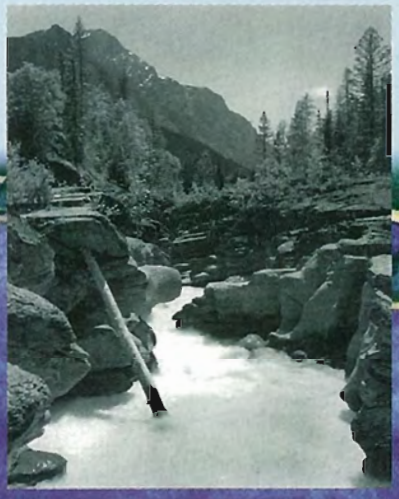
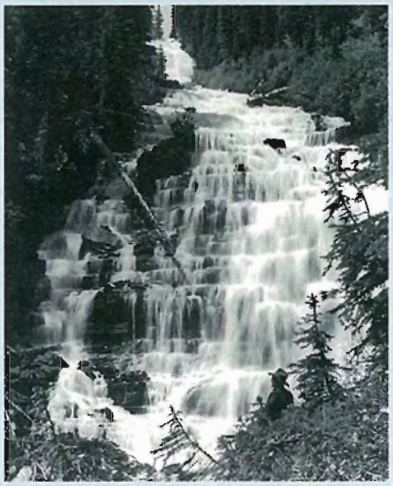




Affected Environment

Contents

Natural Resources

ECOSYSTEM

The park is in the state of Montana in the Rocky Mountains and is bounded to the north by the Canadian provinces of Alberta and British Columbia. The North and Middle Forks of the Flathead River border the park on the west and south, and the park is bisected by the Continental Divide.

The magnificent peaks in what is now Glacier National Park prompted an early park advocate to call this area "The Crown of the Continent," and the Crown of the Continent ecosystem remains one of the most ecologically intact areas in the temperate regions of the world. The park is surrounded mostly by publicly owned and Indian reservation land. Much of the land to the south and west is in the Flathead National Forest, while part of the Lewis and Clark National Forest (known as the Badger-Two Medicine area) adjoins the park on the east side of the Continental Divide. The 1.5 million-acre Blackfeet Indian Reservation lies along the park's eastern boundary.

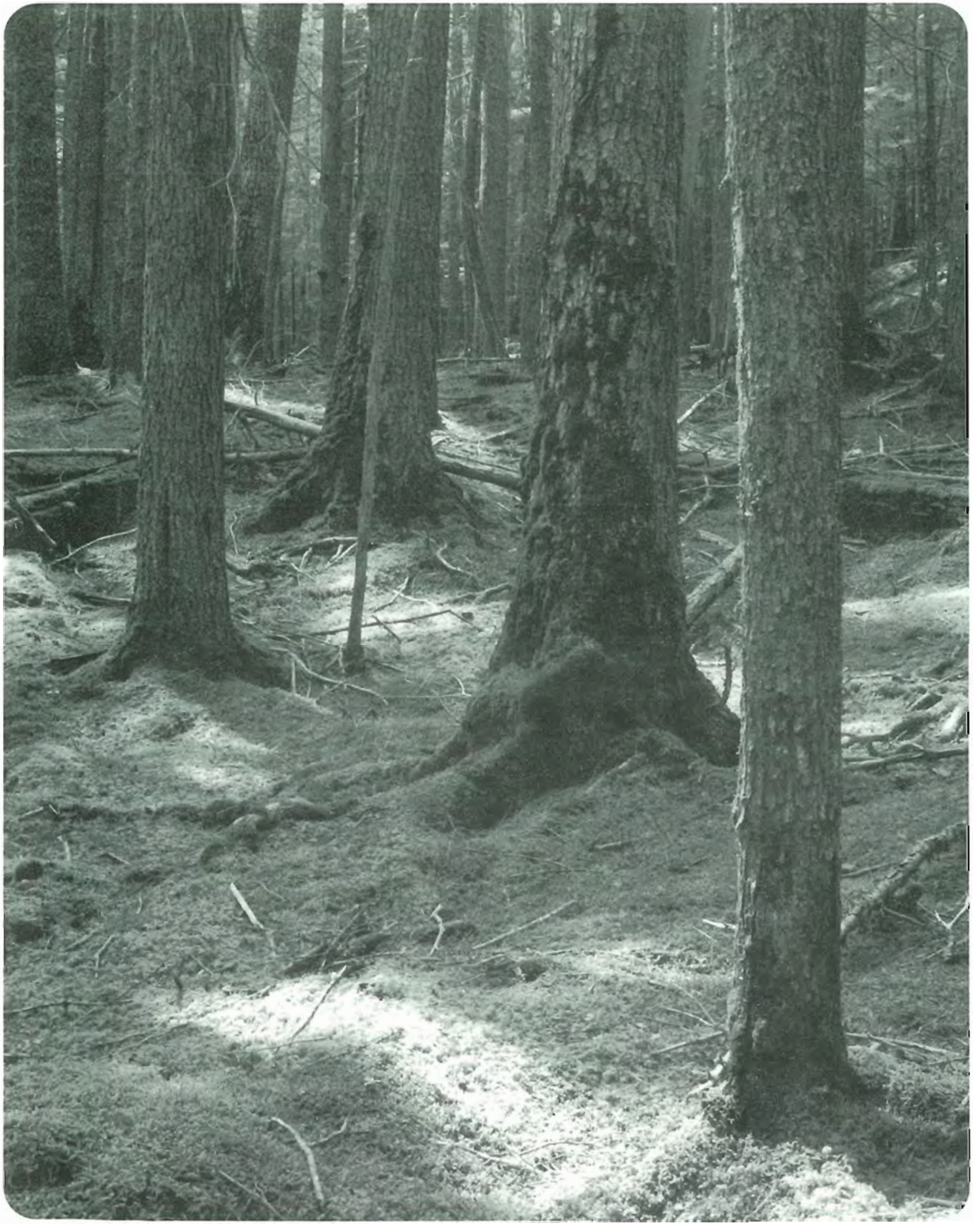
To the north of the international boundary and east of the Continental Divide lies Waterton Lakes National Park, Alberta, while to the north of the international boundary and west of the Continental Divide, land is managed by the province of British Columbia. The British Columbian land that borders the park is managed for multiple use or multiple use with emphasis on special resource values. An exception is the Akamina-Kishinena Provincial Park, which lies at the junction of Montana, Alberta, and British Columbia. This is one of the newest additions to the British Columbian park system.

There are narrow strips of privately owned land in the North Fork and Middle Fork River valleys along the park boundaries. U.S. Highway 2 follows the park's southern boundary as does the northern route of the Burlington Northern–Santa Fe Railroad. A small unit of state-owned forest is in the North Fork Valley adjacent to the park.

National and state forest land near the park is mountainous with moderate to steep slopes and narrow valleys. Dense coniferous forests are the predominant vegetative cover. Several peaks on national forest land near the park exceed 8,000 feet in elevation.

Most of the Blackfeet Indian Reservation is characterized by gently sloping plains with deeply incised stream channels. Both coniferous forest and aspen parkland are found at the juncture of the reservation with park.

Waterton Lake and the broad Waterton Valley are at the core of Waterton Lakes National Park. Adjacent slopes are very steep. A considerable part of Glacier's sister park is characterized by the convergence of prairie and mountain ecosystems.



The North Fork of the Flathead River drainage in British Columbia is densely forested at lower elevations with upper slopes along the Continental Divide extending above treeline.

In a broad regional context, Glacier is near the center of a string of mountainous protected areas that stretch from the Yellowstone-Teton area of Wyoming to the Banff-Jasper-Yoho-Kootenai area of Alberta and British Columbia. Forest Service land to the south of Glacier includes the Bob Marshall Wilderness complex, totaling 1,545,352 acres (National Wilderness Preservation System map, January 1987). Forest Service land on both the western and southern borders of the park has been proposed in the past for addition to the wilderness system.

National and state forest land in the region produces timber products and provides many outdoor recreational opportunities, including world-class hunting and fishing. The mountains adjacent to the park are a source of water for millions of people living in the Missouri, Saskatchewan, and Columbia River watersheds.

Privately owned land in the North Fork and Middle Fork River valleys is used for homesites, tourist-oriented businesses, timber production, and (to a very limited degree) grazing.

The Blackfeet Indian Reservation is used for grazing and other agricultural needs. Along the Glacier boundary, tribal land is also managed for timber. The reservation has a few small oil and gas fields as well as ongoing mineral exploration.

To the south of the park is the Flathead Valley, an area that is dominated by agricultural production and by small, rapidly growing communities. In the northern portion of the Flathead Valley is Flathead Lake, which is the largest freshwater lake west of the Mississippi River and a very important recreational resource.

There is little understanding and documentation of the interrelationships and processes that support single species or entire ecosystems. Ecosystem-level processes and interactions are still poorly understood. However, a number of efforts are underway to increase that level of understanding. A cumulative effects model for grizzly bears has been under development for the last 10 years by the Forest Service, Glacier National Park, Montana Fish, Wildlife and Parks, the Montana Department of State Lands, and the Confederated Salish-Kootenai and the Blackfeet tribe. This model will eventually be used to understand, on a gross scale, the effects on grizzly bear throughout the area from development or changes in habitat that result in fragmentation or changes in use. The Grizzly Bear Recovery Plan provides direction and calls for coordination among all state, local, federal agencies and tribes in the management and protection of grizzly bears. A Wolf Recovery Plan does the same for wolves. In preparation of an upcoming forest plan amendment, the Flathead National Forest has been conducting large-scale assessments of each portion of the forest to provide better information about the resource and interactions between resources. An access management working group has been formed from state and federal agencies to assess roads on Forest Service land and develop a strategy that provides better protection for grizzly bears. The province of British Columbia has been developing a management zoning system to protect resources just north of the United States and Canadian bor-

der while also providing economic and recreational opportunities. These are just a few of the many efforts going on in the ecosystem.

BIOLOGICAL DIVERSITY

Glacier and Waterton Lakes National Parks are noted for the remarkable number and diversity of plant and animal species found inside their boundaries, the result of the parks' unusual geographic position and elevation. Five floristic provinces and three major watersheds converge in an area influenced by both maritime and continental climates. While predominantly associated with the northern Rocky Mountains, Waterton-Glacier is at the southern edge of arctic-boreal influences. Pacific Coast and Great Plains plant and animal associations reach their eastern and western limits in these parks. Past glaciation has isolated many plant and animal populations, and the steep terrain provides a broad range of climates for a wide variety of plant communities.

The geographic location, climate, and topographic gradients of Waterton-Glacier have fostered and sustained an ecology that includes the plants and animals of a much larger region. The parks support about 1,200 species of vascular plants, 675 bryophytes and lichens, 261 birds (including accidentals), 63 mammals, 23 fish, and at least 8 reptiles and amphibians. Invertebrate inventories are incomplete but show a few hundred species for lepidoptera (butterflies and moths), coleoptera (beetles), and hymenoptera (flies, ants, bees, and wasps) combined.

Five large ecoregions are found in Waterton-Glacier: alpine tundra, subalpine forest, montane forest, aspen parkland, and fescue grassland (Alberta Dept. of Energy 1981). These include extensive stands of lodgepole and mixed conifer forests, riparian vegetative zones, and intermediate alpine plant associations.

Waterton-Glacier is noted for its abundant wildlife. There is habitat for over 300 terrestrial wildlife species, including several endangered or threatened birds and mammals and many rare species. The Waterton-Glacier area offers an international sanctuary and a corridor for wildlife interaction, migration, and genetic exchange between the two countries. Due to the distinct ecological setting, a number of southern and prairie subspecies appear in this area.

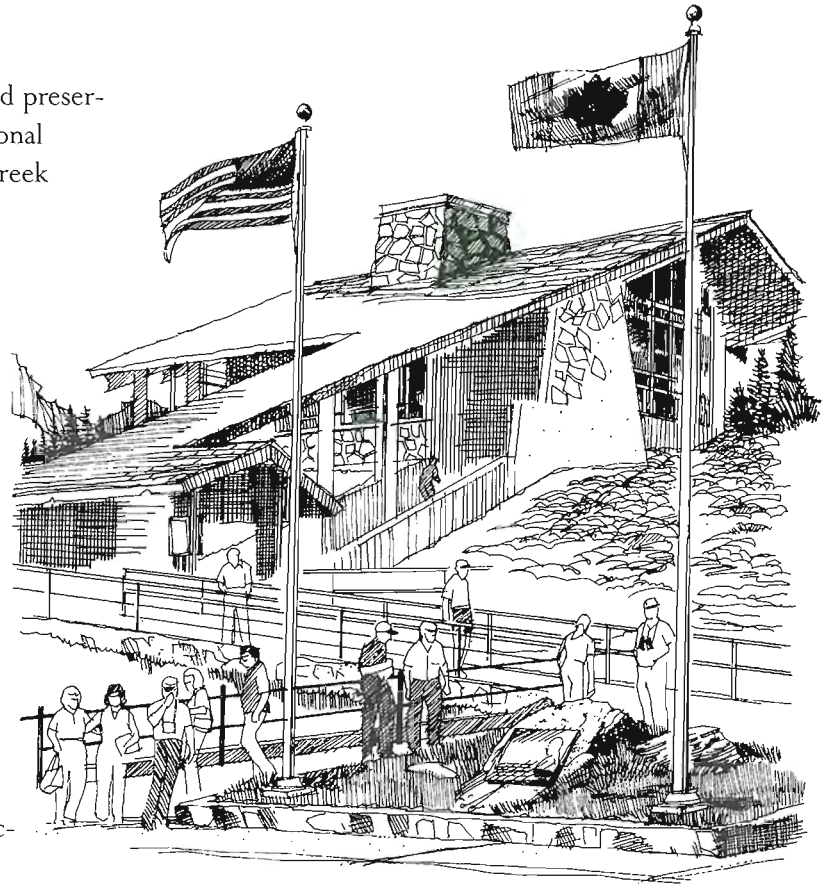
The aquatic resources of the two parks have been examined in some detail. Many drainages where there were originally no fish were stocked at an early date, often with nonnative species. Native fish were probably restricted to the main drainages and those portions of tributary streams that lie below waterfalls and other migration barriers. Twenty-three species of fish have been documented in Waterton Lakes and Glacier. Glacier National Park provides one of the last strongholds for the native subspecies of westslope cutthroat trout.

Several hundred aquatic invertebrate species have been identified in the parks, and scientists believe that many undescribed plankton species are yet to be discovered. Researchers have recently discovered two amphipod species new to science, the first troglobites (aquatic cave dwelling insects) to be identified in Glacier National Park. The opossum shrimp (Mysis relicta) occurs naturally in Upper Waterton Lake. This shrimp is a relic species that exists in the park because of the

pattern of continental glaciers and the glacial lakes associated with them. As the southern margin of the ice retreated, the shrimp were left stranded in a series of lakes, and slight differences were fixed so that they are now known as separate species.

Exotic plant species such as spotted knapweed and common timothy grow in the park as the result of human activity, and the presence of such exotics reduces the diversity of plant communities. It is unlikely that future management actions would totally remove exotics from the park. At best their numbers would be contained. New populations of exotic species would be aggressively controlled through management actions.

WATERTON LAKES NATIONAL PARK



The first major step toward preservation of Waterton Lakes National Park was taken by a Pincher Creek rancher, F.W. Goodsal, who sent a proposal to the central government recommending that Waterton Lakes be set aside as a park. The superintendent of mines also made the government aware of the potential of the area for water and resource management purposes. In 1895 an area of 54 square miles that centered on the main lakes was set aside as Kootenay Lakes Forest Reserve. Scenic qualities and wildlife resources were not recognized until later.

In December 1909 the reserve was renamed Waterton Lakes Forest Park, and Kootenai Brown was appointed superintendent. By 1911 the area had gained national park status as Waterton Lakes Dominion Park. By 1914 Waterton Lakes had a boundary contiguous with Glacier National Park.

Kootenai Brown and Glacier ranger Albert Reynolds were probably the first proponents of the international peace park idea in the early 1900s. They felt that the lake and valley could not and should not be divided. The Rotary Clubs of

Montana and Alberta were responsible for promoting and ensuring that legislation was introduced into both Parliament and Congress, designating Waterton-Glacier as an international peace park.

The two nations agreed by acts proclaimed by the governments of Canada and the United States of America to "permanently commemorate the long existing relationship of peace and goodwill between the peoples and Governments of the United States of America and the Dominion of Canada." The dedications for the international peace park were held on June 18, 1932, in Montana and in Waterton Park on July 4, 1936.

Originally the international peace park commemorated the peace and goodwill that exists along the world's longest undefended border. The parks have also come to represent cooperation and stewardship in a world of shared resources, which is reflected in cooperation in park management and interpretation, a joint interpretation/information newspaper, and exhibits at Goat Haunt and Waterton. The two areas have also been recognized jointly in the United Nations Man and the Biosphere Programme and as a world heritage site.

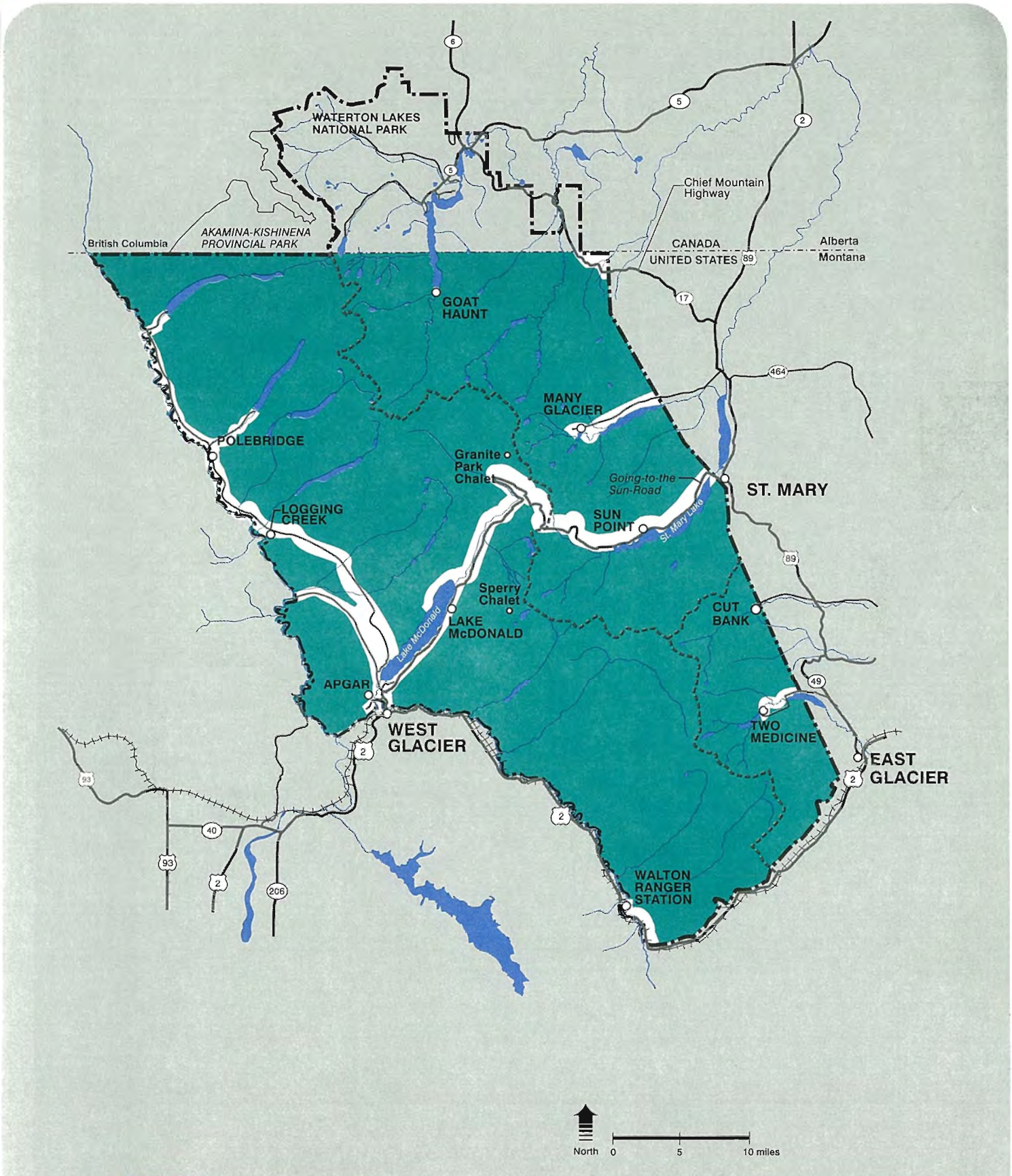
Waterton Lakes visitation has been relatively stable since 1989. There are about 340,000 visitors per year; the peak was almost 350,000 in 1994 (Parks Canada 1997, 186).

Waterton Lakes offers a variety of activities. With 191 miles of trails, all kinds of hiking, including overnight backpacking trips, are possible. Waterton Lakes also allows bicycling and horseback riding on some trails. Water-based sports are popular, and Waterton Townsite offers services not always associated with national parks in the United States. Many visitors to Waterton Lakes National Park also visit Glacier.

Resources common to both parks include the exposure of the Lewis overthrust fault, where 1.6 billion-year-old rock lies on top of younger rock. This results in dramatic terrain, mountains lying directly on the plains.

PROPOSED WILDERNESS DESIGNATION

Glacier National Park completed a study and environmental impact statement in 1973 to comply with the 1964 Wilderness Act. That document, which was subject to public review, resulted in the recommendation that over 90 percent of the park should be designated as wilderness. President Nixon forwarded that recommendation to Congress on June 13, 1974. A bill was subsequently introduced to formally designate the land as wilderness. That bill was never enacted, but since that time it has been reaffirmed by every president. Amendments to the wilderness recommendation of 1974 were made in 1984 and 1994 that made minor adjustments to the original proposal and increased the amount of proposed wilderness to 95 percent. As a result of case law challenging management of proposed wilderness, it is NPS policy to manage proposed wilderness as wilderness until such time as the land is either formally designated or formally rejected by Congress, and until that time all the area identified as proposed wilderness will continue to be managed as wilderness.



1974 WILDERNESS RECOMMENDATION
(INCLUDES UPDATES FROM 1984)

GLACIER NATIONAL PARK

United States Department of the Interior • National Park Service
DSC • MAR 99 • 117 • 20,038B

WILDLIFE

Threatened and Endangered Species

There are five threatened or endangered wildlife species listed by the U.S. Fish and Wildlife Service in Glacier National Park. They are the threatened bald eagle (*Haliaeetus leucocephalus*), grizzly bear (*Ursus arctos*), and bull trout (*Salvelinus confluentus*) and the endangered gray wolf (*Canis lupus*) and peregrine falcon (*Falco peregrinus*).

Bald Eagle. There is bald eagle nesting habitat throughout the park, and there are 11 known bald eagle nesting sites in Glacier National Park. These include five in the North Fork area, two in Goat Haunt-Belly River area, two in the Going-to-the-Sun Road corridor, one in the Middle Fork area, and one in the Two Medicine area. There is another nest within 3 kilometers of the western boundary, and it is likely that those eagles forage inside the park. Recent activity in the Many Glacier Valley suggests that there may be additional nests.

Preferred wintering habitat is near open water where fish are available and waterfowl congregate or near a concentrated food source such as predator or road kills. Wintering areas in the park include the North Fork and Middle Fork Rivers, Lake McDonald, St. Mary Lake, and St. Mary River.

Roosting habitat is usually associated with large trees near a concentrated food source, while foraging habitat typically consists of lake inlets and outlets, shallow lakes, streams, rivers, wetlands, and meadows. These areas provide open flight paths, perches, and security from intrusions and other disturbances.

The U.S. Fish and Wildlife Service, the National Park Service, the U.S. Forest Service, the Bureau of Indian Affairs, the Bureau of Land Management, the Bureau of Reclamation, the U.S. Army Corps of Engineers, the Confederated Salish-Kootenai tribes and the state of Montana updated the *Montana Bald Eagle Management Plan* in July 1994 to guide conservation and management efforts for bald eagles in Montana. The plan provides landowners and resource managers with information on the biology of bald eagles that facilitates informed decisions about land use and promotes conservation of the species and its habitat. This plan is an extension of the 1986 *Recovery Plan for the Pacific Bald Eagle* developed by the U.S. Fish and Wildlife Service. The *Montana Bald Eagle Management Plan* (USFWS et al. 1994) and nest site management zones are general guidelines to be used in lieu of more site-specific data. The *Montana Bald Eagle Management Plan* directs that plans must be developed for each nest site to ensure protection. Specific nest site plans are being developed.

The *Montana Bald Eagle Management Plan* (USFWS et al. 1994) provides guidance for management based on minimum human disturbance and provides for various levels of protection within nesting territories. Specific nest site plans are currently being developed.

Human activity is unacceptable in bald eagle breeding areas during specific stages of the nesting cycle. Those dates are courtship, February 1 to April 15; egg laying, Feb. 7 to April 15; incubation, February 7 to May 30; hatching and rearing young, May 1 to August 15. Less sensitive times are fledging, June 15 to August 15; and when young migrate from the breeding area between mid-September and

early October, but human activity can still impact nesting success (McClelland et al. 1995).

Nest areas are critical, and human activity or development may stimulate abandonment of the breeding area, affect successful completion of the nesting cycle, or reduce productivity. Nest areas are within 0.25-mile (400 m) radius of all nest sites that have been active within 5 years. The objectives of designating nest site areas are to eliminate disturbance and maintain or enhance nest site habitat suitability.

Foraging habitat outside of nest site management zones is also important. Nonbreeding eagles are often excluded from preferred foraging areas by nesting bald eagles, and extensive foraging flights by breeding adults may extend well beyond the 2.5-mile (4 km) radius, or home range zone, as described in the *Montana BaldEagle Management Plan*. Quality and quantity of foraging habitat is essential to the entire population, not just the resident breeding bald eagles. Some of the management considerations of foraging areas include protection from contaminants and physical hazards, management of prey base, and management of human activity. There is bald eagle foraging and wintering habitat throughout Glacier National Park.

The park is within a major bald eagle migratory corridor, and use along the west side of the park has been extensively documented.

Gray Wolf. Since the Wolf Ecology Project began in the 1970s, the wolf population in the North Fork of Glacier has been intensively monitored from 1978-1996. From a lone female trapped and radio-collared in 1979 (Ream and Mattson 1982), the population had increased by fall 1990 to approximately 19 wolves in the Camas Pack (Ream et al. 1990). In 1986 the first documented denning of wolves in the western United States in over 50 years occurred in Glacier (Ream et al. 1986). Wolves have continued to den in the park nearly every year since. Two separate wolf packs with a total of 15-33 wolves have maintained home ranges in the North Fork since the early 1990s. Recent sightings suggest two packs may still occupy the North Fork. There are an estimated 7-12 wolves in each of the two packs. Wolf monitoring activities have been reduced since wolf-ungulate research concluded in 1996.

Gray wolves require an adequate prey base (ungulates). Gray wolves den in isolated areas that are free from human disturbance. Human activity near den sites can lead to the death of pups or to reproductive failure.

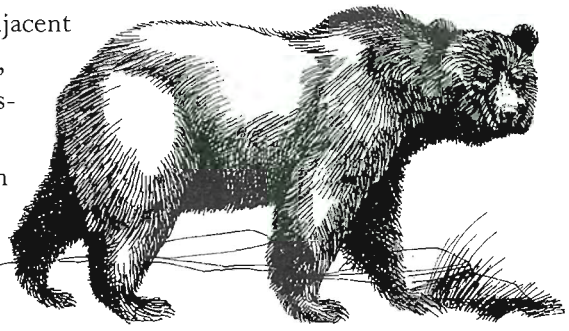
Wolves have been reported in every major drainage in the park in recent years. Wolves denned in 1993 and 1994 in the Belly River area in Alberta. There have been a number of recent reports of wolves in the Many Glacier, Cut Bank, St. Mary, Belly River, and Two Medicine Valleys. The sighting reports appear to be reliable, but to date there has been no verification of pack or denning activity. Continued sightings on the east side suggest that new packs may settle there in the future. The established wolf population in Glacier National Park continues to serve as a source for natural wolf recolonization in other parts of Montana and southern Canada.

Grizzly Bear. The number of grizzly bears inhabiting Glacier National Park is unknown; no reliable estimate is currently available. An earlier estimate of approximately 200 bears (Martinka 1974) was based on sighting reports. Population estimates and trends are of unknown reliability due to the inherent difficulties in counting grizzly bears and the lack of intensive population research in the park. For this reason, very conservative management of grizzlies in the park is necessary.

The *Grizzly Bear Recovery Plan* (USFWS 1993) serves as a general guideline for Glacier National Park managers. It delineates the actions that are believed to be required to recover and/or protect the grizzly bear. The U. S. Fish and Wildlife Service has the legal authority to implement the *Grizzly Bear Recovery Plan* as part of the Northern Continental Divide Grizzly Bear Ecosystem Management Area. Glacier National Park's contributions to these efforts are to report the number of females with cubs through the Bear Information Management System (BIMS) each year and to actively manage the park to protect bears and their habitat to ensure their survival. The grizzly bear population will be judged as meeting recovery population requirements when, among other criteria, the annual number of unduplicated sightings of females with cubs is a minimum of 12 outside Glacier National Park and a minimum of 10 inside Glacier National Park, based on a 6-year average (USFWS 1993). Recent counts have been below the target.

Grizzly bear habitat includes the entire park for most of the year. Grizzly bear habitat is diverse because bears are omnivorous and their food sources are so diverse. The search for food is the primary influence on their movements. In the spring grizzly bears and their cubs feed on dead ungulates and early greening herbaceous plants at lower elevations. As summer begins, the bears move to higher elevations seeking out glacier lilies and other roots. They follow the berries as they ripen first at the lower elevations and then at higher elevations. During the huckleberry season, bears often concentrate in the Apgar Mountains, Belton Hills, Snyder Ridge, upper Harrison Creek, and other areas. Bears have been seen on many peaks feeding on cutworm moths, primarily from late June to late September. During the winter the bears hibernate in dens away from human disturbance, often at higher elevations on steep slopes where wind and topography cause an accumulation of deep snow. Recent evidence suggests that in the North Fork of the Flathead River drainage, some bears are not denning all winter or are denning for shorter periods than elsewhere, probably due to the abundant prey base (*International Bear News*, November 1996).

Grizzly bear/human interaction is of concern to park management. Bears that are attracted to and frequent visitor use areas may habituate to the presence of humans and are at increased risk of contributing to bear/human encounters. Habituated bears are usually relocated or hazed from developed areas and sometimes removed from the population. Adult male bears generally use the higher quality habitat. This behavior may displace females and cubs into lower quality habitat or areas also used by visitors. This behavior may also result in habituation by females and cubs. However, as male cubs grow up, they also become habituated to visitors, and may be less likely to use higher quality habitat. Research indicates that habituated bears have a higher mortality rate than other bears.



Grizzly bear habitat extends beyond Glacier National Park onto adjacent land. The Blackfeet Indian Reservation contains excellent bear habitat, and preliminary information suggests that bear populations are increasing on the east side of the park due to the quality of habitat on the reservation. (Chris Servheen, USFWS). Portions of Alberta and British Columbia and areas west and south of the park in the Whitefish, Flathead, and Swan ranges also provide grizzly bear habitat. Grizzly bears are protected in the United States under the Endangered Species Act, but they are not similarly protected in Canada.

The success of bear conservation in Glacier National Park can not be evaluated without reliable information on population trends. Until now, statistically rigorous grizzly population studies in forested habitat could be accomplished only with radio telemetry. Such studies entail intensive trapping with baiting, snaring, drugging, collaring, ear tagging, lip tattooing, and frequent aerial radio tracking. In a study area the size of Glacier National Park, it would be necessary to handle a large number of bears. This places both the bears and trappers at risk. The use of new DNA fingerprinting technology to estimate the density and a minimum population of the grizzly bears in Glacier National Park began in summer 1998. This technology will allow researchers to identify individual grizzly bears from a tissue sample as small as a follicle from a single hair or an intestinal cell found in scat.

Peregrine Falcon. Peregrine falcons are rare in the park, though sightings are reported nearly every year, occasionally during the nesting season. There have been no recorded peregrine nests in the park. Surveys of potential peregrine falcon nesting habitat began in 1989 and were completed in 1991.

Peregrine falcon habitat has been documented in many areas of the park.

Proposed Species

Proposed species are those that have been determined to be endangered or threatened by the U.S. Fish and Wildlife Service but for which rules have not yet been promulgated.

Lynx (*Lynx canadensis*). The lynx was listed as proposed in March 1998. Lynx have been seen and tracks detected in the coniferous forests of Glacier National Park. Population numbers of lynx in the northwestern United States, including Montana, appear to have declined in the last 25 years (Pers. Comm. L. Nordstrom, USFWS).

All lynx tracks documented in a 1994 survey were on the east side of the Continental Divide. Lynx tracks and sightings have been documented west of the Continental Divide prior to and since that survey.

Lynx use a wide variety of habitats ranging from seral to old-growth stands of coniferous forest but are usually found near their primary prey, snowshoe hare, in mixed coniferous stands (Butts 1992a). Lynx are most susceptible to disturbance during the denning period and while newborns are developing (May–August). Lynx sightings recorded in the park have declined since the late 1960s.

State-Sensitive Species

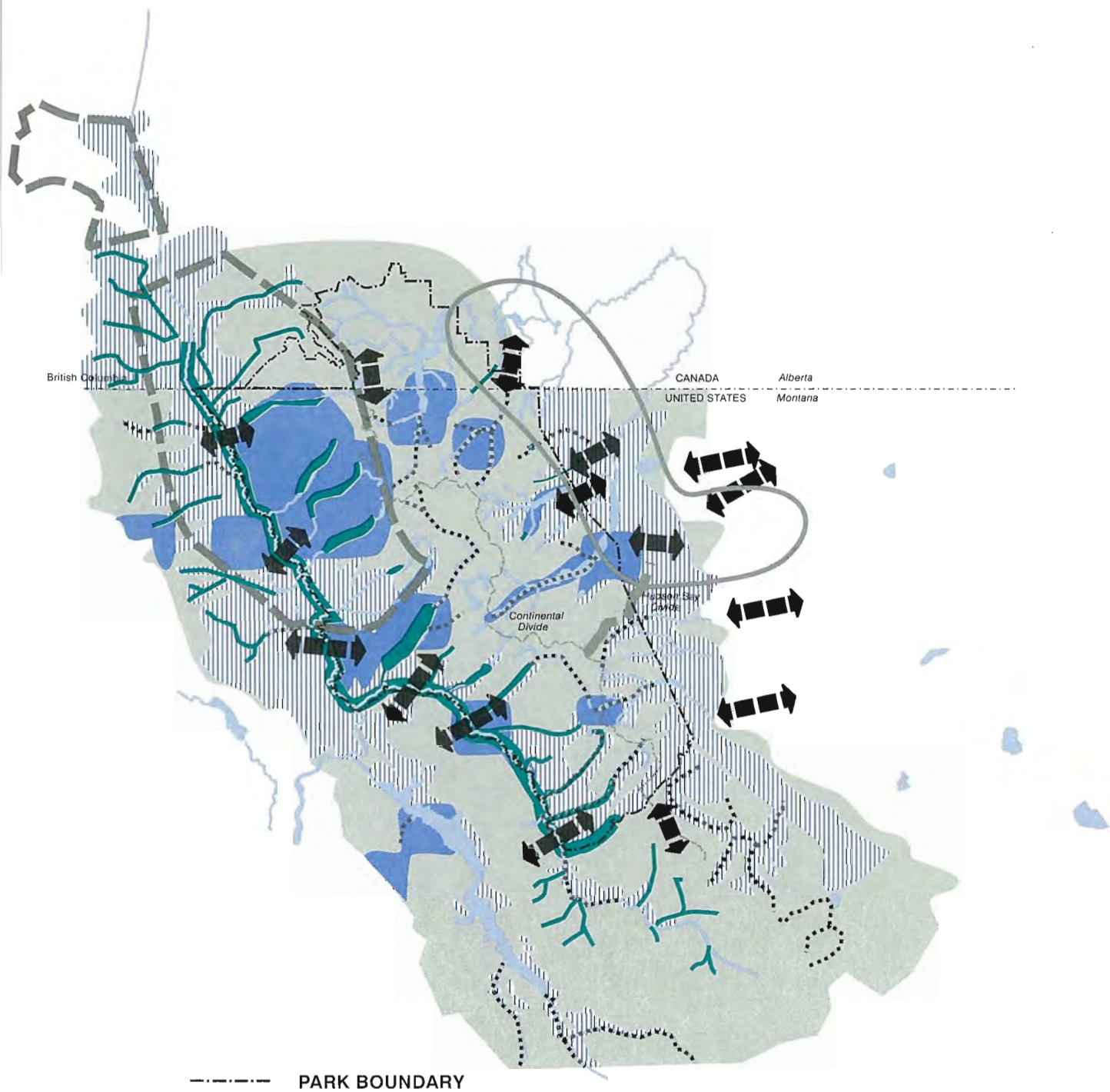
Table 3 presents wildlife species that are listed as state sensitive by the Montana Natural Heritage Program and are sensitive and/or rare in Glacier National Park. All have been sighted in the park. There is also suitable habitat outside the park on privately owned and Forest Service land, in Waterton Lakes National Park, on the Blackfeet Indian Reservation, and on public land in Canada.

NPS policy requires that sensitive species are to be managed to avoid the need to place them on the federal threatened and endangered list.

General Wildlife Discussion

Many wildlife species are common throughout Glacier National Park. There are 261 bird, 63 mammal and 172 native resident aquatic animal species in the park.

Review of the earliest records suggests that wildlife composition, at least for mammals and birds, has changed little since the park was established. Species known to have been extirpated include mountain bison (*Bison bison*) and mountain or woodland caribou (*Rangifer tarandus*). Known or probably exotic or nonnative species include the raccoon (*Procyon lotor*), ring-necked pheasant (*Phasianus colchicus*), turkey (*Meleagris gallopayo*), rock dove (*Columbia livia*), European starling (*Sturmus vulgaris*) and house sparrow (*Passer domesticus*). None of these species is widespread or abundant.



PARK BOUNDARY

HISTORIC WOLF DENNING AREA

GRIZZLY BEAR

BALD EAGLES

GRAY WOLF (known home range)

HARLEQUIN DUCK BREEDING

UNGULATE WINTER RANGE

BULL TROUT SPAWNING

WILDLIFE MOVEMENT CORRIDOR

North Map not to scale

WILDLIFE CONSIDERATIONS

GLACIER NATIONAL PARK

United States Department of the Interior
National Park Service
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TABLE 3: STATE-LISTED RARE WILDLIFE SPECIES

Common loon (*Gavia immer*)	Fairly common from spring to fall on large and small lakes throughout the park productivity declining (Gniadek, unpublished data 1997). A significant proportion of Montana nesting pairs are found in Glacier.
Harlequin duck (Histrionicus histrionicus)	Fairly common from spring to fall in fast moving water (streams and rivers) and may occur on lakes. Productivity is highly variable. Harlequin duck declines have been documented throughout the western populations, including in Montana, where there are approximately 200 pairs. Approximately 20 percent of the Montana population breed in Glacier National Park. Upper McDonald Creek, with about 25 pairs, is considered the most critical harlequin breeding stream in Montana. Harlequins mate for life, and pairing occurs on the west coast. Adult harlequins return to several park streams each spring to breed and raise young. Females born in Glacier return to breed when they are 2-4 years old.
American white pelican (*Pelecanus erythrorhynchos*)	Rare during summer near water bodies along boundary areas, lower elevations on both sides of Continental Divide; no evidence of breeding.
Trumpeter swan (*Cygnus buccinator*)	Rare on lakes, ponds, rivers and streams during spring and fall migration; no evidence of breeding but may nest near eastern boundary. Known to nest in Waterton Lakes National Park and on adjacent ranch lands.
Osprey (*Pandion haliaetus*)	Fairly common from spring to fall along lakes and rivers; nesting documented but trend in productivity unknown.
Northern Goshawk (*Accipiter gentilis*)	Uncommon from spring to fall in forested areas, especially in mature, dense conifer forest; nesting is documented but the trend in productivity is unknown.
Cooper's hawk (*Accipiter cooperii*)	Uncommon from spring to fall in forested areas, especially in mature, dense conifer forest; nesting is documented but the trend in productivity is unknown.
Swainson's hawk (*Buteo swainsoni*)	Rare in grassland habitats from spring to fall, especially on east side; nesting undocumented but suspected in the Belly River area.
Ferruginous hawk (*Buteo regalis*)	Rare in grassland habitats from spring to fall, especially on east side; no nesting documented.
Golden eagle (*Aquila chrysaetos*)	Fairly common in open areas from spring to fall; nests in trees and cliffs throughout the park; trend in productivity unknown; migrate in large numbers.
Merlin (*Falco columbarius*)	Rare from spring to fall in open forests; trend in productivity unknown.
Prairie falcon (*Falco mexicanus*)	Uncommon from spring to fall in open country or meadows; nest on cliffs; nesting documented but trend in productivity unknown.
Long-billed curlew (*Numenius americanus*)	Very rare during spring and fall in open areas, usually near water; no documented nesting.
Upland sandpiper (*Bartramia longicauda*)	Very rare during spring and fall in open areas; no documented nesting.
Northern pygmy owl (*Glaucidium gnoma*)	Fairly common year-round forest resident; nesting documented but population trend unknown.
Barred owl (*Strix varia*)	Uncommon year-round resident of conifer forest and riparian areas; nesting documented but population trend unknown (has generally increased since being first recorded during range expansion in 1970s).
Great gray owl (*Strix nebulosa*)	Rare resident in dense conifer forest with meadows; nesting documented but trend in productivity unknown.
Long-eared owl (*Asio otus*)	Rare resident in thick forested habitat.
Boreal owl (*Aegolius funereus*)	Rare resident in dense forest, especially subalpine; nesting documented but population trend unknown.
Northern saw-whet owl (*Aegolius acadicus*)	Uncommon resident in conifer or mixed forest; nesting documented but population trend unknown.

TABLE 3: STATE LISTED RARE WILDLIFE SPECIES *(continued)*

Northern hawk-owl (*Surnia ulula*)	Rare resident and migrant in recently burned forest; nesting documented in the North Fork but population trend unknown.
Pileated woodpecker (*Dryocopus pileatus*)	Fairly common resident of mature forest; nesting documented but population trend unknown.
Olive-sided flycatcher (*Nattallornis borealis*)	Uncommon from spring to fall in conifer forests, bogs, and recently burned forest; nesting documented but population trend unknown.
Western bluebird (*Sialia mexicana*)	Rare in open woodlands and meadows; few records.
LeConte's sparrow (*Ammodramus leconteii*)	Rare from spring to fall in wet meadows, primarily on the west side; nesting documented but population trend unknown.
Clay-colored sparrow (*Spizella pallida*)	Rare from spring to fall in brushy meadows, riparian areas, and recently burned conifer forest; nesting documented but population trend unknown. Uncommon in Waterton Lakes National Park.
Brewer's sparrow (*Spizella breweri*)	Uncommon from spring to fall in shrubby subalpine habitats. Uncommon in Waterton Lakes National Park.
Gyrfalcon (*Falco rusticolus*)	Rare from fall/winter in alpine/subalpine areas; no evidence of nesting.
Northern bog lemming (*Synaptomys borealis*)	Rare resident in wet meadows, bogs, and marsh borders; breeding documented but population trend unknown.
Marten (*Martes americana*)	Fairly common resident in conifer forests; breeding documented but population trend unknown.
Fisher (*Martes pennanti*)	Rare resident of conifer forest and riparian areas; breeding probable but population trend unknown.
Wolverine (*Gulo luscus*)	Rare resident of conifer forest and alpine meadows, on both sides of the Continental Divide; breeding documented but population trend unknown.

The park provides important year-round habitat for many wildlife species. Riparian areas, meadows, and shrub fields provide important winter range for deer, elk, and moose. Grasslands and forest environments provide important spring range for deer, elk, and grizzly bears. As spring progresses into summer, deer and elk follow greening vegetation to higher elevations. Late winter and early spring may be the most sensitive time for elk and deer. The higher elevations provide important summer habitat for bears, bighorn sheep, and goats. Low elevation valleys in the fall and spring provide important habitat for almost all the wildlife species.

The animals in Glacier move freely (for the most part) across park boundaries onto adjacent land and back again. Plants grow and spread from one side of the boundary to the other. Human activities on one side of the park boundary can have critical consequences both for people and for the rest of the biota on the other side. The protected status of Glacier National Park makes it a genetic storehouse and a refuge, a place where natural processes reign.

There is evidence that the numbers of bighorn sheep may have declined over the past century. Bighorn sheep are vulnerable to diseases and other disruptions. Bighorn sheep make traditional use of seasonal ranges and if access to these areas is restricted, use can be reduced or eliminated.

During autumn 1996, over 3,000 raptors were counted at one site during September, October, and November as they crossed the McDonald Valley; 2,667 were eagles (92 percent golden eagles and 8 percent bald eagles). In spring 1996, 904 eagles were counted at one site in March and April. These numbers represent only a portion of the raptors moving through Glacier National Park in spring and autumn, as there are many documented migration routes that follow mountain ranges and ridges in Glacier National Park. The raptor migration is a significant event, and the park may be one of the largest golden eagle migration areas in North America. This may become even more important because golden eagle numbers may be declining. The biggest threat to migrating raptors in Glacier National Park is helicopter overflights.

More specific wildlife information for each area in the park includes:

The riparian areas, meadows, and forests throughout the North Fork provide important winter range for deer, elk, and moose.

The Many Glacier area contains outstanding wildlife habitat, particularly for grizzly bears, bighorn sheep, and goats and offers excellent opportunities for viewing. There are also abundant populations of other ungulates, and wolves are using the area for hunting, although denning has not been documented. A wide variety of other mammals, raptors, and forest predators such as wolverine, marten, and lynx are also found in the valleys. Considerable movement occurs between the three main valleys by a variety of species. This area also provides critical fall, winter, and spring habitat for several species of ungulates.

Additionally, the Many Glacier area is an important crossroads for wildlife because it lies at the confluence of three valleys. Significant numbers of bighorn sheep, mountain goats, and elk all winter in the area. The meadows at Apikuni Flat are critical bighorn sheep winter range. Other animals, including mule deer, badg-

er, weasel, moose, and black and grizzly bears can be found in the valley. The Many Glacier / Swiftcurrent drainage historically had no fish, but kokanee salmon and brook trout were introduced.

The Goat Haunt-Belly River area contains outstanding wildlife habitat, particularly in the Waterton River and Belly River Valleys. Considerable populations of elk spend the summer in these valleys and moose are commonly seen in the Waterton River Valley. Wolves use the Belly River Valley and grizzly bears utilize the entire area. The area also constitutes important habitat for forest predators such as marten, lynx, and mountain lions. Goats are common in the higher elevations and raptors regularly nest in the rocky cliffs of the area.

The Two Medicine area provides important habitat for grizzly bears and a wide range of other wildlife from elk, moose, black bears, and deer to forest predators such as wolverine, marten, and lynx and higher elevation residents such as bighorn sheep and goats. It also provides critical fall, winter, and spring habitat for bighorn sheep and other ungulates. The transition zone between the prairies and mountains, shared with the Blackfeet Reservation, is an important habitat for ungulate and bird species.

The Going-to-the-Sun Road corridor area supports most of the wildlife species found in the park. Bald eagles, black bear, grizzly bear, elk, deer, fisher, and pine marten all use the area around Apgar (the area between Apgar and West Glacier is a wildlife corridor). Black bears regularly travel and feed in this area. Elk use the Apgar area as spring range and as a calving area. Elk are sensitive to disturbance during calving. White-tailed and mule deer are primarily found in the eastern portion of the Apgar area. Pine martens use the area between Lake McDonald and the Going-to-the-Sun Road and Camas Creek Road in the winter. Pine martens are becoming less common in the United States because of the loss of the forest habitat they require.

Mammals most commonly found in the McDonald Valley include moose, elk, mule and white-tailed deer, black and grizzly bear, snowshoe hare, coyote, lynx, cougar, and red squirrel.

The Logan maintenance pit area provides habitat for white-tailed deer, moose, harlequin duck, pileated woodpecker, and ruffed grouse. The Moose Country area provides habitat for moose, harlequin duck, barrow's goldeneye, raven, and others.

The Lunch Creek area provides habitat for grizzly bear, mountain goat, bighorn sheep, mule deer, ptarmigan, water pipit, and others.

The Sunrift Gorge area provides habitat for deer and other woodland animals.

Rodents such as Columbian ground squirrels use the area in the summer, as do perching birds such as gray jays, mountain chickadees, and Clark's nutcracker. Wolverine and lynx may pass through on their winter rounds.

The Logan Pass area provides habitat for grizzly bears, goats, bighorn sheep, black bear, wolverine, etc.

The vegetation in the Rising Sun area provides excellent forage and cover for many species of mammals. The Rising Sun/St. Mary grasslands area provides critical winter range for elk. Other mammals, including deer, hares, ground squirrels, beaver, and muskrats, can be found in the area. Black and grizzly bears and

mountain lions also use the area. Bighorn sheep and mountain goats live in the surrounding mountains. Bald eagles have nested successfully on St. Mary Lake near Red Eagle Creek.

St. Mary flats provides important wildlife range during the late fall and winter, when the Going-to-the-Sun Road is usually closed to visitor traffic. Elk spend the winter on the open wind-blown meadows between St. Mary and Rising Sun. Wolves have recently been using the area in the winter.

The Granite Park area contains outstanding grizzly bear habitat, and the bears frequently use much of the area along the Garden Wall.

The Middle Fork area provides outstanding pristine habitat for a variety of species. The remote character and low visitation ensure a high level of security. Elk, goats, bears, deer, and moose are common. Forest predators and other smaller mammals utilize the heavily forested valleys. A bald eagle nest has been successfully used on Nyack Creek, far from the heavily floated corridor of the Middle Fork of the Flathead. The Goat Lick near Walton draws goats from a wide geographic area. The winter range along the Belton Hills is used extensively by deer and elk and is a popular viewing area.

The North Fork area contains excellent year-round habitat for elk, deer, and moose, and supports a healthy population of all three. Predators such as wolves and mountain lions depend on these species. Wolves have denned in the North Fork area for the last 12 years. Grizzly and black bears used the entire area from the river corridor to the mountain peaks. The forested valleys provide abundant habitat for forest predators such as marten, lynx, and wolverine.

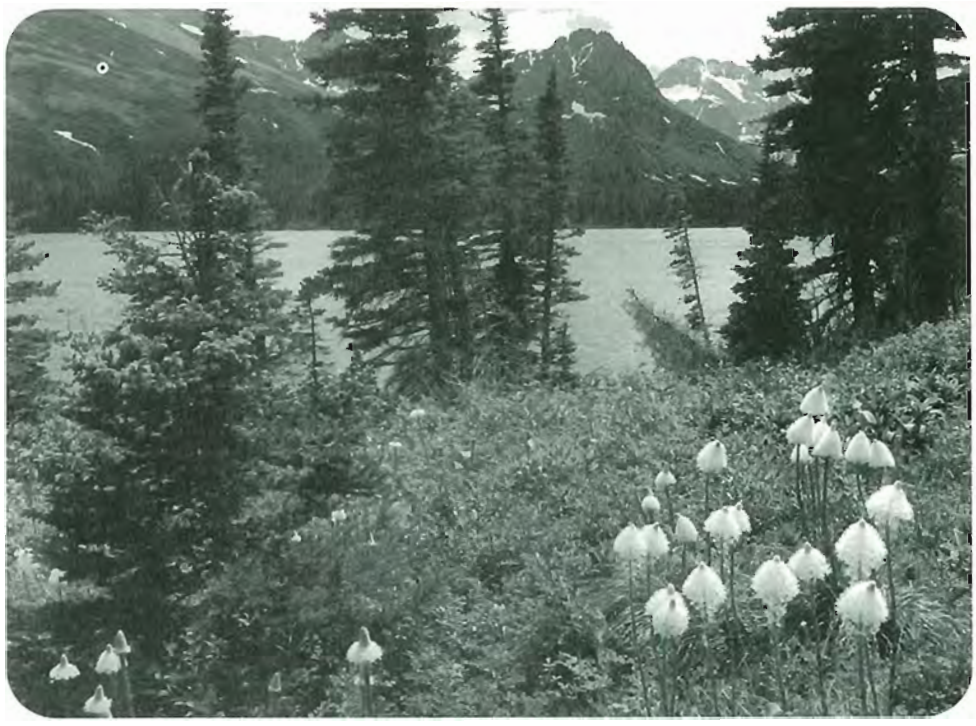
VEGETATION

Threatened and Endangered Species

No federally listed threatened or endangered plants have been identified in the park. Glacier may have habitat for the federally threatened water howellia (*Howellia aquatilis*). This species is found in northwestern Montana wetlands. Water howellia requires a combination of very particular habitat and weather patterns before it can germinate. Water howellia has not been discovered in wetlands that have been surveyed.

Species at Risk

Three "species at risk" are known to exist in Glacier National Park: peculiar moonwort (*Botrychium paradoxum*), lens-fruited sedge, (*Carex lenticularis var. dolia*), and the alpine glacier poppy (*Papaver pygmaeum*). Species at risk were formerly listed as notice of review (category 2) by the U.S. Fish and Wildlife Service. Current information indicates that listing of these species as threatened or endangered is possible, but appropriate or substantial biological information is not on file to support a ruling. Research is underway on many such species to determine whether proposing listing is appropriate. NPS policy directs that these species be consid-



ered as if they were already listed as threatened or endangered until a final determination is made. Further discussion is provided below on each of these species.

Peculiar moonwort grows in open meadows to dense stands of tall herbs in foothill and subalpine zones near the Continental Divide in Montana. It is known to grow along a heavily used trail in the Many Glacier area and in the North Fork.

Lens-fruited sedge grows in wet meadows and boggy ground along lakeshores and on rock ledges. In Montana this plant is present at only two known sites, the North Fork and Going-to-the-Sun Road areas.

The **alpine glacier poppy** is an endemic with a very restricted distribution and occurs mostly near Glacier National Park. It is found at several locations in the park. It grows on talus slopes of high mountains and is known to grow in the North Fork, Goat Haunt, Many Glacier, Going-to-the-Sun Road, and Two Medicine areas.

State-Sensitive Species

The following are state-sensitive plant species according to the Montana Natural Heritage Program and are known to grow in Glacier National Park. For many of these species, there is also suitable habitat outside the park on the surrounding land.

Fringed onion (*Allium fibrillum*) is an endemic species, occurring on scablands and high mountain ridges in shallow soils in moist, open, or particularly shaded areas at low elevations. It is known to grow in the Middle Fork area.

Peculiar moonwort (*Botrychium paradoxum*) occurs near lakeshores and in open meadows and in dense stands of tall herbs in foothill and subalpine zones,

often on disturbed sites near the Continental Divide. It is known to grow in the Many Glacier and North Fork areas.

Giant helleborine (*Epipactis gigantea*) grows on open, wet sites, often adjacent to mineral hot springs and in mossy shady areas along rivers, streams, meadows, seeps, and hanging gardens from warm desert shrub to spruce communities. It is more common in the open than in forests. This is the only native member of its genus in Canada and the United States. It is known to occur in the Going-to-the-Sun Road area.

Glaucous gentian (*Gentiana glauca*) is a tundra species that grows on moist subalpine and alpine banks, ledges, sphagnum bogs, and meadows. The only known Montana population is found in the Going-to-the-Sun Road area.

Northern beechfern (*Thelypteris phegopteris*) grows in areas with boreal, wet temperate, cool mesothermal climates and on moist, calcareous cliff crevices or moist banks in rich, damp forest floors. It is known to grow in the Going-to-the-Sun Road area.

Velvetleaf blueberry (*Vaccinium myrtilloides*) grows in moist to rather dry forests in the montane zone. The only two known occurrences of this species for the entire northern Rocky Mountains are in the Going-to-the-Sun Road area. The largest (in the Middle Fork) may be threatened by development.

Lyre-leaf rockcress (*Arabis lyrata var. kamchatica*) grows on open, rocky slopes in montane and subalpine zones. The only place it is found in Montana is in the Going-to-the-Sun Road area.

Boreal wormwood (*Artemisia norvegica var. saxatilis*) grows on talus slopes and rock outcrops and in open woods at subalpine or alpine elevations and is found in spruce-fir, lodgepole pine, and alpine tundra communities. It is known to occur in the Two Medicine area.

Western moonwort (*Botrychium hesperium*) is endemic and grows in meadows and grasslands in the valleys and foothills. It is known to grow in the Many Glacier, Middle Fork, and North Fork areas. One population in Glacier National Park recently could not be located and is presumed extirpated.

Mingan Island moonwort (*Botrychium minganense*) grows in moist meadows and woods in acid to neutral soil at low to high elevations. It is known to occur in the Many Glacier and Going-to-the-Sun Road areas.

Rope-root sedge or creeping sedge (*Carex chordorrhiza*) grows in sphagnum bogs at low elevations. In Montana rope-root sedge is at the edge of its range and is found only in Glacier National Park. The two locations, both in the North Fork area, are the only known sites in the western continental United States.

Lens-fruited sedge (*Carex lenticularis var. dolia*) grows in wet meadows and boggy ground, along lakeshores and on rock ledges. In Montana this plant is present at only two known sites — in the North Fork and Going-to-the-Sun Road areas.

Maritime sedge (*Carex maritima var. incurviformis*) grows on wet rock ledges and moist tundra in the alpine zone. It is known to occur in the Two Medicine area.

Rock sedge (*Carex petricosa*) grows in barren, stony, limestone soils. In Montana and the rest of the western continental United States, this species is only known to inhabit one site on the east border of Glacier National Park. A disjunct population occurs below the summit of Divide Mountain in the Going-to-the-Sun Road area.

Thin-flowered sedge (*Carex tenuiflora*) grows in the montane zone around the 5,000-foot elevation. In Montana and the western continental United States it has only been found in the North Fork area.

Pink corydalis (*Corydalis sempervirens*) grows most commonly on dry soils of disturbed sites, frequently after a burn. In the western United States, it is found only in the Many Glacier and Going-to-the-Sun Road areas.

Macoun's draba (*Draba macounii*) grows in moist areas. The only known Montana populations of this plant are in the Goat Haunt and Going-to-the-Sun Road areas.

Northern wildrye (*Elymus innovatus*) grows in sandy meadows, riparian areas, and rocky hillsides and in open lodgepole or spruce forests. It is known to grow in the Goat Haunt area.

Green-keeled cottongrass (*Eriophorum viridi-carinatum*) grows in cold, calcareous sphagnum bogs, swamps, and meadows at mid to high elevations. It is known to occur in the Goat Haunt area.

Northern eyebright (*Euphrasia arctica var. disjuncta*) is a member of a stable tundra community and grows in alpine bogs, moist peaty soil, streambanks, open ground, and other wet places. It is known to occur in the Many Glacier and Going-to-the-Sun Road areas.

Viviparous fescue (*Festuca vivipara*) grows between 7,000-8,000 feet. In Montana it has only been found in the Going-to-the-Sun Road area.

Macoun's gentian (*Gentianopsis macounii*) grows in the boggy soil of wet meadows and fens in the foothill zone. It is presently known from only two locations in Montana, one in the Goat Haunt area.

Bractless hedge-hyssop (*Gratiola ebracteata*) grows in drying mud around ponds in the foothills and on the plains. It grows in the Going-to-the-Sun Road and Two Medicine areas.

Three-flowered rush (*Juncus triglumis var. albescens*) grows in wet alpine areas. The only known occurrences in Montana are in the Many Glacier and Going-to-the-Sun Road areas.

Simple kobresia (*Kobresia simpliciuscula*) grows in moist areas. In Montana it has only been found in the Going-to-the-Sun Road area.

Ground-pine (*Lycopodium obscurum*) grows at relatively low elevations. Montana's only populations of ground pine are found in the Going-to-the-Sun Road and Goat Haunt areas where it is at the southern periphery of its range.

Stalked-pod crazyweed (*Oxytropis podocarpa*) grows on exposed rocky alpine ridges or turfy alpine hillsides, often on limestone substrates. It is known to grow in the Goat Haunt area.

Palmate-leaved coltsfoot (*Petasites frigidus*) grows in wet forested areas. In Montana it has only been found in the Goat Haunt area.

Austin's knotweed (*Polygonum douglasii ssp. austinae*) grows in open, graveled, often shale-derived soil of eroding slopes and banks in the montane zone. It is known to grow in the Middle Fork area.

Five-leaf cinquefoil (*Potentilla quinquefolia*) grows in the dry, gravelly soil of windswept ridges and slopes in the alpine zone. It is known to grow in the Going-to-the-Sun Road and Two Medicine areas.

Heart-leaved buttercup (*Ranunculus cardiophyllus*) grows in moist meadows in the foothill zone. It is known to occur in the Goat Haunt area.

Northern buttercup (*Ranunculus pedatifidus*) grows in moist meadows, alpine tundra, or open, rocky soil on windswept ridges, growing best in calcareous regions. It is known to grow in the Going-to-the-Sun Road area.

Arctic pearlwort (*Sagina nivalis*) grows in moist, open, gravelly soil in the alpine zone. Within Montana arctic pearlwort has only been found in the Goat Haunt area. The Glacier National Park population of this species is the only one known in the continental United States.

Barratt's willow (*Salix barrattiana*) grows on boggy meadows, moist open hillsides in mountains, and along lakeshores and streambanks. It has been reported on rockslides and recent alluvial deposits. Barratt's willow grows near the Continental Divide in the Going-to-the-Sun Road area.

Hudson's Bay bulrush (*Scirpus hudsonianus*) grows in wet meadows and springs at low to mid elevations. Montana distribution is limited to the North Fork and Many Glacier areas.

Water bulrush (*Scirpus subterminalis*) grows mostly submerged in rivers, ponds, lakes, streams, and standing water up to 3 or 4 feet deep at low elevations in valleys, foothills, and montane zones. It grows in the Going-to-the-Sun Road area.

Little false asphodel (*Tofieldia pusilla*) grows in moist areas. In Montana it has only been found in Glacier National Park, where there are several small populations in the Many Glacier and Going-to-the-Sun Road areas.

Flat-leaved bladderwort (*Utricularia intermedia*) grows in shallow, standing, or slow-moving water. In Montana it has only been found in the Going-to-the-Sun Road area.

Kidney-leaf white violet (*Viola renifolia*) grows from inland forests to subalpine slopes on cool or damp sites in moist coniferous forests at low to middle elevations. It grows in the Two Medicine and Middle Fork areas.

Pale sedge (*Carex livida*) grows in cold, calcareous, poorly drained lowlands and wet peaty ground at low elevations in foothill and submontane zones. The species is shade intolerant. The only known Rocky Mountain occurrence is in the North Fork area.

Spotted lady's-slipper (*Cypripedium passerinum*) grows in moist to wet forests at low elevations. It also grows on sand dune complexes and near streambanks or lakeshores and grows more rapidly in the open than in the shade. It is known to occur in the North Fork area.

Buckler fern (*Dryopteris cristata*) grows at low elevations in moist woods, forest, thickets, marshes, swamps, and sphagnum bogs. It is known to occur in the Middle Fork area.

Northern rattlesnake-plantain (*Goodyera repens*) is a shade-loving species found in cool, coniferous forests, usually with a mossy understory. Occurrence in Glacier National Park is in the North Fork area.

Round-leaved orchid (*Orchis rotundifolia*) grows along streams and in wet woods, usually with good drainage, often on limestone. It is known to occur in the Goat Haunt area.

Mountain Bladder Fern (*Cystopteris Montana*) grows in moist areas in the mountains in mid to high elevations. In Montana it has only been found in the Going-to-the-Sun Road and Middle Fork areas.

VEGETATION (GENERAL)

Vegetation communities of the central and boreal Rocky Mountains, the Great Plains, the Pacific Northwest, and the alpine all meet in Glacier National Park. Many species are at the limits of their distribution in the park.

Glacier supports over 1,000 species of native vascular plants. Large-scale climatic influences and the variety of environmental conditions in the park foster vegetation diversity. In addition to the large-scale influences, local climate that changes with elevation and proximity to mountain ridges or large bodies of water affects vegetation. The steep, variable terrain, ranging from 3,200-10,500 feet, exhibits marked contrasts in temperature and precipitation over relatively short distances. Glaciation and other geologic processes have also influenced the distribution of vegetation. Across most life zones and vegetated communities fire has had a significant influence through periodic burning and recycling of nutrients and vegetation. Fire regimes have also changed, not only in response to climate but also through suppression and through the elimination of the native cultural practice of igniting fires (USFS, Barrett 1993). In some vegetation communities in the park, fire exclusion has altered historical age-class structures and the natural forest mosaic. As a result, some forests of mixed severity fire regimes have been changed to stand-replacement fire regimes.

Vegetative landcover types in the park include: dry herbaceous, (plants and shrubs that grow in dry areas — approximately 77,067 acres); mesic herbaceous (plants and shrubs that grow in wet areas, including riparian areas — approximately 48,821 acres); deciduous trees and shrubs (64,924 acres); coniferous forests and dense mesic (334,943 acres); coniferous forest and open dry areas (160,744 acres); and barren rock, snow, and ice (298,357 acres).

The major community types in these larger landcover types consist of grasslands (dry herbaceous), pine or woodland savannahs (open, dry coniferous and deciduous), bottomland forests (mesic herbaceous and deciduous), ponderosa pine/Douglas fir forests (open, dry coniferous), western red cedar/western hemlock forests (dense, mesic coniferous), spruce/fir forests (dense, mesic coniferous landcover), and alpine communities (mesic herbaceous and barren). Additional

communities include marshes, swamps, and lakes and barren, rocky talus slopes (Habeck 1970). Though these latter habitats cover only a small area in the park, they contribute an important component of the park's diversity and contain many, if not most, of the rare plant species.

Grassland communities include the fescue-wheatgrass prairie, which is dominated by rough fescue and a variety of other grasses (Wayne Phillips, retired USFS ecologist, pers. comm., Jan. 1999) These include pockets dominated by shrubs such as big sagebrush. While composed of a wide variety of species, east side prairie communities are primarily dominated by Idaho fescue. They include the introduced timothy and smooth brome. A variety of sedge species dominate sedge meadows and marshes.

Pine or woodland savannahs include quaking aspen and black cottonwood groves and open lodgepole pine, ponderosa pine, and limber pine stands. Limber pine is restricted to the east side of the Continental Divide in the park and, like whitebark pine, is suffering because of white pine blister rust. The five needle pines, white pine, limber pine, and whitebark pine are suffering serious ecological effects as a result of fire exclusion and the exotic white pine blister rust.

Currently, 90 percent of the whitebark pine in Glacier are lethally infected with the rust and are likely to die in the next 5-15 years. About one-third of their cone-bearing crowns are already dead. The park has begun a small project to collect seed from apparently rust-resistant trees to restore whitebark and limber pine before they become extirpated. Whitebark pine is an important food source to Clark's nutcracker, red squirrels, and grizzly bears; and it plays an important role in defining timberline, as it can become established under harsher conditions than other trees. It also provides a microhabitat suitable for the establishment of subalpine fir.

Bottomland forests, common in riparian zones and floodplains, are generally dominated by black cottonwood in association with a wide variety of codominants, such as pine, red cedar, or spruce. Thin-leafed alder and willow swales also make up bottomland vegetation.

Ponderosa pine, though common in Montana, makes up only a minor portion of stands in Glacier National Park and is found only on the west side. It occupies the warmest and driest sites that support forests and grades into savannah communities. Douglas fir occupies sites just slightly cooler and more mesic than the ponderosa-dominated sites and is somewhat more common, occurring on both sides of the divide. Even as seral species in the development of climax forests, such as cedar/hemlock, ponderosa and Douglas fir tend to be minor in comparison with lodgepole, western larch, spruce, and fir. The latter are common seral species in forests throughout the park, except western larch, which occurs only rarely on the east side.

The western red cedar and western hemlock forests include nearly every species of tree that grows in the park. Cedar and hemlock do not establish quickly in recently opened stands, and hemlock requires shady conditions for seedling establishment. New stands are first established by pioneering species, such as lodgepole, larch, aspen, or cottonwood, and later filled in with seral species such

as Douglas fir, white pine, spruce, and fir. As these trees die, cedar and hemlock saplings fill in gaps left by the seral species. The process of development from newly opened stands, such as those following a fire, to cedar/hemlock forest takes centuries.

As elevation increases, particularly above 3,500 feet, subalpine fir and Engelmann spruce become increasingly more important, and cedar and hemlock drop out by about 4,000 feet. At higher elevations spruce/fir communities dominate, although subalpine fir remains the most abundant. Whitebark pine communities, once abundant in certain areas, have been decimated by blister rust, and there are only remnant populations. Alpine larch are found in some higher elevations of the park. As elevation increases above 6,000 feet, the stunted growth form referred to as krummholz becomes increasingly pronounced (Habeck 1970).

Above timberline there are alpine communities, including wet meadows found on level terrain adjacent to streams dominated by undergreen willow and a variety of forbs and sedges and rock ledge communities dominated by saxifrages.

The flora of Glacier National Park also includes more than 120 species of exotic plants that have been intentionally or inadvertently introduced. A number of these species are increasing in quantity, area, and density and are threatening native plant communities. They inhibit the perpetuation of native plant communities and hence the quality of the wildlife in the park. Exotic plants also affect the park's scenic quality and have the potential to spread. This has direct effects on wildlife and recreational enjoyment. Most exotics occur in disturbed areas such as roadsides, construction projects, old homesteads, grazed fields, burns, floodplains, and utility sites. Removing topsoil and vegetative cover creates favorable microhabitats for exotic colonization. Spread occurs when seeds are transported by visitors, construction equipment, animals, wind, and water. Particular issues are addressed in the park's "Exotic Vegetation Management Plan."

Within the Going-to-the-Sun Road corridor, the vegetation in the Apgar area is characterized by lodgepole, hemlock, Engelmann spruce, white spruce, (only location in the park), cedar, larch, black cottonwood, riparian, and meadow species. Prior to a large fire in 1929, the Apgar area was a cedar/hemlock forest. It is now in early to mid successional stages. The Avalanche area is characterized by cedar/devil's club, which is a rare habitat type in Montana and may reach its easternmost extension in Glacier. Hemlock, cottonwood, Engelmann spruce, Douglas fir, maple, paper birch, hawthorn, and snowberry are also in the area.

The Logan maintenance pit area has spruce/fir and riparian vegetation. The Moose Country area is in cedar/hemlock forest. The Road Camp and Haystack areas have subalpine fir. The Sunrift Gorge area is characterized by spruce/fir forest near the roadside, and a trail leads to alpine communities. The Packers Roost area is in spruce/fir forest. The Sun Point area is a rocky outcrop with lodgepole pine, dry, herbaceous cover, and downed limber and whitebark pines.

The Logan Pass area is characterized primarily by dry, subalpine meadows, along with krummholz subalpine fir. The Lunch Creek area has subalpine fir krummholz in a riparian setting with willow, honeysuckle, huckleberry, and beargrass and contains rare plant species.

AQUATIC RESOURCES

Threatened and Endangered

Bull Trout. The bull trout in the Upper Columbia River Basin was accorded "threatened" status by the U.S. Fish and Wildlife Service under the provisions of the Endangered Species Act in 1998. Glacier National Park contains a significant amount of lake and stream habitat for bull trout, and management and research regarding this species have high priority in the park's *Resource Management Plan* (NPS 1993b).

The historic range of the bull trout has become fragmented due to habitat alteration and nonnative fish introductions throughout western North America. In addition to populations directly associated with the Columbia River Basin, there are also bull trout east of the Continental Divide in the Hudson Bay drainage. The Hudson Bay population is being considered for listing as threatened under the Endangered Species Act. Because of declining numbers, bull trout fishing is prohibited in the park, and spawning streams in the park and along the Middle and North Forks of the Flathead River are closed to fishing year round. A number of unique subpopulations of bull trout also survive in isolated enclaves in remote lakes in the park.

Proposed Species

Montana Capshell Limpet. A relict population of the Rocky Mountain capshell (*Acroloxus coloradensis*), also known as the "Montana capshell" or simply the "capshell," was discovered in a small pond in the Going-to-the-Sun Road area in the mid-1960s. This is one of only a few sites in the United States where a viable population has survived. Most other documented populations are in Canada. It has also been found in several lakes in Colorado. In 1992, *Acroloxus coloradensi* was petitioned for emergency listing as a threatened species in the United States, but the decision is pending further evaluation.

At present, the U.S. Fish and Wildlife Service is evaluating the westslope cutthroat trout for possible listing under the Endangered Species Act. Westslope cutthroat are native to all major drainages within the park, but they are common in the North Fork and Middle Fork of the Flathead River, which remains one of the last strongholds for genetically pure westslope cutthroat in the United States. Selected spawning streams (along the Middle Fork of the Flathead River and within the park) have been closed to fishing to protect cutthroat spawning areas.

State Species of Special Concern

The state of Montana lists the following fish species found in Glacier National Park as "fish of special concern:" westslope cutthroat trout, Yellowstone cutthroat trout, bull trout, arctic grayling, shorthead sculpin, spoonhead sculpin, and trout-

perch. Of those listed, only the Yellowstone cutthroat trout and the arctic grayling are not native to Glacier National Park.

Places like Glacier become increasingly important as sources for pure genetic stocks of fish as habitats outside the park become more fragmented and as inbreeding with nonnative species becomes more prevalent.

General Aquatic Species

Within the aquatic ecosystem in Glacier National Park there are 17 native and 7 nonnative species of fish. The Columbia River basin, the area west of the Continental Divide, is characterized as a complex network of unique streams and lakes displaying abundant water volumes, low fertility, low temperatures, and high clarity. Major native fish species present are classified as adfluvial (species that spend their adult lives in a lake but migrate into tributaries to spawn) and resident species (which complete their entire life cycle within a specific environment). Eleven of the 16 known fish populations of the drainage are indigenous species. The river-lake system of the Columbia River basin is recognized as an integral unit of importance, with one system relying on the other for survival.

The Missouri River drainage, in the southeast area of the park, is characterized by low productivity lakes and streams but possesses a significantly different fish species composition than the Columbia River basin. Much of this drainage in the park is thought to have been originally barren of fish, although westslope cutthroat trout, mountain whitefish, grayling, and longnose suckers are known to be indigenous to the drainage.

The Saskatchewan River drainage is another unique watershed that flows north to Hudson Bay. The headwaters, which are in the northeast area of the park, are low in productivity, with both native and nonnative species occupying the lakes and streams of this drainage.

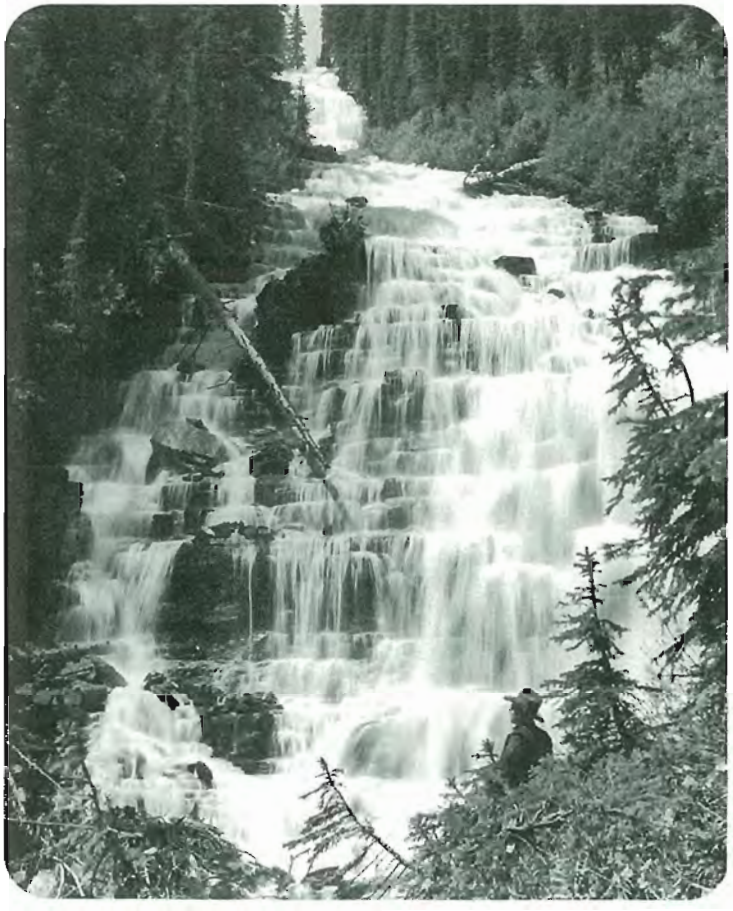
The 11 sport fishes found in the park are westslope cutthroat trout, Yellowstone cutthroat trout, Rocky Mountain whitefish, Lake Superior whitefish, lake trout, rainbow trout, eastern brook trout, kokanee salmon, burbot, northern pike, and grayling. As of 1995, fishing for bull trout was prohibited because of its declining numbers.

In addition to the ichthyofauna of the park's lakes and streams, Glacier is also home to salamanders, frogs, and aquatic macroinvertebrates. Although primary surveys on amphibians and localized studies of macroinvertebrates have been done, no comprehensive parkwide surveys have ever been completed.

WATER RESOURCES

The park's alpine meadows and sculpted peaks form a triple divide from which water descends to three oceans. Water east of the Continental Divide flows into either the Saskatchewan River drainage, which flows into Hudson Bay, or into the Missouri River drainage, which flows into the Gulf of Mexico. West of the Continental Divide, water flows into the Columbia River drainage, which flows into the Pacific Ocean.

The park is divided into four major drainages: the Hudson Bay, the Missouri River, the North Fork of the Flathead River, and the Middle Fork of the Flathead River.



WATER QUALITY

The water quality in Glacier National Park is very high. Between 1984 and 1990 a monitoring study measured the water quality of five large lakes that are heavily used by park visitors and have lakeshore developments (hotels, cabins, commercial boating) and eight backcountry lakes that are in very remote alpine headwaters. The frontcountry lakes were Lake McDonald, Swiftcurrent, Waterton, St. Mary, and Two Medicine. The backcountry lakes were Beaver Woman, Cobalt, Gunsight, Gyrfalcon, Medicine Grizzly, Snyder, Stoney Indian, and Upper Dutch. These lakes were selected because they included all the regions and geology in Glacier National Park. It was assumed that the study lakes represented the array of conditions present in the many park lakes. No trends that could be related to pollutants were evident; only normal variations were documented. This provides a baseline for water quality.

The results of the study indicated that the lakes contained few dissolved solids because of the low dissolution rates of the belt series bedrock. Cobalt, Snyder, Upper Dutch, Gyrfalcon, and Two Medicine Lakes have very little buffer capacity and are extremely sensitive to acidic deposition. All of the lakes were low to very low in nutrients and productivity because of low phosphorus and would be extremely sensitive to phosphorus loading.

The amount of phytoplankton (largely algae) was low, ranging from almost none in Gyrfalcon to 1.84 ml/m3 in Gunsight. The shallow lakes at lower elevations (Medicine Grizzly, Swiftcurrent, and Two Medicine) with fast flushing rates consistently had the most phytoplankton. The more dilute lakes (Upper Dutch, Two Medicine) had more phytoplankton species. Zooplankton (tiny animals and animal matter) numbers were also low, but lakes with higher phytoplankton did not necessarily have high zooplankton numbers. Presence of fish clearly had a negative effect on zooplankton numbers and biodiversity, especially in the small backcountry lakes.

FLOODPLAINS AND WETLANDS

Wetlands

According to a wetland inventory completed in cooperation with the U.S. Fish and Wildlife Service in 1993, there are 4,639 known nonriverine wetlands larger than 5 acres and 1,430 known riverine wetlands in the park. A total of 37,848 acres in the park are classified as wetlands. Glacier has a wide variety of wetlands due to local differences in vegetation, hydrology, water chemistry, soils, topography, climate, and other factors. According to the wetlands and deepwater classification system, Glacier contains 39 subclasses of wetlands in three major systems: lacustrine, palustrine, and riverine.

The riverine wetlands are those areas associated with rivers and streams. Water is usually, but not always, flowing in the riverine system. There may be upland islands or palustrine wetlands in the channel, but they are not included in the riverine system. Palustrine moss-lichen wetlands, emergent wetlands, scrub-shrub wetlands, and forested wetlands may occur adjacent to the riverine system, often in the floodplain. The bogs and fens in Glacier, although generally small and sparse throughout the park, are quite special.

The lacustrine systems include wetlands and deepwater habitats and (1) are situated in a topographic depression or a dammed river channel, (2) lack trees, shrubs, persistent emergents, emergent mosses, or lichens with greater than 30 percent area coverage, and (3) total more than 20 acres. Where a river enters a lake, the extension of the lacustrine shoreline forms the riverine-lacustrine boundary. It includes permanently flooded lakes and reservoirs and intermittent lakes. Typically, there are extensive areas of deep water. Islands of palustrine wetland may lie inside the boundaries of the lacustrine system.

The palustrine system includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. The palustrine system was developed to group the vegetated wetlands traditionally known as marsh, swamp, bog, fen, ponds, and prairie. Palustrine wetlands may be situated shoreward of lakes, river channels, or estuaries on river floodplains, in isolated catchments, on slopes, or as islands in lakes or rivers.

In the Many Glacier area there are approximately 3,094 acres of wetlands. Most of them are associated with Lake Sherburne and Swiftcurrent Lake. They are primarily palustrine (612 acres) and lacustrine (2,375 acres) wetland types. There are 106 acres of wetlands associated with rivers and creeks (riverine).

In the North Fork area there are approximately 11,991 acres of wetlands. Most of these are in the North Fork Valley near the North Fork of the Flathead River and some of the lakes. They are primarily palustrine (3,397 acres) and lacustrine (7,432 acres) wetland types. There are 1,161 acres of riverine wetlands.

In the Goat Haunt-Belly River area there are approximately 4,220 acres of wetlands. Most of these are in the area north of the head of Waterton Lake and the Belly River Valley. They are primarily palustrine (936 acres) and lacustrine (3,030 acres) wetland types. There are 254 acres of riverine wetlands.

In the Going-to-the-Sun Road area there are approximately 13,527 acres of wetlands. These are spread throughout the entire geographic area. They are primarily palustrine (1,052 acres) and lacustrine (11,698 acres) wetlands. There are 776 acres of riverine wetlands.

In the Two Medicine area there are approximately 1,953 acres of wetlands. These are primarily concentrated near lower Two Medicine Lake and in the southern half of the geographic area. They are primarily palustrine (627 acres) and lacustrine (1,252 acres) wetlands. There are 73 acres of riverine wetlands.

In the Middle Fork area there are approximately 3,053 acres of wetlands. They are spread throughout the area, with a major concentration in the vicinity of the Middle Fork of the Flathead River. They are primarily palustrine (1,183 acres) and lacustrine (1,016 acres) wetlands. There are 853 acres of riverine wetlands.

Floodplains

The 100- and 500-year floodplains have only been identified for the rivers and creeks in Glacier National Park that are adjacent to developed areas.

In the Going-to-the-Sun Road area there are a number of developments in the 100- and or 500-year floodplains. Based on the 1964 flood, which was determined to be in excess of a 200-year flood, it was determined that the 100-year floodplain for McDonald Creek includes the area occupied by the Village Inn and the adjacent motel. The 500-year floodplain for McDonald Creek includes Apgar Village.

The 100-year floodplain of Sprague Creek probably includes a portion of the Sprague Creek Campground, sewage lift station, and picnic area.

The 100-year floodplain of McDonald Creek includes the picnic area and comfort station at Avalanche. The campground is not in the 100-year floodplain. The 100-year floodplain also includes a portion of the Going-to-the-Sun Road. The 500-year floodplain boundaries have not been determined for that area of McDonald Creek.

The 100-year floodplain for Divide Creek and the St. Mary River may include the St. Mary Visitor Center and the parking lot. In 1986 the Army Corps of Engineers determined that the 100-year floodplain did not include these areas, but both creeks are very unstable and have moved. The exact boundaries of the 100- and 500-year floodplains of these two creeks are not known.

Divide and Wild Creeks, like many of the creeks in Glacier National Park, transport and deposit glacial material. The streams erode and transport this material through most of the length of their steep channels with high velocities and deposit it in the stream bottoms when they slow on the flat, alluvial fans of the St. Mary housing and administrative area and St. Mary Campground. This deposition raises the elevation of the stream bottoms and causes the streams to seek alternate courses in the lower portion of the floodplain. For this reason, the stream channels of these two creeks are very unstable, and historically have shifted over a large area.

The entire extent of the alluvial fans of Divide and Wild Creeks in the area of development should be considered in the base (100-year) floodplain. This is because of the frequency of recent flooding in the area, the uncertainty of determining flood magnitudes, instability of the Divide and Wild Creek alluvial fans, and the difficulty in interpreting hydraulic modeling.

VISUAL RESOURCES

Many of the names that were given to the mountainous terrain, such as "Backbone of the World" and "Land of the Shining Mountains," relate to the visual prominence of the mountains that were both a barrier and a backdrop for the lives of the people who lived in the area. The establishment of Glacier National Park was rooted in the preservation and appreciation of the scenic resources of the area, which are still very important.

The North Fork provides views primarily in a natural forested environment with open meadows along streams and in the prairies north of Polebridge. Outstanding views of the mountains along the Continental Divide are to be found at several lakes that extend to within a few miles of the divide.

The Going-to-the-Sun Road area provides views of a cross-section of Glacier's environment from the forested, lake, and streamside areas on each side of the park to the rocky, exposed alpine areas near the divide. The road provides a viewpoint for the park scenery that is harmonious with the natural features it traverses.

The Middle Fork area is heavily forested with few viewpoints. Views of mountain peaks are most important in the valley of the Middle Fork.

The Two Medicine area has an open landscape and views of the abrupt, prominent escarpment of the Rocky Mountain front. The mountains that make up the front are visible from a great distance to the east and define the landscape of the region. The mountains have been seen as a barrier, as a destination, and as a dwelling place of the gods.

In the Many Glacier area there is a sense of enclosure in the lower valley, and there are views of the mountain peaks from all points in the valley. The Many Glacier Hotel and associated facilities were constructed to take advantage of the outstanding views. The rest of the geographic area is well known for its views of alpine meadows, lakes, and glacier-carved mountains.

The Goat Haunt-Belly River area has a sharp interface between the mountains and the prairies to the north and east. It has several lakes that lead the eye to the prominent mountain ranges. Chief Mountain, astride the park boundary and the Blackfeet Indian Reservation, is visible from a great distance on the plains to the east. It has been a prominent landmark for many cultures.

NATURAL SOUNDS

Natural sounds predominate through most of the park. Natural sounds include those made by animals, water, wind, and other natural phenomena. Natural quiet does not mean complete silence; it exists when the only sound is produced by the

natural and historic components of the park. It may include silence - the apparent absence of any sound - or the rush of air over the wings of a soaring bird or the overwhelming roar of waterfalls or gale force wind. Most agree that it is thought of as a mixture of mostly low decibel background sounds punctuated by the songs and wingbeats of birds and insects or the faint clatter and calls of other wildlife.

Noise levels in the park vary depending on time, wind direction, and location (Harris, Miller, Miller and Hansen, Inc. 1998). Sources of noise in the park include scenic air tours, road traffic, motorboats, railroad traffic, and developed area activity (generators, music, and people). There are also administrative activities that create noise, such as chainsaws, helicopter flights, and emergency vehicle sirens. Noise is generally concentrated and more apparent in developed areas and along roads. Noise from scenic air tours can be heard throughout the park. Future developments outside the park, including mineral development, logging, and new construction, also pose possible threats.

SOILS

There are no prime and unique farmlands in the park as defined by the U.S. Department of Agriculture, Natural Resources Conservation Service (Pers. com. Dutton 1997).

The soils in the park are characterized by a variety of parent materials, climates, topography, vegetation, and ages (Dutton and Marrett 1997). A soil mapping project was begun in 1995 and has been completed except for the Middle Fork. Many soils in the park were found to have severe limitations for most common uses due to steepness, high rock content, high clay content, and shallow bedrock. This does not prevent development and use, but development and use may be more difficult and more expensive and require more cost and mitigation to avoid adverse environmental effects.

In the Going-to-the-Sun Road area the soils on the west side of Logan Pass are identified as alluvial soils, bedrock (colluvial) soils, glacier till soils, and bedrock limestone soils. In the Apgar developed area the soils are identified as floodplain, cobbly alluvial, sandy over cobbly alluvial, and silty over cobbly alluvial. These soils each have individual ratings, and they are rated from low to high for productivity and revegetation. The ability depends on the amount of rock content and low water and nutrient holding capacity. They are moderately to well suited for road and trail development based on the rock content and ability to drain. They are very susceptible to invasion by weeds when disturbed. They have a low to moderate erosion potential depending on the sand content of the soil, and they are rated from low to high for waste disposal with septic tanks or drainfields, dependent on the silt loam texture and rock content. At the southern end of Lake McDonald on the east bank the soils are a mixture of bedrock colluvial soils that are shallow, moderately deep, and deep. These soils have very low to high potential for productivity and revegetation depending on the depth, rock content, and water and nutrient holding capacity. They range from poorly to well suited for road and trail development. They are moderately to highly susceptible to invasion by weeds

and have a low to moderate erosion potential depending on the rock content. They are rated as low to moderate for waste disposal using septic tanks or drainfields.

The majority of the soils surrounding Lake McDonald, including the Lake McDonald developed area, Moose Country, and Avalanche developed area, are glacial till soils. These soils have a high potential for productivity and revegetation. They are not well suited to road and trail development and are moderately susceptible to invasion by weeds. They have a moderate erosion potential and are rated moderate for waste disposal using septic tanks and drainfields. The Logan maintenance pit and Packers Roost areas are characterized by stony glacial till soils. The Road Camp area is a colluvium land type with 80 percent rock and gravel and 20 percent soils. They have low water-holding capacity and low fertility. The Going-to-the-Sun Road historic quarries are near the west tunnel across the road from the Bird Woman Falls overlook. The soils in these areas are classified as limestone bedrock. The area just above the tunnel has only shallow soils, whereas Bird Woman Falls overlook has shallow to moderately deep limestone soils. Due to the high rock content and limited soil depth, revegetation potential is moderate, and there is a moderate erosion potential.

On the east side of the park in the Going-to-the-Sun geographic area (including Logan Pass) the soils are largely bedrock limestone in the higher elevations and bedrock quartzite and argillite in the mid elevations. Surrounding St. Mary Lake are glacial landslide and mixed alluvial soils. In the Logan Pass area, the soils are largely limestone rock outcrop, shallow soils, and alpine meadow soils. There is very little actual soil material in the limestone rock outcrops. The shallow and alpine meadow soils are rated low to moderate for potential productivity and revegetation. Both soils are rated low for road building due to the limited depth, loamy texture, and low rock content. They are rated moderate for trails. They have a low to moderate susceptibility for weed invasion when disturbed and a moderate to high erosion potential. They have a low suitability for waste disposal using septic tanks or drainfields due to the limited soil depths. The soils at Lunch Creek are similar to those at Logan Pass. The soils at Sunrift Gorge are moderate, deep, and shallow colluvial soils, with small areas of quartzite, argillite outcrops. They are well-drained soils with loam and a large amount of gravel. The bedrock below them is fractured. The soils surrounding St. Mary Lake are a mixture of glacial and colluvial. The revegetation and productivity potential of the soils are moderate to high. They are rated as moderate for road and trail construction, although trail erosion is often 6-10 inches deep. They are moderately susceptible to invasion by weeds. They have a high erosion potential and moderate suitability for waste disposal due to their texture and rock content. Soils in the St. Mary developed area are alluvial and rocky sandy alluvial grasslands. These soils have a moderate to high potential for revegetation and productivity in the upper layers that decreases in the deeper layers due to high rock content and low ability to hold water and nutrients. They are well suited to road and trail construction due to good drainage and rock content but are highly susceptible to weed invasion when disturbed. They have a

moderate erosion potential and a moderate potential for waste disposal (Land and Water Consulting, Inc. 1995, Dutton and Marrett 1997).

AIR QUALITY

Glacier is designated as a mandatory class I area under section 162(a) of the Clean Air Act. This designation gives the federal land manager (the assistant secretary of the interior for fish and wildlife and parks) and the park manager the responsibility to protect the air quality and air quality-related values in the park. Air quality-related values are defined as visibility and those scenic, cultural, biological, and recreational resources of an area that are affected by air pollution. The park is in two air quality control regions: the Missoula Intrastate region west of the Continental Divide, and the Great Falls Intrastate region east of the divide. The Missoula region is maintaining all national air quality standards except for fine particulate matter (PM-10), while the Great Falls region is maintaining all standards except for carbon monoxide in the city of Great Falls. However, no major metropolitan areas are within 125 miles (200 km) of Glacier, and regional smog typical of highly populated areas with high vehicle use is not present. The "Special Report on Transboundary Air Quality Issues" reported that visibility is being affected by wildfires, prescribed fires, and industrial emissions from sources in the northern states and Canadian provinces on the boundary. Monitoring in Waterton Lakes and Glacier National Parks showed that two-thirds of the particles that reduce visibility in Waterton-Glacier International Peace Park originate in Canada and that half of the contribution comes from sources in Alberta.

Air quality is considered good in the park. Visibility is occasionally marred by airborne particulate matter, including smoke from both natural and manmade fires and dust from unpaved roads. Sulfuric compounds, including sulfur dioxide and ammonium sulfate from industrial emissions, can also contribute to local haze. When inversions occur, visibility problems in the park can be more severe. Flathead County, which includes the part of the park west of the Continental Divide, is currently out of compliance with Montana standards for particulate emissions. Montana is required to develop a state implementation plan to attain the particulate standard.

Air pollution in national park system units reduces visibility, injures vegetation, changes lake and stream chemistry, and causes the deterioration of cultural resources. Since the late 1970s, the National Park Service has monitored visibility and ambient levels of fine particles (particles with diameters less than 2.5 micrometers), ozone, and wet deposition.

The annual average visibility levels at Glacier National Park are about 84 kilometers (corresponding to a 1993-1997 average extinction of 46.3 mm), which is less than the typical 130 kilometers or greater in the Colorado Plateau and Central Rocky Mountains but greater than the 20 to 30 kilometers typical of many eastern sites. Impaired visibility results from concentrations of fine particles suspended in the ambient air. On the average at Glacier National Park, about 31 percent of the visibility reduction is caused by sulfate fine particles, 22 percent by organic fine

particles, 10 percent by nitrate fine particles, 8 percent by soot fine particles, and 8 percent by coarse mass and soil particles. The organic and soot particles have their origin in vegetative burning and urban sources; sulfates and nitrates originate from sources of sulfur dioxide and nitrogen oxides like power plants, and coarse mass and soils from wind-blown dust. In the nine years 1988-1996, on the dirty days (when measured fine particle concentrations were at or above the 80th percentile of the mass distribution) visibility showed a statistically significant improving trend at the $p = 0.10$ level. On average days, (when measured fine particle concentrations were between the 40th and 60th percentiles of the mass distribution) visibility exhibited a statistically significant improving trend at the $p = 0.05$ level. On clean days (when measured fine particle concentrations were at or below the 20th percentile), visibility showed no statistically significant change in the nine-year period.

Sulfate and nitrate ion concentrations in precipitation measured at Glacier National Park are very low compared to most sites in the eastern United States. In 1997 Glacier reported a sulfate ion concentration of 0.3 milligrams per liter (mg/L). Sulfate ion concentrations throughout Washington, Oregon, Idaho, Montana, and Wyoming varied between 0.2 and 0.5 mg/L. By comparison, the 1997 sulfate ion concentration at Shenandoah National Park was 1.9 mg/L. Nitrate ion concentrations at Glacier and the northwestern United States exhibit a similar spatial trend for 1997, with an annual nitrate ion concentration of 0.5 mg/L at Glacier and a range of 0.2 to 0.8 mg/L recorded at sites in the above states. Shenandoah's nitrate ion concentration in the same year was 1.4 mg/L. The 1997 pH measured at Glacier and other sites in the Northwest varied between 5.0 and 5.4. The 1997 pH at Glacier was 5.0; that measured at Shenandoah was 4.4. For the period 1985-1993, the National Atmospheric Deposition Program reported a negative-sloped trend for sulfate ion concentration and a positive-sloped trend for nitrate ion concentration and Glacier National Park. However, neither trend was statistically significant ($p > 0.05$).

At higher elevations in Glacier National Park, much of the annual wet deposition falls as snow. Research to understand seasonal snow hydrology and chemistry are being sponsored by both the BRD global change program of the U.S. Geological Survey and the PRIMENet program of the Environmental Protection Agency and the National Park Service. Glacier National Park has been a part of the Rockies-wide synoptic snow survey for about five years, which makes it possible to determine where Glacier National Park fits in the regional deposition picture.

The annual maximum 1-hour ozone levels at Glacier National Park are lower than those measured at most of the other monitoring sites in the national park system. Annual daily maximum one-hour concentrations at Glacier varied between 58 and 77 ppb between 1992 and 1997. Glacier's peak ozone levels are comparable to those measured at other national park system sites in the Pacific Northwest but are significantly lower than ozone concentrations measured in national park system units in southern California and in the northeast and east-central United States. Glacier's ozone levels are also well below the U.S. Environmental Protection Agency (EPA) 8-hour average ozone standard designed to protect human health.

The EPA standard is exceeded if the three-year average of the fourth highest daily maximum 8-hour concentration exceeds 84 ppb. The 1995-1997 three-year average at Glacier National Park as 47 ppb. During 1988-1997, the May-September average daily maximum one-hour ozone concentration showed no statistically significant trend at the $p = 0.15$ level.

Winter inversions cause local increases in carbon monoxide at Kalispell, 13 miles (20 km) south of West Glacier. Most of Flathead County's 70,000 residents live within 15 miles (25 km) of Kalispell, the largest city in northwestern Montana. Emissions from automobiles, wood-burning stoves, and the Columbia Falls Aluminum Company, combined with winter meteorological conditions, cause seasonal increases in carbon monoxide (NPS 1998).

Glacier National Park participates in the following air quality monitoring programs:

The National Dry Deposition Network measures gaseous pollutants and meteorological data. Ambient ozone, sulfur dioxide, particulate sulfate, particulate nitrate, and nitric acid are measured in addition to meteorological data.

The Visibility Monitoring and Data Analysis Program / Interagency Monitoring of Protected Visual Environments measures visual range, air temperature, and relative humidity. Visibility conditions are measured by the IMPROVE sample, which collects fine particles (PM2.5) of sulfate, nitrate, elemental carbon, soil, and PM10 coarse soil.

The National Atmospheric Deposition Program / National Trends Network measures acidity, conductivity, precipitation, chemical concentrations, deposition, anions, and cations.

Fluoride is measured using sodium bicarbonate tube instrumentation and forage and vegetation sampling. This monitoring allows the park to participate in the Columbia Falls Aluminum Company baseline fluoride monitoring program.

It is important to distinguish between emission source regions and receptor regions, where effects occur. Because air pollutants are transported in the atmosphere, their adverse effects can occur not only within the emission source regions but also in other regions downwind of the primary contributing sources. For some air issues such as persistent toxic substances, the primary source regions and the primary receptor regions of concern may not be at all coincident; they may in fact be quite distant from each other. However, the pollutants can be controlled only where they are emitted.

Glacier's air quality monitoring program measures a number of parameters that would indicate sources of airborne pollutants. In addition to this onsite monitoring, the Air Resources Division of the National Park Service models new source pollutants or changes from existing sources to measure their effects on the park.

The main sources of pollutants surrounding the park west of the Continental Divide are industrialized areas south and west of Glacier. These sources are under the authority of the state of Montana, which works closely with Glacier on air quality issues. Sources around the park include Columbia Falls Aluminum Company, Plum Creek Lumber, Stoltze Land and Lumber, Pack and Company, Fording Coal, Crestbrook Forest Industries, Cominico Ltd. Shell, Waterton Gas

facilities, and Gulf compressor stations. On the east side of the park, airborne pollutants are often associated with a northern air flow. A variety of regional air quality management frameworks for managing this transboundary air quality issue are being considered in the United States and Canada.

Glacier National Park has been selected to take part in the Environmental Protection Agency's Demonstration Index Site Project (DISPro) program along with 12 other national parks. The intent of the program is to examine whether a network of sites in the parks can be used to address monitoring issues for both global and local environmental stressors such as water-borne pollutants or air deposition. As an initial program, ultraviolet-B radiation will be measured in the DISPro parks. To best meet these conditions at Glacier a site at St. Mary was chosen.

Cultural Resources

AMERICAN INDIANS

Prehistoric Use

Recent archeological and ethnographic studies have shown that the area that became Glacier National Park has been used by people for 2,000-10,000 years. American Indian tribes have long been associated with the area that became Glacier National Park. The tribes' cultural memories are preserved in oral tradition and in writing by ethnographers. The tribes include the Pikuni (Blackfeet, Blood), Cree, Kootenai, Gros Ventre, Stony (Assiniboine), Crow, Pend Orielle, and Salish.

The tribes moved seasonally, usually in response to food sources, special events, or spiritual needs. All lived in the mountains as their needs dictated, and they used the various areas differently according to the seasons. They hunted for food and raw materials and collected plants and other items for medicinal, utilitarian, and religious purposes. They protected the resources they needed from others. People on both sides of the divide traveled across the mountains to hunt, fish, or raid on the other side.

Historic Use

East of the Continental Divide, the Blackfeet fiercely defended their territory. Despite repeated smallpox epidemics they maintained a strong presence in the area through the 19th century. They interacted with the Lewis and Clark party.

During the westward expansion of the United States, more and more land was taken from all of the American Indian tribes, including those living around what would become Glacier National Park. The United States began developing a formal relationship with the Blackfeet in the 1850s through treaties. A reservation was created in 1855 for the Blackfeet beginning at the Continental Divide and extending east. Despite the established boundaries, the Blackfeet spent much time and effort keeping new residents of the area from encroaching on the land that had been set aside for their use.

Soon after 1800 Catholic missionaries began spreading Christianity among local American Indian groups. In 1855 the first attempt was made to establish

reservations for Indians in Montana. Historical records show that Blackfeet and Kootenai groups camped at the foot of upper St. Mary Lake periodically during the 19th century. The Cree and Metis camped near Babb during that time. A group of Stony Indians were camped at Quartz Lake in 1876. Crees and Kootenais were sometimes encountered on the North Fork drainage prior to the establishment of the park.

Some of the white men drawn to the area became close friends and champions of the rights of the Blackfeet, and some of them married into the tribe. Notable were J.W. Schultz, a writer, and G.B. Grinnell, who was instrumental in establishing the area as a national park.

The first indication that there were minerals on Blackfeet land came in 1889. Eager prospectors had no legal way to exploit the minerals. In 1894 serious efforts began to encourage the Blackfeet to cede the mountainous portion of their reservation so that mineral claims might be staked. There was very little evidence that large amounts of mineral wealth were hidden there.

Negotiations began and included conferences with J. W. Schultz and G.B. Grinnell. Grinnell was later appointed to the formal negotiating commission seeking agreement on the details of selling the mountainous land. An 1895 agreement with the Blackfeet withdrew the land that was to become the eastern part of Glacier National Park from their reservation.

After the establishment of the park, the association of the Blackfeet people with the park was publicized by the Great Northern Railway. Traditionally dressed Blackfeet were often employed to greet tourists at depots and hotels. Their presence was used by the railway as an attraction to increase visitation to the area. This association continued through the 1930s.

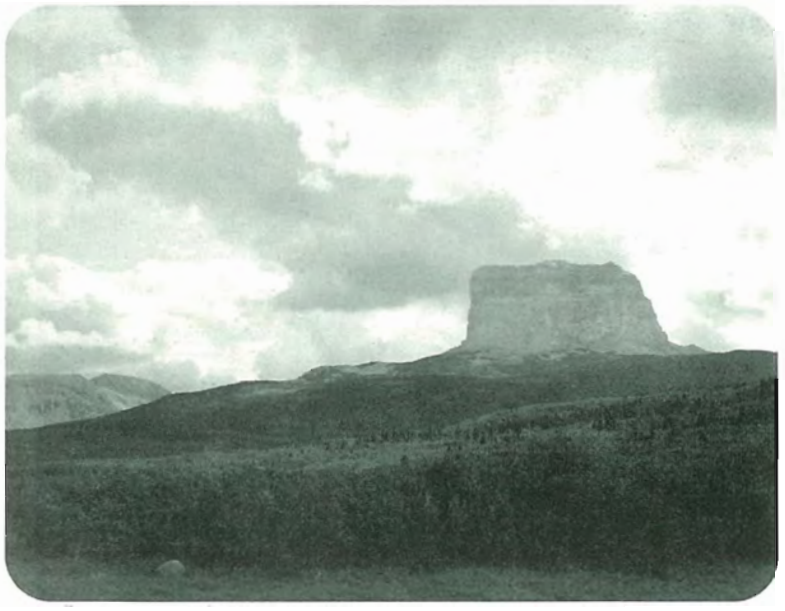
The close physical, emotional, and religious ties of all involved tribes to this area have never diminished. What makes this area important to native groups is the diversity of resources in the area and their sacred aspects. The area was and is a source of many physical resources and spiritual quests, contains landmarks of importance, and (because of its sacred nature) lends more power to the resources collected and the experiences found.

Archeology

Field studies have located over 400 archeological sites in Glacier National Park. The prehistoric sites are camps, sites associated with fishing and hunting, religious sites, and a quarry. There are also historic archeological sites associated with homesteads and other historic developments such as roads, trails, and chalets.

Sacred Sites Associated with American Indians

American Indian religions in the area recognize the significance of natural features such as high ridgetops and mountaintops for vision quests. Chief Mountain is a sacred place to many different tribes, including the Blackfeet and the Salish and Kootenai. There are a number of other vision quest sites in the park.



There are plants that grow in the park that are used in ceremonies and in healing, and the places where the plants grow are sometimes considered to have spiritual power, as are areas where certain ceremonies were once performed. Animals and their totems, such as the bear, are also believed to possess spiritual powers.

HISTORIC RESOURCES

National Register Sites, Historic Districts, and National Historic Landmarks. The National Historic Preservation Act of 1966 mandated that all facilities more than 50 years old on federal land be evaluated for eligibility for nomination to the National Register of Historic Places. National register listing has been completed for 357 park structures, and six are national historic landmarks.

The national historic landmarks include the Many Glacier Hotel, which was listed on the national register in 1976 as the centerpiece of the historic district that now includes the pedestrian trails, outbuildings, and dormitories and the boatmen's residence. It was made a national historic landmark in 1987 in a nomination that included the Two Medicine lodge, Granite Park Chalet, and Sperry Chalet. The chalets were celebrated for their massive Swiss chalet style architecture and for being the remnants of a linked network of hotels and chalets built by Great Northern Railway. In 1976 Lake McDonald Lodge was made the centerpiece of a historic district that now includes all the cabins and outbuildings and the Snyder Creek bridges closest to the hotel, as well as cabin 1105, the boatmen's quarters, and the horse concession quarters. In 1987 it achieved national historic landmark status for its architecture, which combines elements of the Swiss chalet and hunting lodge styles, the integrity of its interior and exterior, and its setting. The Going-to-the-Sun Road was listed on the national register in 1984 and became a national historic landmark in 1997 for its singularity as an engineering feat and for its narrowness, the stonemasonry guardrails and bridges, its precipitousness, and its views.

Management of the Going-to-the-Sun Road is focused on conserving and maintaining its historic fabric and character and the outstanding natural environment that it traverses.

Other historic facilities include Rising Sun and Swiftcurrent cabin camps; Logging Creek and Walton Ranger Stations; employee housing at headquarters and St. Mary, maintenance shops and sheds, patrol cabins such as those at Coal Creek and Baring Creek; fire lookouts such as Numa Ridge and Scalplock; campgrounds such as Avalanche; and trails such as the Grinnell Glacier Trail.

In the Goat Haunt-Belly River area there is one historic district, two sections of historic trail, and 11 structures listed on the National Register of Historic

Places. Examples of some of the historic structures include the Belly River Ranger station, Slide Creek patrol cabin, and the Goat Haunt shed.

In the North Fork there are three historic districts, one historic phone line, two sections of historic road, one rural historic landscape, and 29 structures listed on the National Register of Historic Places. Examples of some of the structures include Polebridge Ranger Station residence, Kintla Lake Ranger Station and the Ford Creek patrol cabin.

In the Two Medicine area, there are two historic districts, two sections of historic trail, and 14 structures listed on the National Register of Historic Places. Examples of some of the structures include the Two Medicine boathouse, the Cut Bank Ranger Station, and the East Glacier Ranger Station.

In the Going-to-the-Sun Road area there are seven historic districts, two sections of historic trails, and 165 structures listed on the National Register of Historic Places. Examples of some of the structures include the Lake McDonald Ranger Station, Rising Sun Motel and St. Mary 1913 Ranger Station.

In the Many Glacier area there are four historic districts, three sections of historic trail, and 74 structures listed on the National Register of Historic Places.

Examples of some of the structures include the Many Glacier Hotel caretaker house, horse concession bunkhouse and the Swiftcurrent fire lookout.

In the Middle Fork area there is one historic district, and there are 15 structures listed on the National Register of Historic Places. Examples of some of the structures include Scalplock Mountain fire lookout, Walton Ranger Station and the Harrison Lake patrol cabin.

Cultural Landscapes. Glacier has a number of landscapes that have been used over the years that could be considered cultural landscapes. Chief Mountain is a prominent feature on the eastern front of the mountains that has been significant to almost every culture associated with it. The Going-to-the-Sun Road and Lake McDonald Lodge and their surroundings are significant to many people. All of these landscapes are managed in a broad, all-encompassing manner that takes the entire visible landscape into account. The Going-to-the-Sun Road, with its scenic views, turnouts, vegetation, and proximity to vast wilderness areas, is a good example of a resource that is difficult to understand or manage without considering the entire landscape. To view a resource area as a cultural landscape provides a way of understanding and managing the full range of the values represented. No cultural landscapes have been formally evaluated and documented in the park, but a study has been proposed that would identify those areas.

Museum Collection. The museum collection includes historical and archeological artifacts; biological, geological, and paleontological specimens; and archival material. Housed in several storage areas in the headquarters complex, these objects document the park's history and its cultural and natural resources. Photographs, architectural drawings, and correspondence files contain documentation of the park's cultural history, its historic districts, national register properties, national historic landmark buildings, roads, and trails. Archeological artifacts attest to the longevity of the human presence in the area. The herbarium, other natural history specimens, and associated files provide a permanent record of the park's plants and animals. Acquired through donations, research projects, and day-to-day park operations, these resources help to tell the park's story.

The collection is organized and managed to provide the staff and the public with access to the information it contains. Interpreters, resource management staff, maintenance employees, and administrative personnel use the collection in the preparation of planning documents, public programs, publications, and for other day-to-day business purposes. Writers, historians, researchers, the media, and the general public also use the collection for magazine articles, video productions, research reports, books, and personal research. Most access the collection on an individual basis, because there are few opportunities for the long-term exhibit of the collection.

Physical and environmental conditions provided by current storage and exhibit facilities vary. The two primary storage locations in the headquarters complex provide the most acceptable conditions and house the bulk of the collection. Most of the archival material is stored in a modular structure built inside one of the older headquarters area buildings; most artifacts and specimens are stored in the basement of another old building. Both of these structures provide minimum protection from environmental damage (light, extremes of heat, cold, and humidity, and

pests) and physical threats (fire, theft, and improper handling). Most items are stored in standard museum cabinets and on shelves and have been organized to use the space available in the safest and most efficient manner.

PARK USE AND DEVELOPMENT

Transportation

Early access to the backcountry chalets and camping areas was on horseback and foot. The large hotels, constructed by the Great Northern Railroad, were accessed by rail and by horse-drawn coaches, wagons, and steamboats. The hotels provided a jumping off point for visitors to experience the backcountry areas of the park.

The Great Northern Railroad constructed a road to provide access for the construction of the chalets at Two Medicine, St. Mary, Sun Point, and the hotel at Many Glacier. This road was later named the Blackfeet Highway and is now traversed by portions of Highways 49 and 89. Glacier National Park received funding for and assisted in the maintenance of this road outside the park for many years, then funding was discontinued. The state of Montana now maintains Highways 49 and 89.

The Going-to-the-Sun Road, initially called the Transmountain Road, was completed in 1933. It was built to accommodate the emerging use of the park by visitors in private automobiles. From the start there were privately owned concessioner tour buses operating on the road. Use of the road rapidly increased after World War II, and congestion became a major issue for park management by the late 1970s. A vehicle length restriction was placed on the road that reduced congestion.

The park's primary concessioner has the right to provide all transportation services in the park. In 1992 the primary concessioner waived its contractual right to provide shuttle services, and a separate permit was issued. The right was again waived in 1994 to allow for contracting for Blackfeet interpretive tours. These services were provided under the permit through the 1996 season. Since 1997, a limited shuttle service has been offered by the major concessioner.

U.S. Highway 2 traverses the southern boundary of the park and is inside the park boundary for about 4 miles near Goat Lick and the Walton Ranger Station.

There are several access roads on Blackfeet land outside of the park on the east side. These roads connect with either Highway 49 or 89 and are maintained by the park under the authority of the Park Approach Roads Act.

Visitor Service Development and Concession Operations

The park has a variety of buildings, roads, trails, and sites that support visitor use and operational activities. They are summarized in the following table.

Many of these developments were built during the early days of the park and are valuable historic resources. In the early development of the national park system the large natural parks in the west did not have facilities for meals and lodg-

ing. The size of the parks and the time required to traverse them before there were roads necessitated the establishment of lodging and food services in the park. Concessions became an effective means for providing the services. To some extent this still holds true. Although modern methods of transportation have improved, there is still a strong desire on the part of the public to stay in or near the park.

Visitors were originally transported to the park by rail. They traveled by horse or foot around the park; road construction made travel by vehicle possible and other developments resulted. Some developments have been removed or were destroyed by avalanches or fires. Concession development is currently limited to seven distinct areas.

Apgar. The Village Inn is a 36-unit, concession-operated motel with an office and managers' quarters. Other commercial visitor services are provided on privately held land in the Apgar area, including four retail shops, a restaurant, motel and cabin rentals, a deli, and some associated employee housing. A short distance away a horse stable provides trail rides and houses 6-8 employees.

Lake McDonald Lodge Historic District. The Lake McDonald Lodge historic district has the oldest visitor accommodations in the park. Originally homesteaded in the early 1890s, the area played a major role in westside visitor services at the turn of the century. Built between 1913-1914, construction of the lodge was a massive undertaking. Most of the building materials had to be hauled 10 miles by barge up the lake from Apgar. The Swiss-alpine style hotel provided a convenient base for people to hike or take saddle horse trips into a park that was still remote and primitive while enjoying the comforts of civilization. Other buildings around the hotel date to as early as 1906. The lodge and the original guest cabins are of log and frame construction, which gives the complex a rustic European appearance with the charm it originally possessed when it was known as the "Lewis Glacier Hotel."

Lake McDonald Lodge, which is operated as a concession, includes 32 lodge rooms, 38 cabin rooms, 30 motel units, 11 employee housing buildings (housing approximately 146 employees), a post office, two restaurants, a lounge, a gift shop, a campstore, and a maintenance facility. A separate concessioner operates a horse stable with trail rides, housing for seven employees, and ticket offices. Another concessioner provides boat tours and small boat rentals with employee housing for two employees and a ticket office. The lodge operates June-September and is extremely popular. Occupancy rates typically range mid 80 percent to high 90 percent. The overall annual occupancy rate is about 94 percent.

The lodge was partially renovated by the National Park Service in 1989, but the kitchen, upper floors, cabins, and site developments were not completed due to lack of funding. Although most of the structures are owned by the National Park Service and assigned to the concessioner under a contract, the concessioner retains a

Table 4.

Built Environment
Glacier National Park

Other Data: 110 Full time employees;
45 full time employees live in park housing = 40%
287 Part time employees;
173 part time employees live in park housing = 60%

Location	Acres	Campground Sites	Number Campers 2.9 per Car	Guest Rooms	Number of Guests	Picnic Areas Picnic Tables	100 Year Floodplain	Arch Site	Historic District	Buildings Quarters Employ	Park Building	Private and Concession Bldg.	Sewer	Water	Electricity
Apgar	150	1-202	568	36	116	1/ 25	Yes	Yes		2 / 3 / 3	22		Lagoons	Surface	Commercial
Apgar Private				48	200?		Yes					40	Lagoons	Surface	Commercial
Avalanche Campground	35	1- 87	252			1/ 26	Yes			1 / 2 / 2	8		Leach Field	Surface	Generators
Belly River Ranger Station	10						Yes		Yes	3 / 3 / 7	4		Pit	Surface	None
Bowman Lake Campground	10	1- 48	139			1/ 10	No	Yes		2 / 2 / 3	3		Vaults	Surface	None
Cut Bank Campground	5	1- 15	43				No		Yes	1 / 1 / 1	4		Pit	Well	None
Fish Creek Campground	70	1-180	525			1/ 30	Yes			1 / 2 / 2	12		Lagoons	Well	Commercial
Goat Haunt Ranger Station	30						Yes			2 / 5 / 10	12		Leach Field	Well	Generators
Granite Park Chalet	10			12	35		No		Yes	0	5		Compo/Leach	Surface	None
Headquarters/YCC	100						No		Yes	57 /73 /101	45		Lagoons	Surface	Commercial
Kintla Lake Campground	2	1- 13	37				No		Yes	1 / 1 / 1	4		Vaults	Well	None
Lake McDonald Lodge/Bldg.#1105	70			100	337		Yes		Yes	1 / 1 / 2	37	32	Lagoons	Well	Commercial
Lake McDonald R.S.	5						No		Yes	2 / 2 / 2	6		Leach Field	Well	Commercial
Sprague Creek Campground	5	1- 25	72			1/ 25	Yes			0	3		Lagoons	Well	Commercial
Logging Creek Campground	10	1- 8	23				Yes		Yes	3 / 3 / 3	6		Pit	Well	None
Logan Pass V.C.	10						No			0	3		Lagoons	Surface	None
Many Glacier Hotel	160			211	533		No		Yes	0	8	13	Lagoons	Well	Commercial
Polebridge Ranger Station	10						No			5 / 5 / 8	7		Leach Field	Surface	Generators
Quartz Creek Campground	5	1- 7	20				Yes			0	1		Pit	Well	None
Rising Run Campground/Area	30	1- 83	240	72	240	1/ 5	No		Yes	1 / 1 / 1	7	27	Lagoons	Well	Commercial
Sherburne Entrance Station	2						No		Yes	2 / 2 / 2	3		Leach Field	Surface	Commercial
Sperry Chalet	10			20	42		No		Yes	0	4		Compo/Leach	Surface	None
St. Mary Headquarters	77						Yes		Yes	24 / 36 / 72	15		Lagoons	Well	Commercial
St. Mary Campground	0	1-156	252				Yes			0	10		Lagoons	Well	Commercial
Swiftcurrent Campground/Area	30	1-110	319	88	237	1/ 15	No		2-Yes	13 / 25 / 35	15	53	Lagoons	Well	Commercial
Two Medicine Campground/Area	50	1- 99	287			1/ 25	No	Yes		2 / 3 / 3	18	5	Leach Field	Well	Commercial
Walton Ranger Station	5					1/ 5	No		Yes	2 / 2 / 2	5		Leach Field	Well	Commercial
Roads - 250 Miles	1,212						No			0					
Trails - 732 Miles	443									0					
Backcountry Campground	31	62-221	640							8 / 8 / 13	34		Pit	None	
Approx. 100 - Inholdings	419											120+	Leach Field	Surface/Well	
Kishenehn R.S.	5						No		Yes		5		Pit	None	None
East Glacier R.S.	0						No		Yes	5 / 6 / 8	9		Lagoons	Surface	Commercial
Sun Point	8					1/ 7	No						Vaults	None	None
Goat Lick	5						No						Vaults	None	None
TOTALS	**2,867**	**13-1,027**	**3,614**	**587**	**1,740**	**10/173**			**18**	**135/182/271**	**313**	**270**			
		75-1,248								**718**					

Revised 9/1/95 WRN
5/98 DSC

compensable ownership interest (possessory interest) in several of the buildings and full ownership of the Stewart Motel.

Sperry Chalet. Sperry Chalet will offer lodging and meals in a setting that is only accessible by foot or horse when it reopens after renovation in 1999. The chalet can host up to 42 guests per night and has employee housing for 11.

Granite Park Chalet. Also under separate concession, Granite Park Chalet offers overnight accommodations to hikers who bring their own food and bedding. No meals are provided. The chalet can host up to 38 guests per night and has housing for one or two employees. Plans for the chalet are pending funding and include renovation of the water and sewer system to allow for food service.

Two Medicine. The primary concessioner operates a campstore and snack bar in the Two Medicine Chalet. A separate concessioner operates a tour boat and small boat rentals and has housing for five employees.

Many Glacier Hotel Historic District. There are two distinct concession developments in the Many Glacier Valley, Many Glacier Hotel, and Swiftcurrent Motor Inn. Many Glacier Hotel was built between 1910 and 1915 by the Great Northern Railway and its subsidiary, the Glacier Park Hotel Company. The company constructed a series of hotels and backcountry chalets; the Many Glacier Hotel and the Glacier Park Hotel were the core structures. The Great Northern development in Glacier used one architectural theme in extensive backcountry development that encouraged the visitors to leave the luxury of the enormous hotels and experience the park. Louis Hill, president of the Great Northern Railway and responsible for much of the development in Glacier, chose a style that provided architectural unity and a sense of place for the entire region. The historic district has been identified, and the hotel has been designated as a national landmark.

The facilities at the Many Glacier Hotel typically operate from the first week in June through the first week in September. Occupancy rates range from 70 percent to more than 90 percent. The overall average occupancy rate is about 90 percent. The Many Glacier Hotel complex includes 211 guest rooms, a restaurant, a lounge, a gift shop, a small grocery, maintenance offices, an employee pub, and housing for 20 employees. Two dormitories provide housing for 159 employees. A separate concessioner operates a horse stable that provides trail rides. The corral and housing for approximately 12 employees are offsite. Another concessioner operates tour boats and small boat rentals and has housing for 6-8 employees.

Swiftcurrent Historic District. In 1933, under pressure from the National Park Service to construct economical accommodations for auto tourists, the Glacier Park Hotel Company began construction of the Swiftcurrent auto camp. The Swiftcurrent complex is about 3 miles west of the Many Glacier Hotel near Many Glacier Campground. The buildings are concentrated in an obscure wooded area away from the lakeshore and are screened from the mountains.

This complex includes 62 motel units, 26 cabins without baths, a restaurant, a campstore, public showers, laundry, and 18 units for approximately 51 employees. The Swiftcurrent auto camp shows the changes that were made in the infrastructure to respond to changing travel patterns and the increased mobility of the middle class. The district reflects an important change in the tenor and tone of devel-

opment in the national parks evidenced by the small scale of the developments and their siting away from the lakeshore and prominent vistas.

The Swiftcurrent Motor Inn operates from mid June-mid September. The cabins without baths are popular and occupancy rates range from 70-96 percent.

Rising Sun. Construction of the Rising Sun auto camp in 1941 marked the culmination of a construction program initiated at Swiftcurrent eight years earlier. The complex is just east of Rose Creek and just north of the Going-to-the-Sun Road on the east side. Modern additions include a large coffee shop and two motel units. Historic components of the district (a large general store, motel, two dormitories, a powerhouse, and 19 cabins) are concentrated in the scrub pine on a slight slope behind the modern development. These buildings were sited in an irregular pattern along the natural topographical lines of the wooded area and provide only occasional and incidental views of the mountains. The buildings are small and finished with rustic materials. The concentrated location and consistent use of the rustic style and paint colors lend coherence to the district.

This facility was the only Glacier concession that remained open throughout World War II. The Rising Sun auto camp historic district is listed on the National Register of Historic Places for significance in architecture and history. Like those at Swiftcurrent, Rising Sun facilities represent a major shift in NPS policy and concession development. The small-scale rustic design and the isolated random placement of the buildings exemplify a shift in NPS policy regarding the appropriate mass and placement of concession facilities.

The concession-operated Rising Sun Motor Inn complex includes 37 motel and 35 cabin rooms, a restaurant, a campstore, public showers, and housing for up to 53 employees. A separate concessioner operates a tour boat and small boat rentals on St. Mary Lake and also has housing in the Rising Sun developed area for six employees. These facilities typically operate from mid June-mid September. Occupancy rates for the location range from 50-97 percent.

Others. Commercial services that are not tied to a specific area include tours that use a fleet of historic 1920s-1930s red buses, a limited point-to-point shuttle service on the Going-to-the-Sun Road, interpretive motor tours giving a Blackfeet Indian perspective of the park, guided backpacking and day hiking services, guided cross-country ski tours, photography and art seminars, and guided bicycle tours.

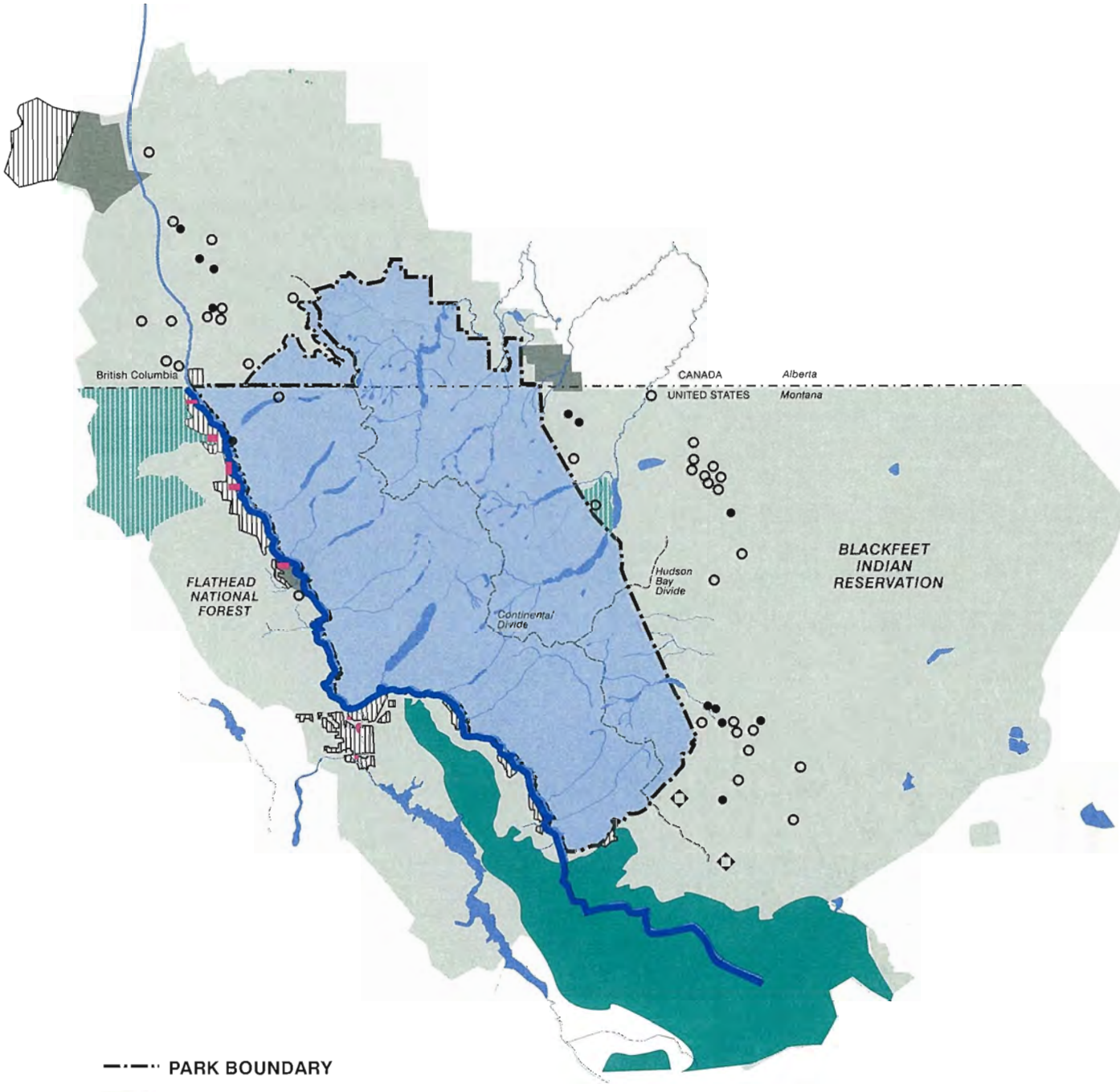
Socioeconomic Environment

PARK VISITATION AND USE

In 1911 (the first year statistics were kept) 4,000 visitors arrived in Glacier. Visitation gradually increased as the park's reputation spread. In 1933 when the Going-to-the-Sun Road opened, some 77,000 visitors were counted. Most facilities in the park closed during World War II; only a small caretaker staff remained. Even with gasoline rationing and the world in upheaval, over 23,000 visitors came to the park in 1943. In 1946 the war was over and more than 200,000 visitors were counted. The highest recorded visitation, 2,204,131, was in 1983. Since then park visitation has exceeded 2 million only four times. In recent years visitation has ranged between 1.7–1.8 million. Visitation has been up and down over the years, but the overall trend is for increasing visitor numbers.

Visitors come to Glacier for a variety of reasons. A 1991 visitor survey found that 65 percent of those contacted came to view scenery and wildlife, and 18 percent were looking for recreational opportunities such as hiking, fishing, and biking. Another 11 percent were just passing through on their way to another primary destination. Those surveyed said they were participating in a variety of activities during their stay. The most frequently mentioned activities by all respondents were sightseeing, photography, wildlife viewing, day hiking, stopping at visitor centers, camping, taking part in guided activities, and picnicking.

The 1991 survey found that most of the park's visitors were family groups (71 percent) or family and friends traveling together (17 percent); 9 percent were traveling alone. Of the visitors contacted, 84 percent were from the United States (13 percent from Montana), 12 percent from Canada, and 4 percent from other countries. Forty percent of all visitors reported that they would spend less than one day in the park, while 33 percent would stay 1–3 days and 27 percent would stay 4 or more days.



PARK BOUNDARY

VARIOUS USES
(Timber, grazing, harvest, oil & gas,recreational)

PARK

WILDERNESS

WILD & SCENIC RIVER

RESOURCE PROTECTED
(In accordance with established plans)

GRAZING

PRIVATE - CONSERVATION EASEMENT

PRIVATE

PLUGGED WELL SITE

OPEN WELL SITE

APPLICATION TO DRILL (USFS)

North Map not to scale

ADJACENT LAND USES

GLACIER NATIONAL PARK

United States Department of the Interior
National Park Service
DSC • FEB 99 • 117 • 20,036A

The majority of park visitors enter through West Glacier. Approximately 60 percent of all Glacier visitors first experience thepark from the foot of Lake McDonald. Approximately 30 percent enter at St. Mary, and the rest are evenly divided among Many Glacier, Two Medicine, and Polebridge.

Glacier has 735 miles of maintained trails that provide a variety of experiences for hikers and horseback riders of all skill levels. Day hiking was identified as a popular activity. A study to determine trail use by day hikers was conducted in 1988 (McCool, Brathwaite, and Kendall 1988). Most of the park's trails (with the exception of the Trail of the Cedars and the Hidden Lake Trail) were surveyed. The surveys of hikers and nonconcession stock users indicated that about 180,000 visitors took day trips. Adjustments for concession stock use, the Hidden Lake trail, and late season use brought the total to approximately 200,000.

Backcountry camping also attracts park users. Glacier's extensive trail system links approximately 60 backcountry campgrounds. A permit system regulates use and ensures that users are well informed concerning trail conditions, bear sightings, and the "leave no trace" backcountry skills. Registration also provides exact use figures. In 1996 approximately 5,000 permits were issued for a total of 27,806 camper nights.

There are 13 auto campgrounds containing over 1,000 sites. In 1997 approximately 200,000 visitors used frontcountry campgrounds.

In FY97 approximately 700,000 visitors were contacted by ranger naturalists at a visitor center while another 136,000 took a ranger-led hike or attended an evening campfire talk. The Internet made the mountain scenery and wildlife available by computer to more than 121,000 cybervisitors.

PRIVATELY OWNED LAND

There are 418.68 acres of privately held land in the park. The land is undeveloped or used for residential, recreational, or commercial purposes. Most tracts are small, but a few are over 50 acres. Most of the residential use and all of the commercial use occurs during the summer. Most of the private land is in the Going-to-the-Sun Road area in Apgar Village or on Lake McDonald. There is also privately held land in the North Fork area.

REGIONAL USE AND ECONOMY

Glacier National Park lies within a day's drive of several world class areas with natural, cultural, and recreational opportunities. Yellowstone and Grand Teton National Parks to the south and the Banff, Jasper, Yoho, and Kootenay National Parks to the north encompass some of the most spectacular wild country in North America. Head-Smashed-In Buffalo Jump and Frank Slide Interpretive Center in Alberta, Canada, and Grant-Kohrs Ranch in Montana interpret portions of the region's cultural history.

The Forest Service manages 51 percent of the land in Flathead County. Glacier National Park manages 19 percent. Only 18 percent of the land base is privately

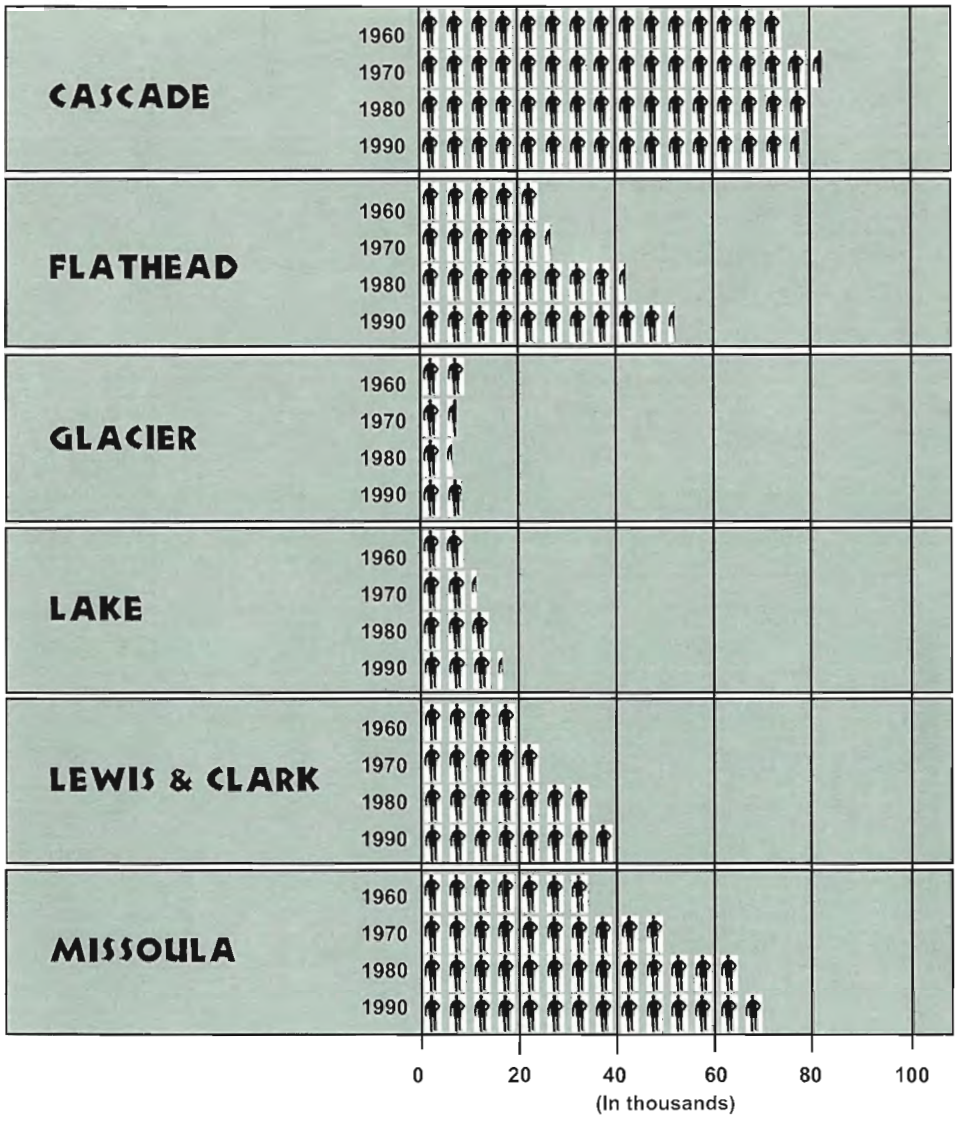


Figure 1. Population growth of regional counties

owned. Figures on landownership are not readily available for Glacier County, but most land is held by the Blackfeet or is privately owned. The Blackfeet reservation encompasses approximately 1.5 million acres. Hunting, fishing, and other recreational opportunities are controlled by the Blackfeet nation but are available to non-Indians for a fee.

Flathead Lake, the largest natural freshwater lake in the western United States, is another recreational focus in the region. It is unknown how many visitors are coming to the area primarily to vacation on Flathead Lake, but the number is probably significant.

Winter use of the Glacier region is much lower than summer use. Park visitation is approximately 75 percent local during the winter. Many of the out-of-state visitors who arrive in Glacier during the winter are in the area to ski at Big Mountain Ski Resort. Winter visitation in the Flathead Valley is almost solely for ski vacations. Big Mountain is the winter tourism anchor for the region.

Tourism is a significant part of the Montana economy, and it has experienced a dramatic increase in the region. Tourism has grown steadily during the last several years. Regional growth in tourism and service jobs reflects a national and local trend.

Tourism has dramatically increased as this region has become one of Montana's premier tourism destinations. The growth in tourism has been spawned by a number of factors, such as increased state and regional promotion, expanding interest in environmentally related recreation and western or American Indian culture, and enhanced local capacity for providing more recreational opportunities. Tourism is a cross-sectorial industry. Unfortunately, no specific figures estimating the number of nonresidents or their expenditures are available on a county basis. Maiorano (1995) identified a variety of nonresident visitor segments based on travel patterns in Montana. The analysis suggested that about 20 percent of all nonresident visitor groups in the state traveled through the Flathead-Glacier area, and about 50 percent visit the park. These figures translate to roughly 750,000 people, assuming 7.7 million nonresidents visiting Montana in 1993-94.

The trend in tourism can be estimated by examining visits to the park, traffic counts on U.S. Highway 2, and lodging tax revenue. All three show steady growth from 1980 to about 1994. Accommodations tax revenue for the summer quarter (July, August, and September), when about 70-73 percent of the annual visits to the park are made, shows continuous and dramatic increases from 1987, when the tax was first implemented, to 1993 or 1994, depending on the county. While this is not a direct indicator of the economic significance of the park, it does show the rise in travel to northwestern Montana.

For confidentiality reasons, data for metals processing (a potentially large sector of Flathead County's economy) cannot be displayed. The Bureau of Business and Economic Research at the University of Montana estimates that it represents about 12 percent of basic industries in the county (Polzin 1996). This figure is not comparable to personal income because it excludes a wide variety of sources of income from nonbasic industries. Personal income from lodging for Glacier County is not available for confidentiality reasons.

Accommodations tax revenue is a function of the number of room nights sold and average room rate. Some of the increased revenue is due to rises in the average room rate rather than increased tourism. Reliable statistics on regional room rates over this period are not available.

Annual and summer visitation to the park also show an increase for the period ending in 1994. The increase is substantial (about 30 percent), although not as high as accommodations tax revenue. Part of the increase may be due to changes in visitor patterns, and some may be due to changes in the methodology for calculating the number of visits. The 1995 yearly figure, down about 14 percent from 1994, reflects construction on the Going-to-the-Sun Road, its temporary closure in June, and probable reductions in Canadian visits.

Traffic on Highway 2 (as measured by a permanent traffic counter just west of Kalispell) has increased dramatically. This figure compares only the 1980 and 1995 figures and the data is displayed on a monthly basis. It shows, however, that traffic volumes have increased 2-3 times over the comparable 1980 figures. While some of this may be due to population growth, a portion of the increase relates to growth in recreational travel in the region.

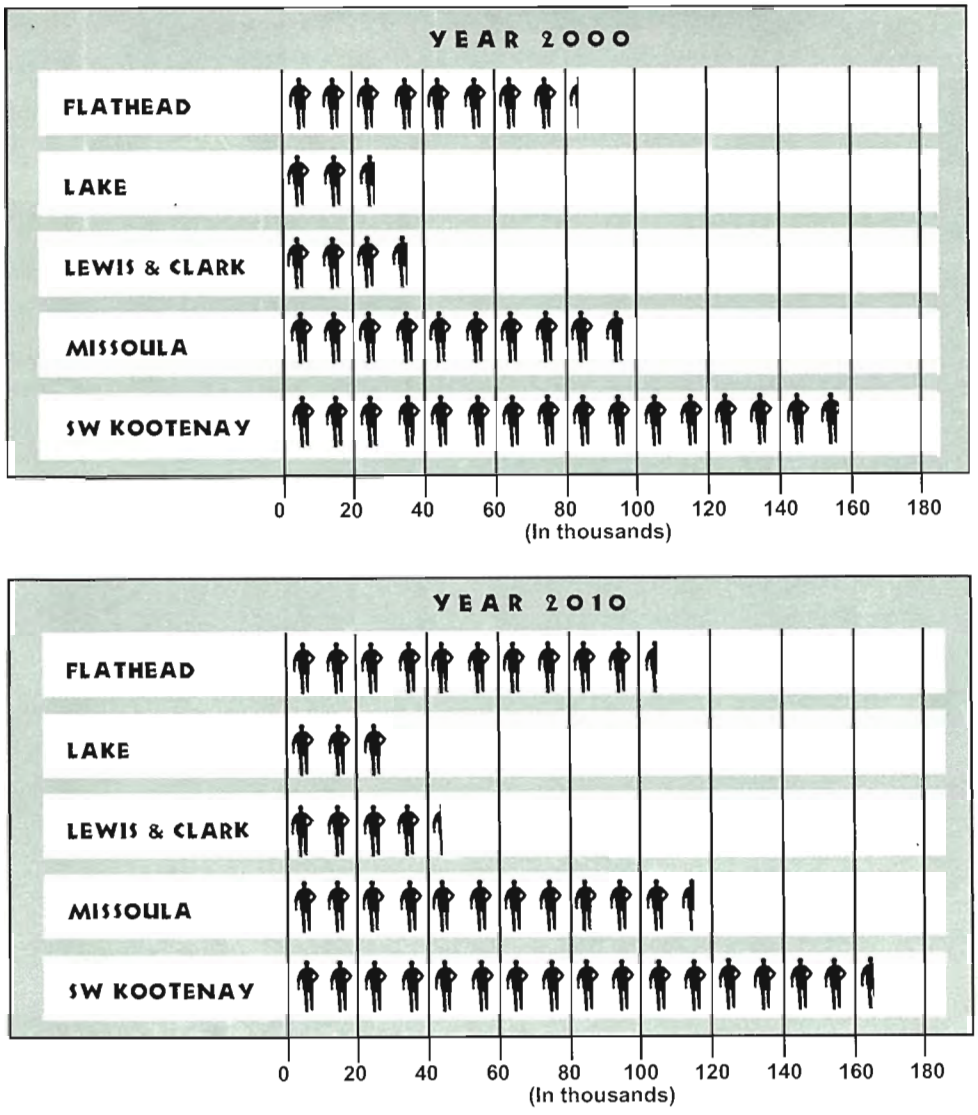


Figure 2. Expected Growth by the Year 2010

= 10,000 PEOPLE

U.S. Data adapted from McCool and Haynes.

Glacier National Park exists within the context of a changing economy, one increasingly dependent on the outstanding amenities in the region, including the park. While the tourism industry may be diversifying in the sense that a wider variety of recreational opportunities exist in the region than before, the park remains one of the principal cornerstones of the regional and state tourism economies. At the same time, Glacier represents the type of amenity that business and industry find increasingly attractive as a reason for locating in the region. For these firms, it is difficult to estimate the importance of the park and access to it. Businesses locating in the region for amenities may be as dependent on the park as firms more directly linked to the tourism industry, and the park has amenities that are important to individuals deciding to retire in the area. These factors together suggest greater interest in the management of the park as well as demand for recreational opportunities.

Tourism in Montana generates $1.2 billion annually and directly employs 32,000 workers. Tourism, the service industry, and transfer payments (money that is paid to employees in Montana, but earned elsewhere, such as social security and pensions) comprise the only growing areas of the region's economy.

Figure 3. Yearly and Summer Visitation at Glacier National Park

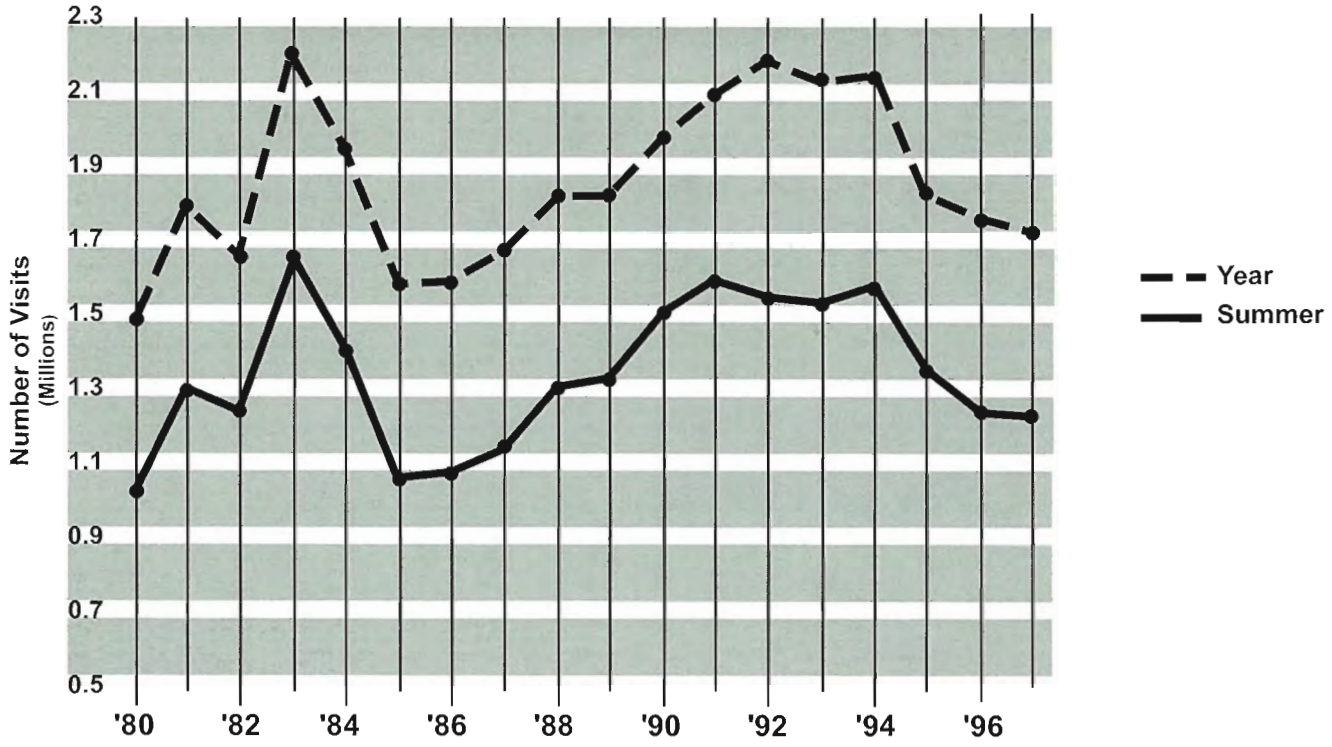
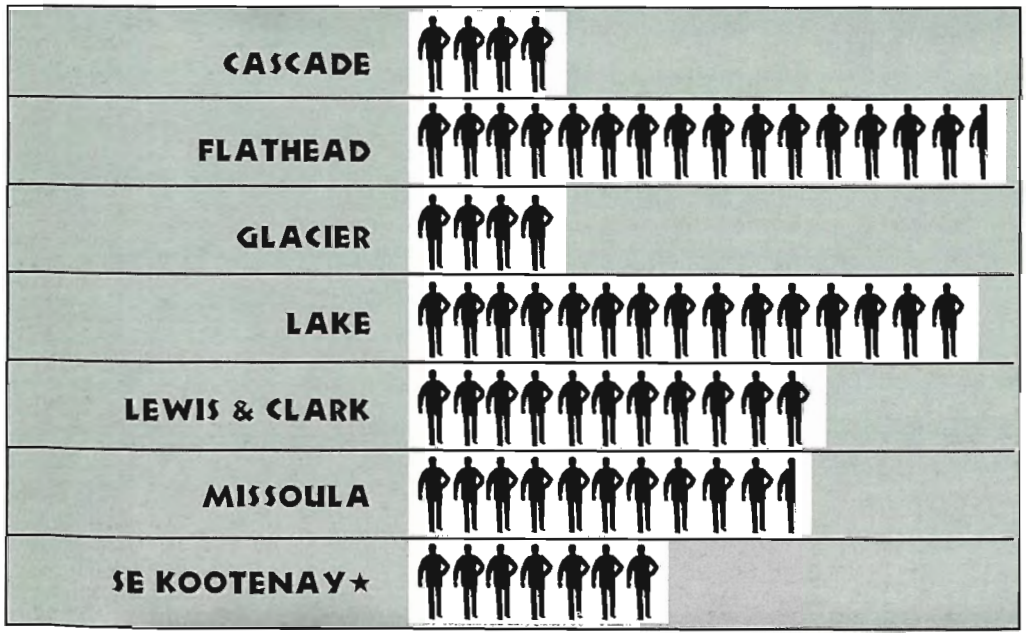


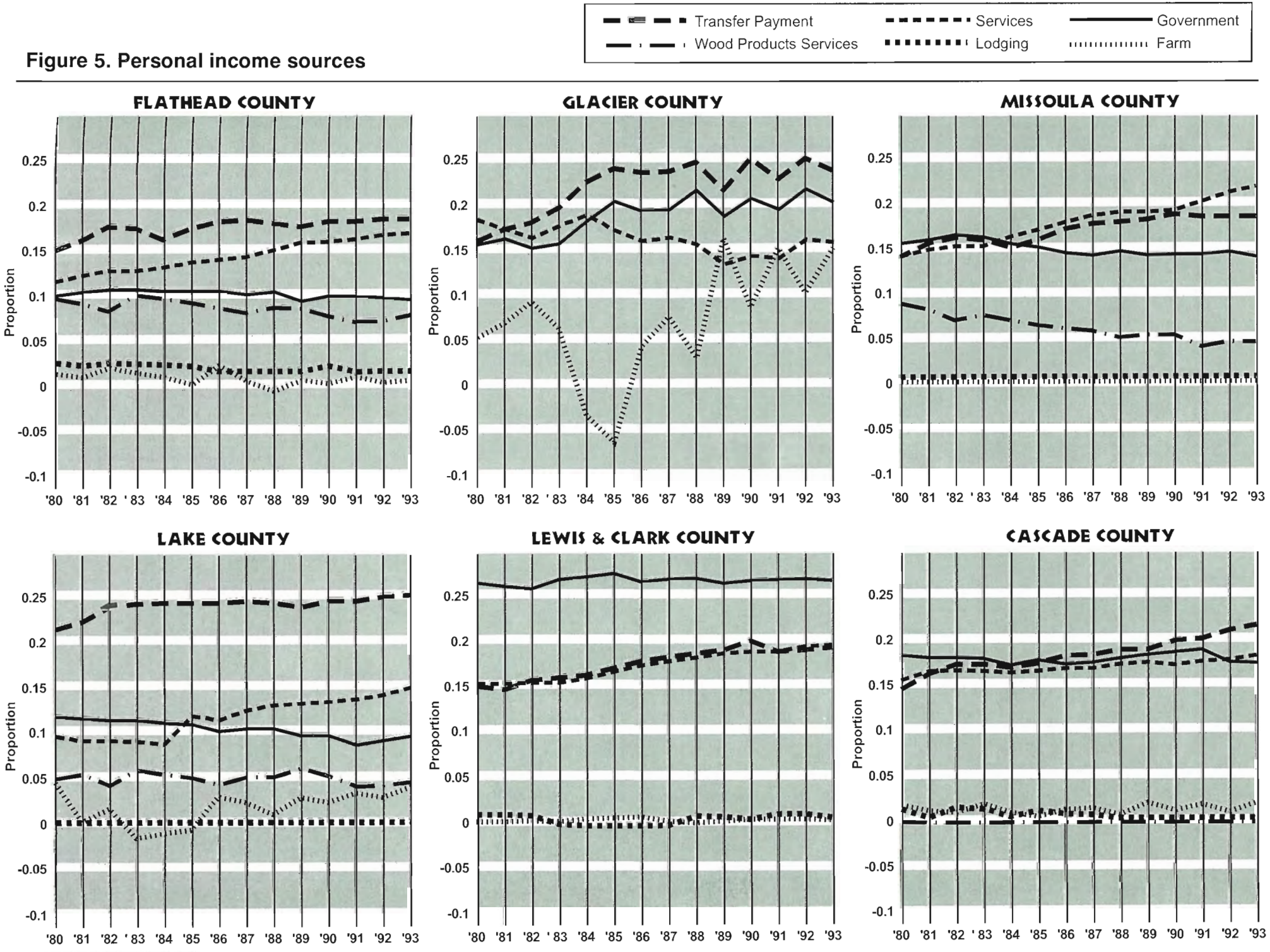
Figure 4. Rapid population change between 1990-95 of local areas



= 1 PERCENT CHANGE

★ POPULATION DATA FOR 1990-94

Figure 5. Personal income sources



In western Montana incomes are relatively low, and people live in rural or remote locations. Montana incomes are 82 percent of the national average. Regionally, Flathead and Missoula Counties have the highest per capita incomes and Glacier County has the lowest. Historically the wood products industry has been significant in Flathead and Missoula Counties, but the industry is on the decline. Farming is a significant source of income in Lake and Glacier Counties. Traditionally the northwest Montana economy has relied on timber and wood processing. Over the last 10 years, there has been a reduction in wood products processing, aluminum smelting, mining, and agriculture.

Over the last several years there has been considerable population growth on the west side of the Continental Divide. Growth has been slow on the east side of the mountains. A slow rate of growth is expected to continue in the region. If the predicted rate of growth continues, it is estimated that Flathead and Missoula Counties will each exceed 100,000 people by 2010. If population predictions materialize for Flathead County, 11,000 new housing units will be needed to accommodate growth. Increase of commercial and private traffic flow can be anticipated.

Population centers within a day's drive of Glacier include Great Falls, Bozeman, Billings, Missoula, and Kalispell, Montana. Other areas are Spokane, Washington; Calgary and Edmonton, Alberta; and Boise, Idaho. Continued population and economic growth in these areas would affect visitation to the park.