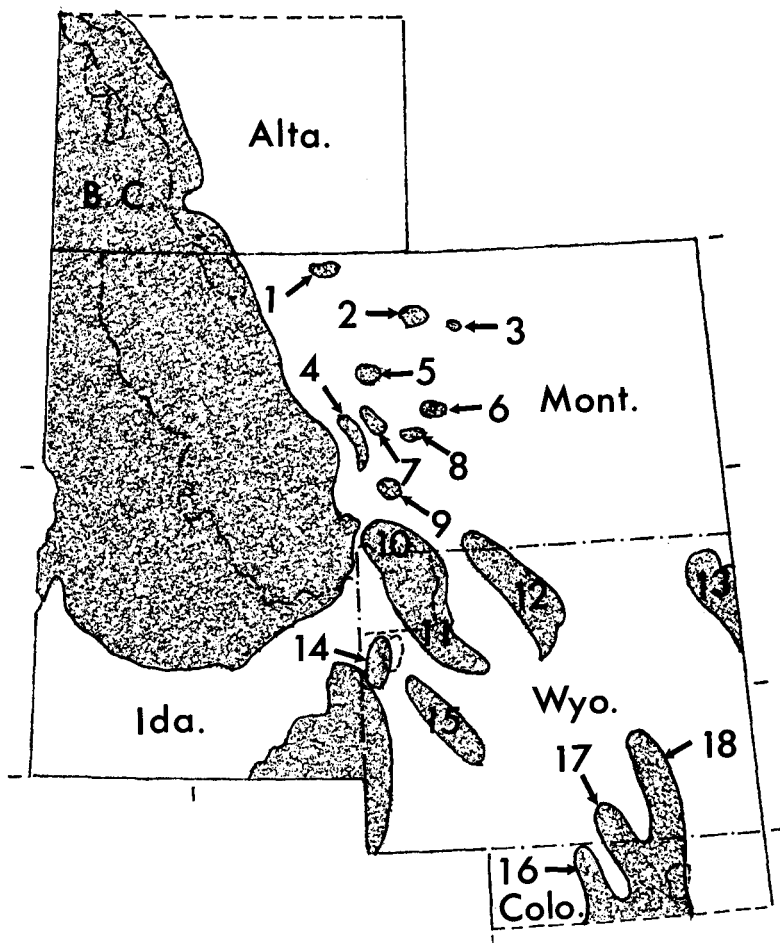


Figure 5. Outline map of region, showing state or provincial boundaries and locations of major and minor mountain ranges. Numbered ranges include 1: Sweetgrass Mts. 2: Bearpaw Mts. 3: Little Rocky Mts. 4: Big Belt Mts. 5: Highwood Mts. 6: Judith Mts. 7: Little Belt Mts. 8: Big Snow Mts. 9: Crazy Mts. 10: Snowy Mts. 11: Absaroka Mts. 12: Big Horn Mts. 13: Black Hills. 14: Teton Mts. 15: Wind River Mts. 16: Park Mts. 17: Medicine Bow Mts. 18: Laramie Mts.

in some areas of Wyoming and Colorado the white-barked pine (*Pinus albicaulis*) is a major timberline species, and somewhat farther south limber pine (*Pinus flexilis*) is a characteristic timberline species as well as occurring on drier foothill areas.

**DOUGLAS FIR CLIMAX:** Dominated by Douglas fir (*Pseudotsuga menziesii*), sometimes in dense, single-species stands, but also often sharing dominance in the Central Rockies with blue spruce (*Picea pungens*) or Engelmann spruce.

**WESTERN RED CEDAR, WESTERN HEMLOCK CLIMAX:** On the moist western slopes of Glacier Park, and elsewhere in the northern Rockies, this distinctive community, dominated by these massive and beautiful forest giants, is locally found. The western red cedar (*Thuja plicata*) has fluted trunk, fern-like foliage, and grayish bark. The western hemlock (*Tsuga heterophylla*) is a similarly beautiful and important timber tree, and few of these forests remain except in protected areas such as parks.

**PONDEROSA PINE:** This forest is extremely widespread throughout the Rockies, often forming the lower edge of the montane coniferous forest, and frequently extending out into the high plains in scattered groves on mesas or other favored sites. The dominant, and sometimes only, tree is ponderosa pine (*Pinus ponderosa*), which typically grows in open rather than dense groves, with considerable grassy or shrubby cover between the trees. In eastern Wyoming the limber pine is an important component of this forest type; in western Wyoming and Colorado various junipers replace it to some degree.

**LODGEPOLE PINE:** Vast areas of the lower and middle portions of the montane forest are covered by lodgepole pine (*Pinus contorta*) in the central and northern Rockies; for example, most of Yellowstone Park is dominated by such forests, which typically occur following fire. The stands are usually very dense, with little undergrowth, and do not support a diverse breeding bird population.

**QUAKING ASPEN:** Aspen (*Populus tremuloides*) groves occur widely in the central and northern Rockies, either as a successional community following fire or logging, or as an apparent climax community in low hillsides too dry to support coniferous forests. It is an easily recognized community type, and often is rich in bird life.

**PINYON-JUNIPER:** On foothills and other areas below the coniferous forest a low forest composed of various species of junipers (*Juniperus monosperma*, *J. scopulorum*, *J. occidentalis*, etc.) and arid-adapted pines (*Pinus monophylla*, *P. edulis*, etc.) locally occurs. It is poorly represented in our area, but extends north to the Snake River of Idaho.

**OAK-MOUNTAIN MAHOGANY:** Like the last community type, this is also an arid-adapted community better developed in the southern

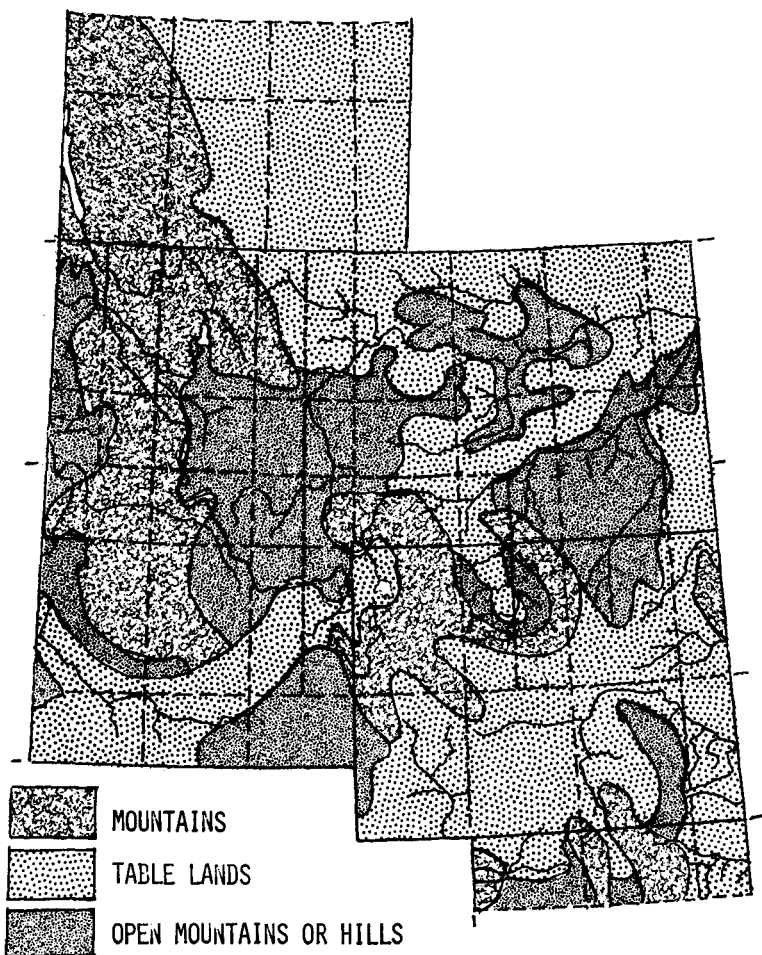


Figure 6. Outline map of region, showing distribution of table lands, open mountains or hills, and mountains.

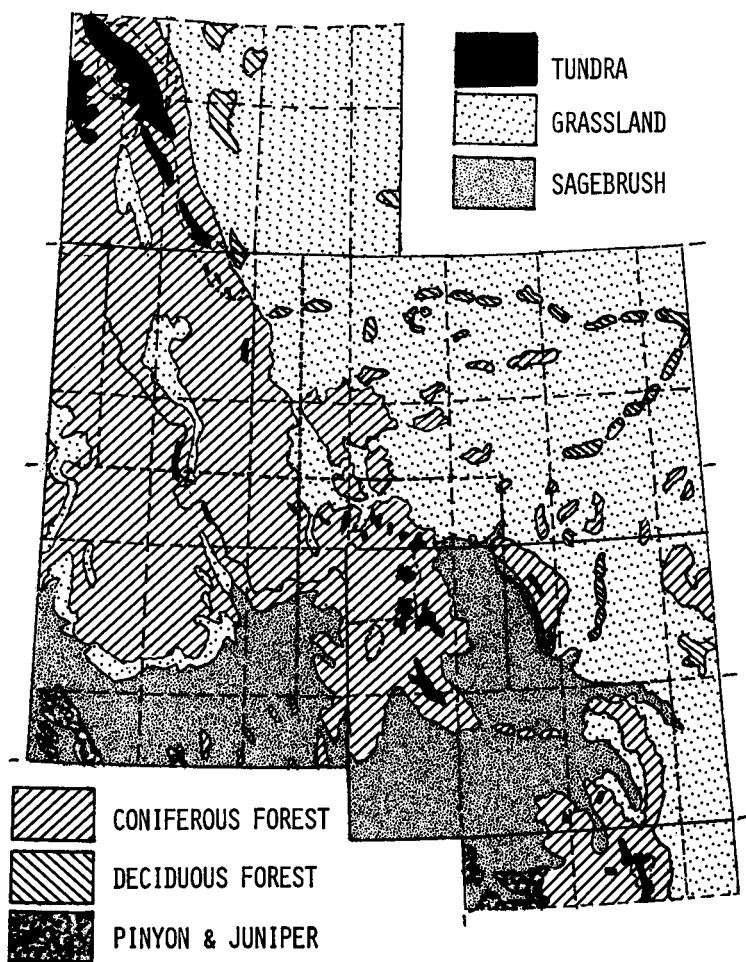


Figure 7. Outline map of region, showing distribution of natural vegetation community types.

Rockies than in our area. It is largely limited to Colorado and extreme southern Idaho. It consists of several species of low oaks (*Quercus gambelii* primarily) and mountain mahogany (*Cercocarpus parviflorus*, *C. ledifolius*, etc.), as well as other low shrubs such as serviceberry (*Amelanchier utahensis*). These shrubs typically grow in clumps, separated by grassy areas, forming chaparral-like community types. Like the pinyon-juniper community, it supports a distinctive bird life.

**SAGEBRUSH SCRUB:** Over vast areas of the intermountain west the land is dominated by sagebrush, especially big sagebrush (*Artemisia tridentata*). In some areas the sage shares dominance with various grasses, but its distinctive silvery gray color allows for ready identification. In recent years much of the sagebrush lands have been converted to agriculture through irrigation, and such sage-adapted species as the sage grouse have suffered accordingly.

**SALTBUSH, GREASEWOOD:** In the Great Divide Basin area of Wyoming, and locally elsewhere, the alkaline soils allow only for the growth of this distinctive community type. The vegetation is scattered, shrubby, and bunch-like, with the dark green color of the greasewood (*Sarcobatus vermiculatus*) strongly contrasting with the more grayish shadscale (*Atriplex canescens*) and saltbush (*A. confertifolia*). The bird life of these communities is similar to that of sagebrush scrub, but is generally low in species diversity and abundance.

**SHORTGRASS PLAINS:** The vast grassy plains lying to the east of the Rocky Mountains support such attractive species as long-billed curlew, upland sandpiper, and several species of grassland sparrows such as grasshopper sparrow, lark bunting, vesper sparrow, McCown's longspur and chestnut-collared longspur. They are dominated by numerous species of low, perennial grasses such as grama (*Bouteloua* spp.) and buffalo grass (*Buchloë dactyloides*), as well as other taller grass species in protected or ungrazed areas.

**RIPARIAN DECIDUOUS FOREST:** The upper reaches of the Yellowstone, Missouri, Platte, and other major rivers of the Great Plains bring west into the region an important biota that is especially rich in eastern bird life, as noted earlier. The major trees are cottonwoods, alders, and willows, which sometimes attain considerable height, depending on amounts and seasonality of water availability.

## Typical Rocky Mountain Avifauna

On the basis of their widespread occurrence in the national parks under consideration here (reported from at least five of the eight), a collective list of fifty-three "typical" Rocky Mountain birds can be com-

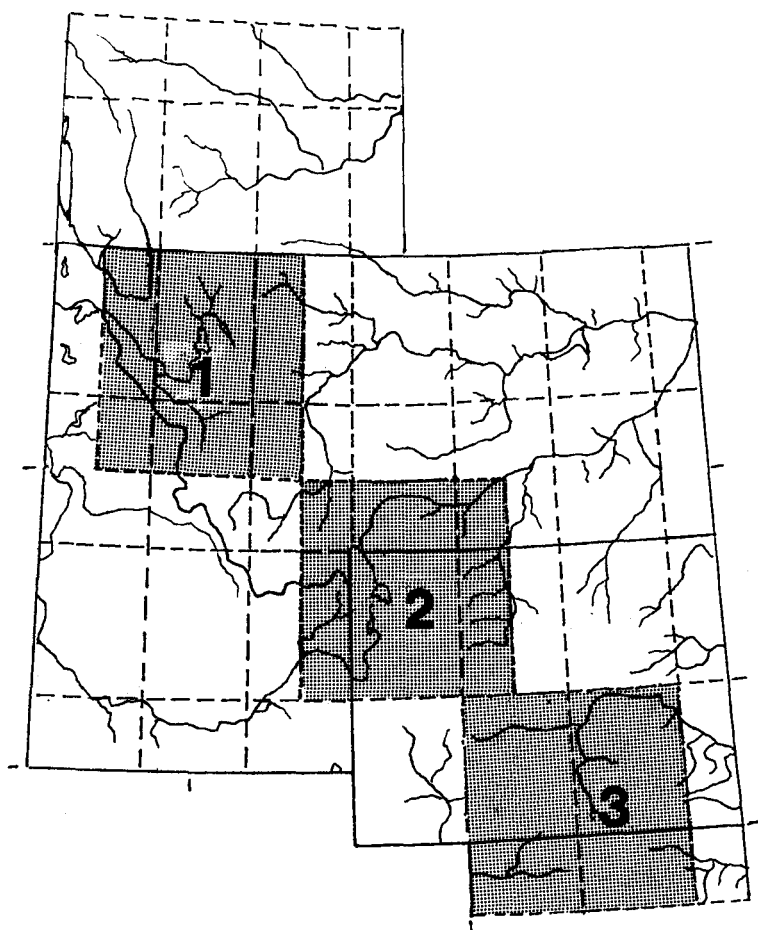


Figure 8. Outline map of region, showing river drainages and (shaded) latilong groupings.

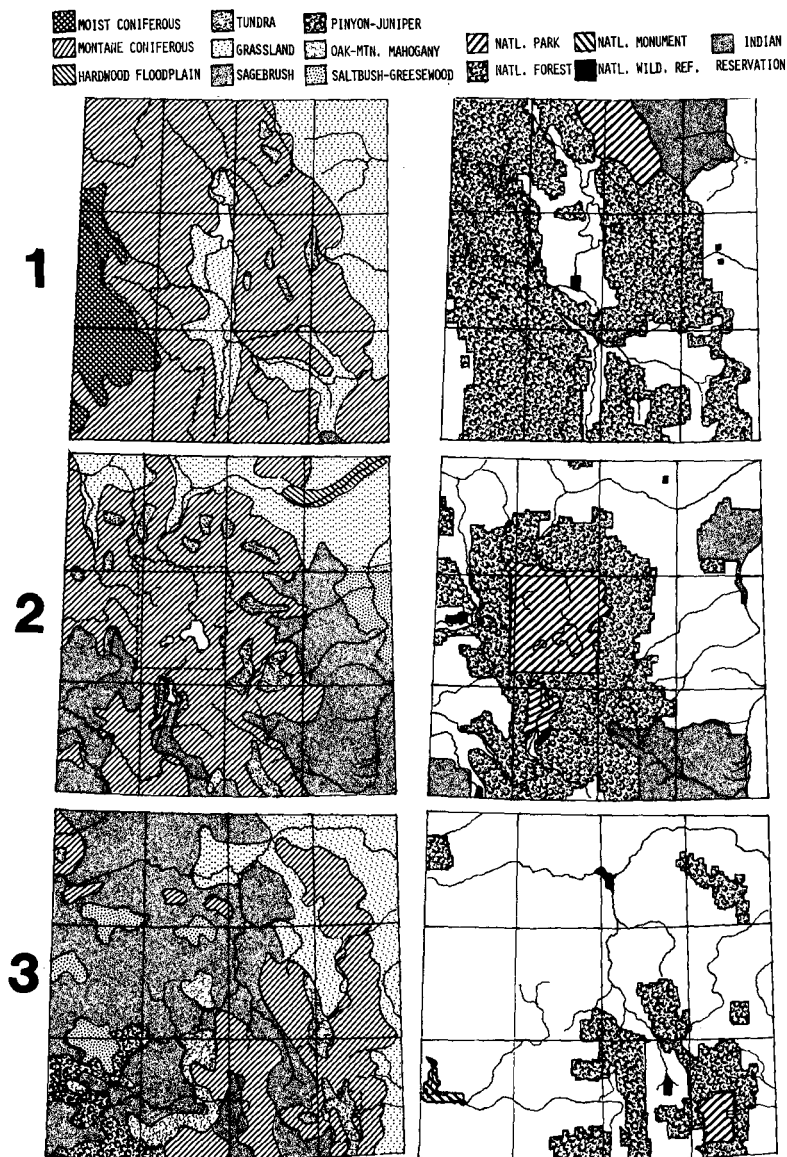


Figure 9. Details of latilong groupings indicated in Figs. 1 and 8, showing natural vegetation community types (left) and patterns of federal land usage (right).



piled, which provides a nuclear group of birds that might be observed while visiting almost any of the Rocky Mountain parks.

<i>Water-related Species</i>	<i>Forest-related Species</i>	<i>Widespread and Other Species</i>
Mallard	Blue Grouse	Killdeer
Blue-winged Teal	Ruffed Grouse	Common Nighthawk
Common Merganser	Great Horned Owl	Willow Flycatcher
Osprey	Northern Pygmy Owl	Tree Swallow
Spotted Sandpiper	Yellow-bellied Sapsucker	Violet-green Swallow
Common Snipe	Three-toed Woodpecker	Rough-winged Swallow
Belted Kingfisher	Olive-sided Flycatcher	Cliff Swallow
American Dipper	Gray Jay	Barn Swallow
Water Pipit	Steller's Jay	American Robin
Common Yellowthroat	Clark's Nutcracker	Yellow Warbler
Lincoln's Sparrow	Common Raven	McGillivray's Warbler
	Black-capped Chickadee	Chipping Sparrow
	Mountain Chickadee	Vesper Sparrow
	Red-breasted Nuthatch	Savannah Sparrow
	Brown Creeper	Brewer's Blackbird
	Ruby-crowned Kinglet	Rosy Finch
	Mountain Bluebird	
	Townsend's Solitaire	
	Hermit Thrush	
	Yellow-rumped Warbler	
	Wilson's Warbler	
	Western Tanager	
	Fox Sparrow	
	White-crowned Sparrow	
	Dark-eyed Junco	
	Pine Grosbeak	

## Widespread Western Avifauna

Besides the "typical" Rocky Mountain avifauna just listed, there are also a considerable number of species that are rather generally distributed through the Rocky Mountain region, even though they may not occur in the majority of the parks covered here. The following is a list of fifty of these, exclusive of those species included in the immediate previous listing.

<i>Water-related Species</i>	<i>Forest-related Species</i>	<i>Widespread and Other Species</i>
Great Blue Heron	Sharp-shinned Hawk	Northern Harrier

<i>Water-related Species</i>	<i>Forest-related Species</i>	<i>Widespread and Other Species</i>
Canada Goose	Cooper's Hawk	Swainson's Hawk
Northern Pintail	Northern Goshawk	Red-tailed Hawk
Green-winged Teal	Downy Woodpecker	Golden Eagle
Sora	Hairy Woodpecker	American Kestrel
Wilson's Phalarope	Common Flicker	Prairie Falcon
Yellow-headed Blackbird	Western Wood-pewee	Rock Dove
Red-winged Blackbird	House Wren	Mourning Dove
	Golden-crowned Kinglet	Western Kingbird
	Veery	Eastern Kingbird
	Swainson's Thrush	Horned Lark
	Cedar Waxwing	Black-billed Magpie
	Solitary Vireo	Loggerhead shrike
	Warbling Vireo	European Starling
	Orange-crowned Warbler	Lazuli Bunting
	American Redstart	Western Meadowlark
	Black-headed Grosbeak	Common Grackle
	Rufous-sided Towhee	Brown-headed Cowbird
	Northern Oriole	American Goldfinch
	Cassin's Finch	House Sparrow
	Red Crossbill	
	Pine Siskin	

## Individual Park Specialties

Nearly every one of the Rocky Mountain parks, because of its location or special ecological attributes, offers the bird watcher a few species not found, or at least not so easily found, in any of the other parks. The following is a list of the relatively unique breeding species that might be looked for in particular when visiting one of these localities during summer, although some of them are relatively rare.

<u>U.S. SITES</u>		
<u>Dinosaur Natl. Mon.</u>	<u>Rocky Mountain Natl. Park</u>	<u>Grand Teton Natl. Park</u>
Turkey Vulture	Band-tailed Pigeon	Trumpeter Swan
Plain Titmouse	Common Poorwill	Sandhill Crane
Bushtit	Pygmy Nuthatch	Sage Grouse
Brown Towhee	Western Bluebird	Black Rosy Finch
Black-throated Gray Warbler	Virginia's Warbler	
	Brown-capped Rosy Finch	

U.S. SITES*Dinosaur*  
*Natl. Mon.**Rocky Mountain*  
*Natl. Park**Grand Teton*  
*Natl. Park*Canyon Wren  
House Finch  
Lesser Goldfinch*Yellowstone*  
*Natl. Park**Glacier*  
*Natl. Park*White Pelican  
Double-crested  
Cormorant  
Caspian Tern  
Pinyon Jay (rare)  
Sage Thrasher (rare)Hooded Merganser  
Vaux's Swift  
Chestnut-backed  
Chickadee  
LeConte's Sparrow  
Chestnut-collared  
LongspurCANADIAN SITES*Waterton Lakes*  
*Natl. Park**Yoho Natl. Park*Sharp-tailed Grouse  
Black-billed Cuckoo  
Ruby-throated Humming-  
bird  
Brown Thrasher  
Ovenbird  
Indigo Bunting  
LeConte's SparrowBarred Owl  
Rusty Blackbird*Banff Natl. Park**Jasper Natl. Park*Alder Flycatcher  
White-throated Sparrow  
Golden-crowned Sparrow  
Purple FinchGreater Yellowlegs  
Willow Ptarmigan  
Palm Warbler  
Rusty Blackbird  
(Plus all Banff specialties)**Substrate-dependent Avifauna**

A considerable number of species that breed in the Rocky Mountain region do so under special ecological conditions, and their nest-site or

foraging requirements tend to dictate local distributions more so than do vegetational characteristics. These include the following species:

*Cliff-nesting Species*

Turkey Vulture  
 Ferruginous Hawk  
 Peregrine Falcon  
 Prairie Falcon  
 Rock Dove  
 White-throated Swift  
 Black Swift  
 Say's Phoebe

*Fish-dependent Species*

Common Loon  
 Grebes (especially Western)  
 American White Pelican  
 Double-crested Cormorant  
 Great Blue Heron  
 Hooded Merganser  
 Common Merganser  
 Osprey  
 Bald Eagle  
 Caspian Tern  
 Common Tern  
 Belted Kingfisher

*Nest in Pre-existing Holes*

Wood Duck  
 Barrow's Goldeneye  
 Bufflehead  
 Hooded Merganser  
 Common Merganser  
 American Kestrel  
 Flammulated Owl  
 Western Screech Owl  
 Northern Pygmy Owl  
 Barred Owl  
 Boreal Owl

*Northern Saw-whet Owl*

Vaux's Swift  
 Violet-green Swallow  
 Tree Swallow  
 Chickadees (all species)  
 Brown Creeper  
 House Wren  
 Western Bluebird  
 Mountain Bluebird  
 European Starling  
 House Sparrow

*Self-excavating Hole-nesters*

Woodpeckers (all spp.)  
 Nuthatches (all spp.)

*Nest in Banks or Burrows*

Belted Kingfisher  
 Burrowing Owl  
 Bank Swallow  
 Rough-winged Swallow

*Nest on Low Islands*

American White Pelican  
 Ring-billed Gull  
 California Gull  
 Common Tern  
 Caspian Tern

*Nest on Human-made Structures*

Rock Dove  
 Barn Swallow  
 Cliff Swallow  
 Eastern Phoebe  
 Say's Phoebe

*Nest along Mountain Streams*

Harlequin Duck  
 American Dipper

## Synopsis of Major Bird-watching Areas

### *Colorado*

**ROCKY MOUNTAIN NATIONAL PARK.** This national park (Fig. 10) encompasses about 417 square miles of Colorado's magnificent Front Range, and altitudes range from Longs Peak, 14,255 feet above sea level, to 7,800 feet at Estes Park. Tourists can drive over the continental divide, at 12,183 feet, on Trail Ridge Road, the highest road in any national park. About one-third of the park is above 11,000 feet in elevation, and there are over 50 square miles of tundra vegetation present. As a result, this park includes many areas of alpine tundra that are easily accessible; there are also large tracts of montane coniferous forest, mainly of ponderosa pine, plus Engelmann spruce and subalpine fir at subalpine levels, and associated birds. Besides a locally available park checklist of birds, there is also an excellent (but out of print) booklet on the birds of this park ("Birds of Rocky Mountain National Park," A. Collister, 1970, Museum Pictorial of the Denver Museum of Natural History). For more information, contact the Superintendent, Estes Park, Colorado 80517.

**DINOSAUR NATIONAL MONUMENT.** This national monument is located on the Colorado-Utah border, and comprises 320 square miles. The vegetation and topography are not typical Rocky Mountain, but instead are an extension of the basin and range topography of Utah and Nevada. As a result, the bird life is distinctly arid-adapted, and includes many species otherwise occurring only to the west and south. There is no published checklist as of this writing, but the list for Brown's Park National Wildlife Refuge (see below) is probably applicable, and a preliminary mimeographed bird list for the Monument is also available. Species listed as breeding in the Monument in the text of this book include those reported for Brown's Park. For further information, contact the Superintendent, Box 128, Jensen, Utah 84035.

**BROWN'S PARK NATIONAL WILDLIFE REFUGE.** This is a refuge of more than 13,000 acres in extreme northwestern Colorado along the Green River and adjoining Dinosaur National Monument. It consists mostly of mountain meadows and rocky slopes, bluffs and marshy habitats as well as the Green River itself. A bird checklist is available. For more information, contact the Refuge Manager, Greystone Route, Maybell, Colorado 81640.

**ARAPAHO NATIONAL WILDLIFE REFUGE.** This 12,814-acre refuge in north-central Colorado is located near the Continental Divide, at about

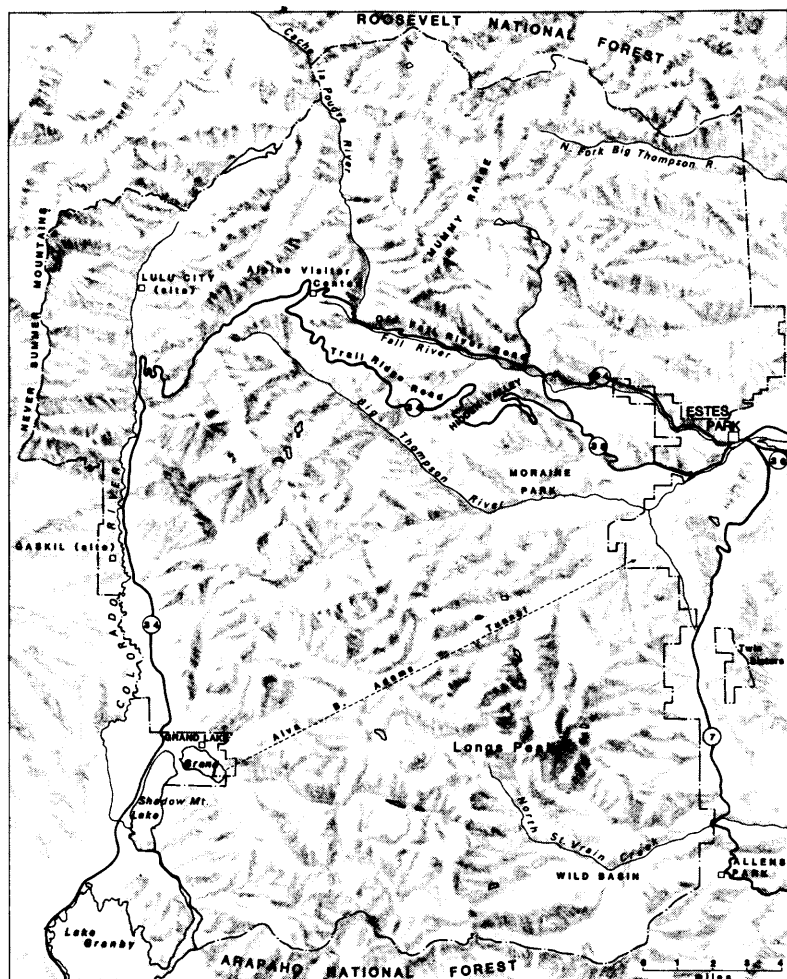


Figure 10. Outline map of Rocky Mountain National Park

8,300 feet elevation, in an arid rain-shadow area only about 60 miles away from Rocky Mountain National Park. It is located in the North Park region of Colorado, with "park" indicating a mountain meadow or relatively treeless area in an otherwise generally forested region. A bird checklist is available. For further information, contact the Refuge Manager, Box 457, Walden, Colorado 80480.

## Wyoming

**GRAND TETON NATIONAL PARK.** This national park (Fig. 11) includes Jackson Hole and the adjacent Teton Range, and consists of more than 480 square miles of high mountains (maximum height 13,766 feet), coniferous forests, and sage-covered plains between 6,000 and 7,000 feet. All the roads are limited to the lower elevations, but many hiking trails extend into the mountain forests and alpine zones, where many birding opportunities exist. A checklist of Grand Teton birds has been published by the Grand Teton Natural History Association and the National Park Service, and another covering all of Jackson Hole has been produced by the Wyoming Game and Fish Department (260 Buena Vista, Lands, Wyoming 82520). A more extended coverage, illustrated with color photos of many of the commoner species, is "Birds of Yellowstone and Grand Teton National Parks," by D. Follett, Yellowstone Library and Museum Association in cooperation with the National Park Service. For more information, contact the Superintendent, Moose, Wyoming 83012. For information, including a checklist of 173 bird species that have been observed on the adjoining National Elk Refuge, contact the Refuge Manager, P.O. Box C, Jackson, Wyoming 83001.

**YELLOWSTONE NATIONAL PARK.** This, the oldest national park (Fig. 12), is also the largest south of Canada, covering more than 3,400 square miles. Its highest point (Eagle Peak) is 11,358 feet. Most of the roads are in excess of 7,000 feet, with passes as high as 8,850 feet. The majority of the land area of the park is covered with dense lodgepole pine forests, with Engelmann spruce and subalpine fir at the higher elevations, and some fairly extensive areas of sage-dominated grasslands between 5,000 and 7,500 feet. Yellowstone supports the only nesting colony of white pelicans in any national park, and is also notable for its nesting populations of bald eagles, ospreys, and trumpeter swans. Besides the booklet mentioned in the account of Grand Teton National Park, there is also a checklist published by the Yellowstone Library and Museum Association. For more information, contact the Superintendent, Mammoth Hot Springs, Wyoming 82190.

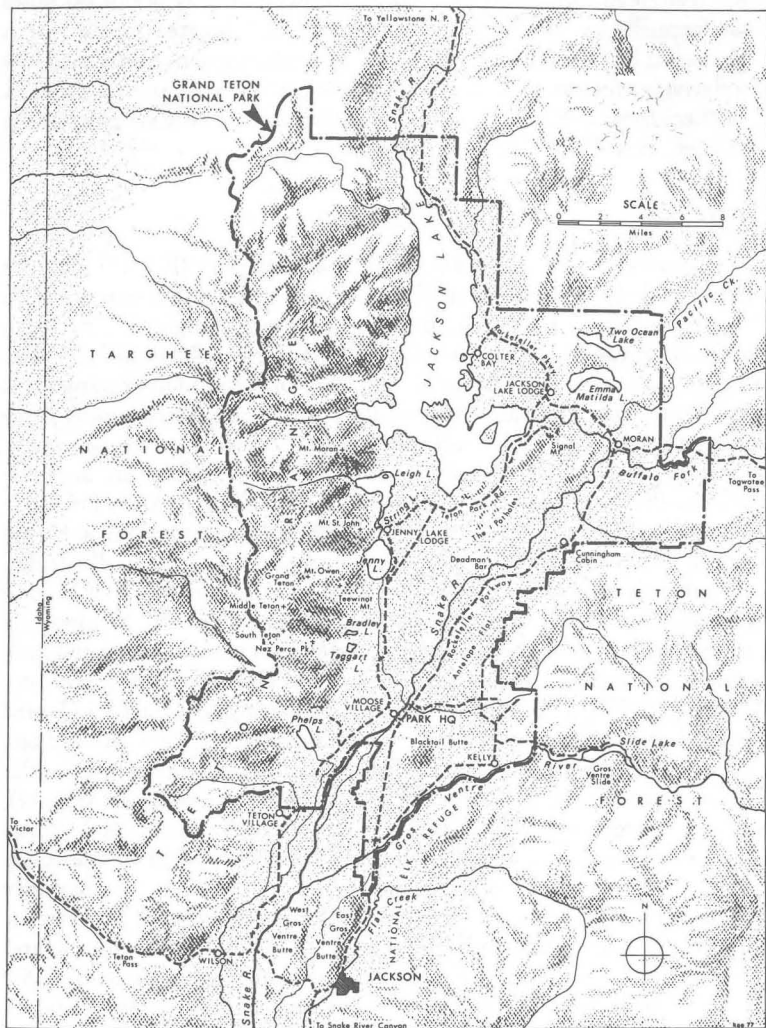


Figure 11. Outline map of Grand Teton National Park.



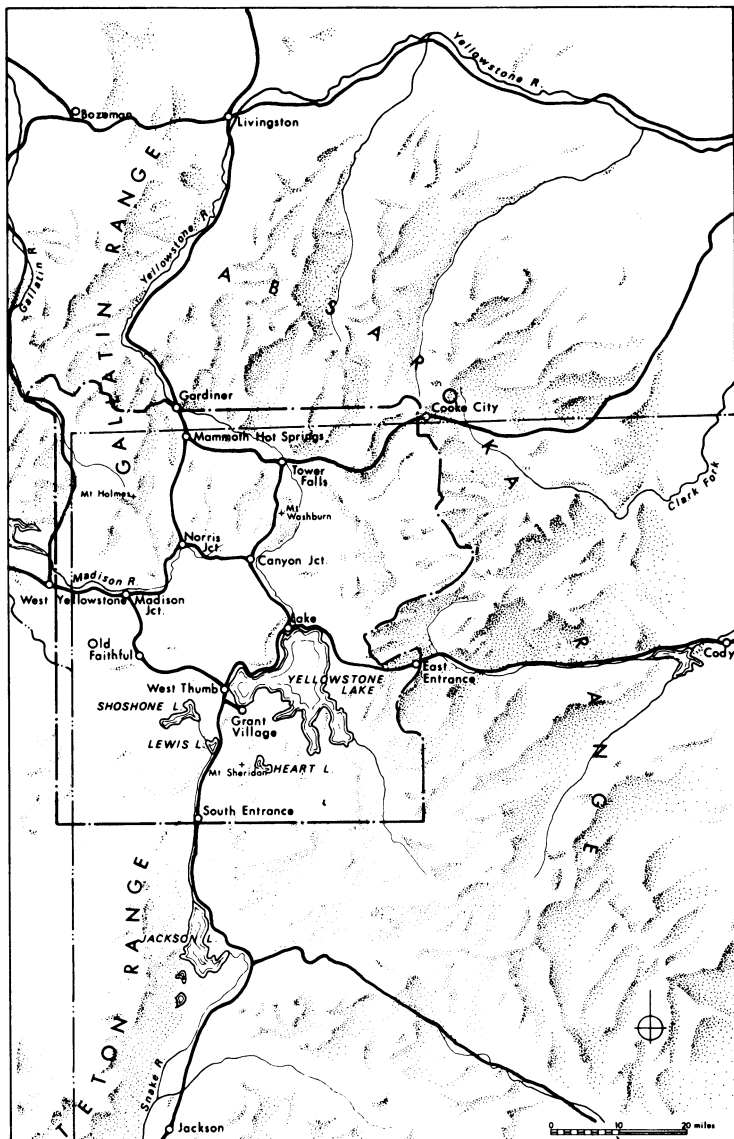


Figure 12. Outline map of Yellowstone National Park.

**SEEDSKADEE NATIONAL WILDLIFE REFUGE.** This refuge of 14,455 acres in southwestern Wyoming lies at about 6,000 feet elevation, in the Green River Valley. It is dominated by sagebrush and other arid-adapted plants, and has an associated bird fauna, together with bluff-associated and riparian woodland birds, although no refuge checklist is yet available. Further information can be obtained from the Refuge Manager, P.O. Box 67, Green River, Wyoming 82935.

## *Montana*

**RED ROCK LAKES NATIONAL WILDLIFE REFUGE.** This refuge is located in the Centennial Valley of southwestern Montana, directly west of Yellowstone National Park. It encompasses some 63 square miles and its elevations range from 6,000 to nearly 10,000 feet. Its centerpiece is a 12,000-acre marsh that is a primary breeding area for trumpeter swans, as well as more than 20 other species of waterfowl. A checklist of 209 refuge birds (144 breeders) is available. For more information, contact the Manager, Box 15, Lima, Montana 59739.

**GLACIER NATIONAL PARK.** This park (Fig. 13) consists of nearly 1,600 square miles in northwestern Montana, and includes some of the most spectacular glacial topography to be seen anywhere south of Canada. Logan Pass at 6,664 feet lies at the crest of the Continental Divide. The park ranges in altitude from 10,243 feet to slightly over 3,000 feet at its eastern boundary. Slightly more than a third of the park lies in the alpine zone. Below 7,000–8,000 feet the park is largely covered by montane coniferous forest, especially of lodgepole pine, Engelmann spruce, and subalpine fir, but on the lower western slopes there is a moister phase dominated by western red cedar and western hemlock. A major bird attraction is provided by the concentrations of several hundred bald eagles (444 in 1977) at McDonald Creek each October. In addition to an excellent early analysis of the bird and mammal life in the park, "Wild Animals of Glacier National Park," 1918, by V. and F. M. Bailey, U.S. Government Printing Office, Washington, D.C.), there is a more recent "Birds of Glacier National Park," 1964, by L. P. Parratt, Special Bulletin No. 9, Glacier Natural History Association, and U.S. National Park Service. A checklist of Glacier National Park birds is also available from the Glacier Natural History Association. For more information, contact the Superintendent, West Glacier, Montana 59936.

**NATIONAL BISON RANGE.** This area of steep hills and narrow canyons lies southwest of Glacier National Park in the Flathead Valley, and consists of nearly 30 square miles of grassland and forest habitats. A list of 187 bird species includes breeding golden eagles, wood ducks, and

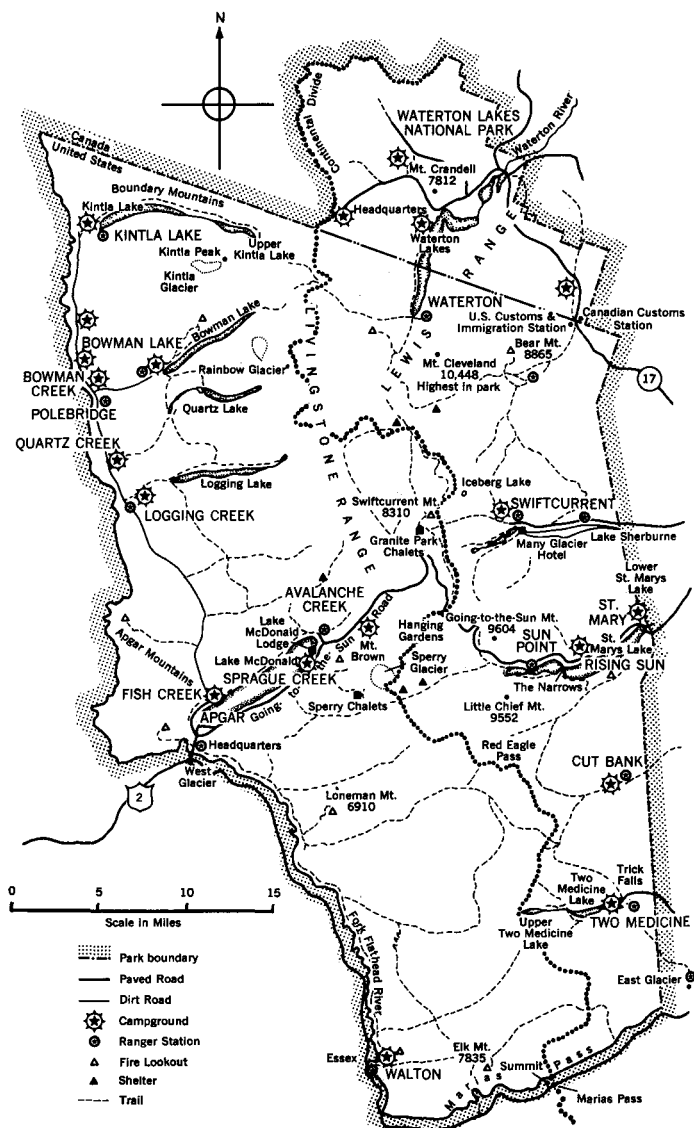


Figure 13. Outline map of Glacier and Waterton Lakes National Parks. From *A Guide to the National Parks*, Volume I by William H. Matthews III, copyright 1968 by William H. Matthews III. Reprinted by permission of Doubleday & Company, Inc.

hooded mergansers. For more information, contact the Refuge Manager, Moiese, Montana 59824.

**NINEPIPE AND PABLO NATIONAL WILDLIFE REFUGES.** These refuges are northeast of the National Bison Range, and collectively consist of about seven square miles of water, marsh, and upland grasslands. A collective bird checklist of 188 species includes five species of nesting grebes and 16 species of nesting waterfowl. For more information, contact the Refuge Manager, Moiese, Montana 59824.

**CHARLES M. RUSSELL NATIONAL WILDLIFE REFUGE.** This refuge consists of some 1,700 square miles of grassland habitats, in addition to Fort Peck Reservoir. A bird checklist of 236 species is available, and includes such breeding species as ferruginous hawk, golden eagle, prairie falcon, piping plover, and mountain plover. For more information, contact the Refuge Manager, P.O. Box 110, Lewistown, Montana 59457.

**MEDICINE LAKE NATIONAL WILDLIFE REFUGE.** This refuge in northeastern Montana consists of marshes and grasslands, with many typical prairie nesting species. The bird checklist includes 221 species, and has such prairie breeders as Sprague's pipit, Baird's sparrow, LeConte's sparrow, and chestnut-collared longspur, plus some colonial marsh nesters such as double-crested cormorant, American white pelican, and California and ring-billed gulls. For more information, contact the Refuge Manager, Medicine Lake, Montana 59247.

**BENTON LAKE NATIONAL WILDLIFE REFUGE.** This refuge of more than 12,000 acres consists mostly of grasslands and associated wetlands, and its bird life consists of a variety of shorebirds, waterfowl, and marsh birds, as well as a considerable diversity of raptors. It is located about 10 miles north of Great Falls, Montana. Breeding colonies of eared grebes and Franklin's gulls are among the conspicuous marsh birds, and there is a large population of breeding ducks. A bird checklist is available that lists 175 species, including 59 breeders. For more information, contact the Refuge Manager, Benton Lake National Wildlife Refuge, P.O. Box 450, Black Eagle, Montana 59414.

**BOWDOIN NATIONAL WILDLIFE REFUGE.** This refuge of some 15,000 acres is similar to the preceding one in that it consists mostly of grasslands and associated wetland habitats. It is located about 7 miles east of Malta, Montana. Colonial nesting marsh birds include American white pelicans, double-crested cormorants, eared grebes, and California, Franklin's, and ring-billed gulls. A bird checklist is available that lists 207 species, including 96 breeders. For more information, contact the Refuge Manager, P.O. Box J, Malta, Montana 59538.

**METCALF NATIONAL WILDLIFE REFUGE.** This rather small (2,700-acre) refuge is located in the Bitterroot Mountains of Montana, about 25

miles south of Missoula. It is centered along the Bitterroot River, and includes coniferous woodland as well as open field and aquatic habitats. For more information, contact the Refuge Manager, P.O. Box 257, Stevensville, Montana 59870.

## *Idaho*

**GRAY'S LAKE NATIONAL WILDLIFE REFUGE.** This refuge of some 15,000 acres in southeastern Idaho is located about 35 miles north of Soda Springs, and supports the densest known breeding population of greater sandhill cranes. It also is the location of the egg-transplant experiment involving whooping cranes, and thus it is the best location in the region for seeing this rare species. A bird list is available that totals over 160 species, including 69 breeding species. For more information, contact Refuge Manager, Box 837, Soda Springs, Idaho 83276.

**CAMAS NATIONAL WILDLIFE REFUGE.** This is a little-visited refuge of more than 10,000 acres, located about 4 miles northwest of Hamer, Idaho. It consists of a diverse array of habitats ranging from wetlands to prairie, irrigated meadows, and sagebrush. For more information, contact the Refuge Manager, Hamer, Idaho 83425.

**KOOTENAI NATIONAL WILDLIFE REFUGE.** This small refuge of less than 3,000 acres in extreme northern Idaho is located about five miles west of Bonners Ferry. It consists of montane forest and marshland habitats, and the refuge checklist lists 218 species of birds, including 85 breeders. For more information, contact the Refuge Manager, Star Route 1, Box 160, Bonners Ferry, Idaho 83805.

## *Alberta*

**WATERTON LAKES NATIONAL PARK.** This national park (Fig. 13) is contiguous with Glacier National Park (U.S.), and shares many of the same habitat types and topographic characteristics. It covers 203 square miles, and has a maximum elevation of 8,833 feet. A bilingual bird checklist is available. For more information, contact the Superintendent, Watertown Park, Alberta T0K 2M0.

**BANFF NATIONAL PARK.** This national park (Fig. 14) encompasses some 2,564 square miles along the western border of Alberta, and is largely a high montane park, with a maximum elevation of about 11,500 feet. A considerable part of the park is above timberline, and several large glaciers are found within its boundaries. A bilingual bird checklist covering both Banff and Jasper national parks is available. For more information, contact the Superintendent, Box 900, Banff, Alberta T0L 0C0.

**JASPER NATIONAL PARK.** This national park (Fig. 14) consists of some 4,200 square miles of high mountain scenery along the western border of Alberta, directly north of Banff National Park. Its highest point is 12,294 feet, the highest point in Alberta, but some of the river valleys are only slightly above 3,000 feet, providing an enormous vertical habitat range. A bilingual checklist of birds is available, and a birder's guide to the park has also been recently published (*Alberta Naturalist* 11:134-140, 1981). For more information, contact the Superintendent, Box 10, Jasper, Alberta T0E 1E0.

### *British Columbia*

**YOHO NATIONAL PARK.** This national park (Fig. 14) encompasses 507 square miles of montane habitats, and has a maximum elevation of 10,346 feet. It lies along the western border of Banff National Park, and shares many of the same species with that park. A bilingual bird checklist is available. For more information, contact the Superintendent, Field, British Columbia V0A 1G0.

**KOOTENAY NATIONAL PARK.** This national park (Fig. 14) encompasses 543 square miles, and is contiguous with Yoho National Park on the north and with Banff National Park on the east. Its highest elevation is 10,511 feet, on the western edge of the park, but much of the area along the highway is at elevations of under 5,000 feet. A checklist of the park's birds is available. For more information, contact the Superintendent, Radium Hot Springs, British Columbia V0A 1M0.

**GLACIER NATIONAL PARK AND MT. REVELSTOKE NATIONAL PARK.** These two national parks (Fig. 14) occur west of the main chain of mountains forming the Continental Divide, and are not dealt with in detail here. Their topography and bird life are very similar to those of Yoho and Kootenay parks. A preliminary bird checklist for Glacier National Park is available. For more information, contact the Superintendent, Box 350, Revelstone, British Columbia V0E 2S0.

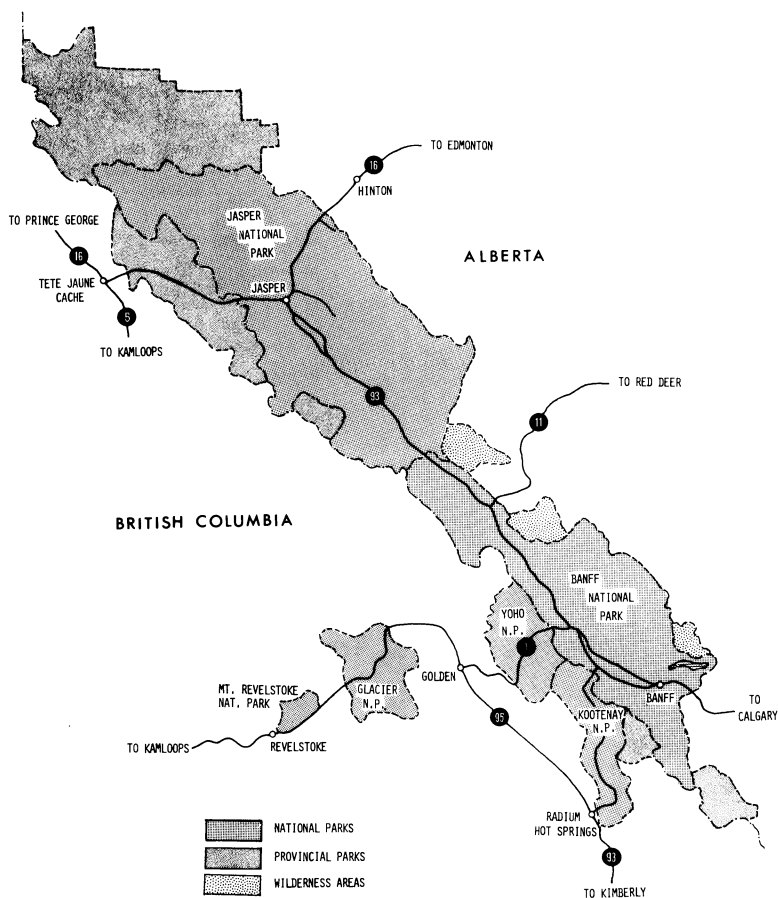


Figure 14. Outline map of Canadian national and provincial parks and wilderness areas in the region covered by this book. Map by the author.

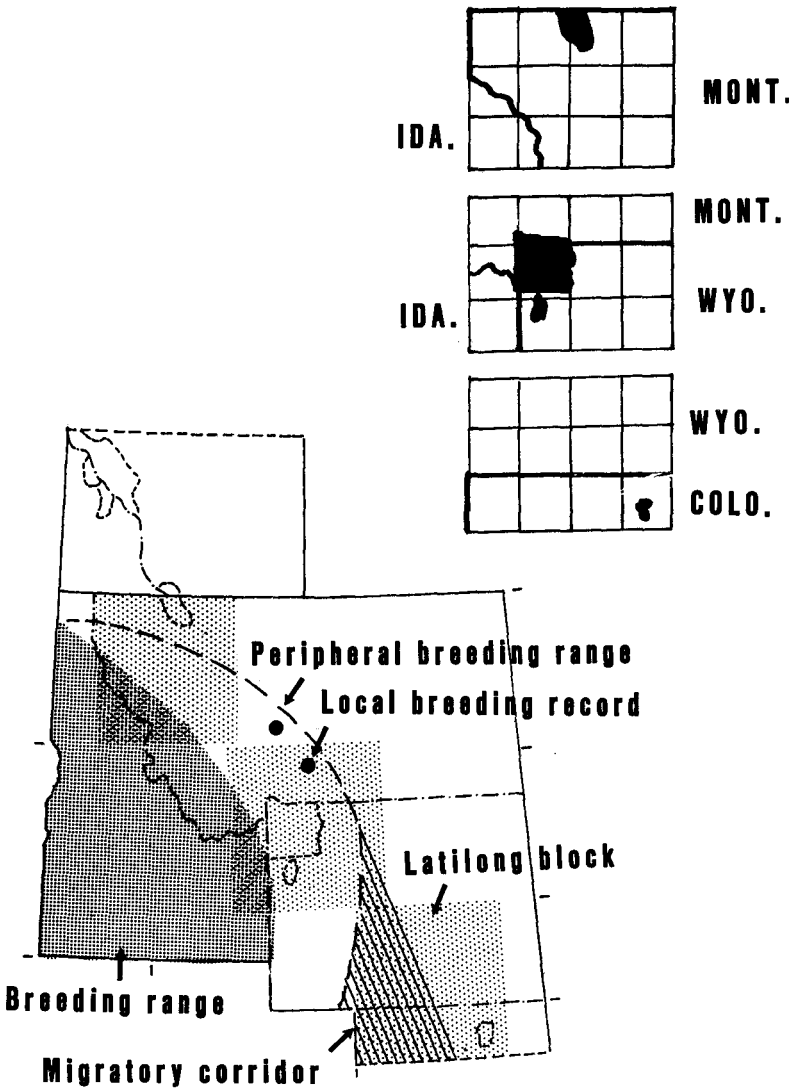


Figure 15. Hypothetical range map, indicating meanings of graphic symbols, and showing (light shading) latilong blocks summarized in text accounts.