Chapter 3 Affected Environment

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INTRODUCTION

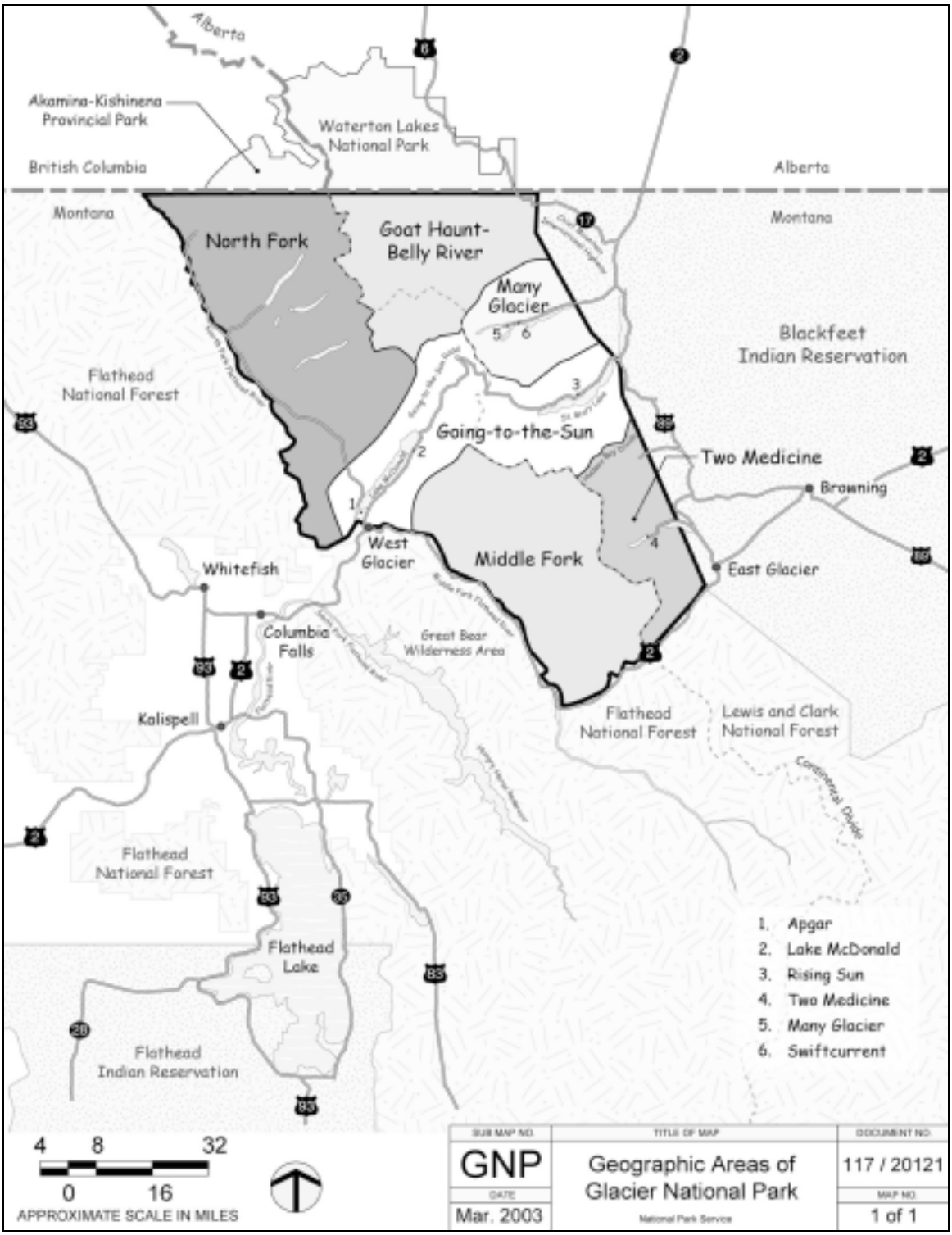
This chapter describes the existing environment that could be affected by implementing actions proposed by the alternatives. Natural, cultural and socioeconomic resources are discussed.

REGIONAL LOCATION AND SETTING

Glacier National Park is located in the state of Montana in the Rocky Mountains and 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 Continental Divide bisects the park. The western entrance to the park is 33 miles from Kalispell on U.S. Highway 2, 20 miles from Columbia Falls and 27 miles from Whitefish. The east side of the park is near Browning, on the Blackfeet Indian Reservation, 32 miles from the St. Mary entrance. The Two Medicine area entrance is 12 miles from East Glacier. (See Chapter 1, Map 1-1. Vicinity of Glacier National Park.)

The park is at the apex, or triple divide, of three oceans: the Arctic, Atlantic and Pacific. It includes 1,013,572 acres of breathtaking mountain scenery. Its jagged peaks and crystalline lakes are remnants of extensive glaciation in the last ice age, and nearly 26 glaciers still remain in the park. The park is the relatively undisturbed core of a large ecosystem that supports a large variety of plants and animals.

It is surrounded mostly by publicly owned and Reservation land. Much of the land to the south and west of the park is in the Flathead National Forest. The southeast corner of the park borders a portion of the Lewis and Clark National Forest known as the Badger-Two Medicine area. The 1.5 million-acre Blackfeet Reservation is located along the park's eastern boundary. Waterton Lakes National Park, Alberta, is north and east of the Continental Divide, and land managed by the province of British Columbia is north and west of the Continental Divide. A small portion of land managed by the Province of Alberta borders the northeast corner of the park. Except for the Akamina-Kishinena Provincial Park, which is at the junction of Montana, Alberta and British Columbia, the British Columbian land that borders the park is managed for multiple uses or multiple uses with emphasis on special resource values.



MAP 3-1 GEOGRAPHIC AREAS OF GLACIER NATIONAL PARK

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 and the Burlington Northern-Santa Fe Railway follow the park's southern boundary.

Kalispell is the largest city in both the Glacier National Park area and northwestern Montana. It is approximately 33 miles southwest of the park's entrance at West Glacier on U.S. Highway 2.

The Rocky Mountains cover more than 1,500 square miles of the park. The Livingston Range to the west and the Lewis Range to the east extend from northwest to southeast through the park, with the Continental Divide following the crest of the Lewis Range. Elevation ranges from a low of 3,150 feet at the junction of the Middle and North Forks of the Flathead River to a high of 10,466 feet on Mt. Cleveland. The park has six peaks over 10,000 feet and 32 peaks over 9,100 feet.

National and state forest lands near the park have mountains with moderate to steep slopes and narrow valleys. Several peaks on national forest land near the park exceed 8,000 feet in elevation, and most of the vegetative cover is dense coniferous forest. Most of the Blackfeet Indian Reservation has gently sloping plains with deep stream channels. There are both coniferous forest and aspen parklands where the reservation and the park join. Waterton Lake and the broad Waterton Valley are the center of Waterton Lakes National Park, and the adjacent slopes are very steep. A large part of Waterton Lakes National Park is the convergence of prairie and mountain ecosystems.

Glacier-Waterton International Peace Park is part of the Crown of the Continent Ecosystem, which also includes the wilderness areas of British Columbia and Alberta adjacent to the park, portions of the Blackfeet Indian Reservation, the Bob Marshall-Great Bear-Scapegoat Wilderness complex and adjacent U.S. Forest Service (USFS) lands. The entire area is a large ecosystem of interconnected plant and wildlife populations. Some wildlife move seasonally throughout the ecosystem beyond the boundaries of the park. The park is one of the few places in the world where all the native predators existing at the time of the park's establishment and most of their historic prey continue to survive in the wild.

National and state forest lands in the region produce timber products and provide many outdoor recreational opportunities, including world-class hunting and fishing. The mountains bordering 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, tourism-oriented businesses and timber production. The Blackfeet Indian Reservation is used for grazing and other agricultural needs. Along the park boundary, tribal land is also managed for timber. The reservation has a few small oil and gas fields as well as ongoing mineral exploration. The Flathead Valley south of the park is an area that is dominated by agricultural production and small, rapidly growing communities. Flathead Lake in the northern portion of the Flathead Valley is the largest freshwater lake west of the Mississippi River and a very important recreational resource.

Diverse recreational opportunities and experiences are available in Glacier National Park. Visitors can drive the famous Going-to-the-Sun Road in their own vehicles. They can stay in the park's grand historic lodging facilities or choose from a variety of campgrounds and motor inns. Other activities, such as snowshoeing, cross-country skiing, horseback riding, canoeing, fishing, or commercial boat or vehicle tours are also available. Visitors can hike on approximately 747 miles of trails throughout the park, where primitive campsites are available.

NATURAL RESOURCES

WATER QUALITY


USNPS Photo

Water quality in Glacier National Park is considered to be very good. The water use classification for the streams in the park is A-1 (Montana Water Quality Act ARM 17.30.608). This classification is for high quality water suitable for drinking and culinary food processing following conventional treatment, as well as bathing, swimming, and recreation. It is also suitable for growth and propagation of salmonid fishes and aquatic life, waterfowl, furbearers, and agricultural and industrial water supplies (Montana Water Quality Act ARM 17.30.622).

Between 1984 and 1990, the National Park Service and the Flathead Lake Biological Station conducted a monitoring program to establish a baseline for water quality in the park (Ellis et al. 1990). Throughout the six geographic areas, five large frontcountry lakes near developed areas with development along the lakeshore and heavy use by park visitors were monitored. Also, eight backcountry lakes in remote alpine headwaters were monitored. The study included the chemical, physical and biological sampling of each lake. Lake McDonald, and St. Mary, Two Medicine, and Swiftcurrent Lakes were part of the study.

The Apgar Village and Lake McDonald developed areas are in the Lower McDonald Creek watershed. The Apgar Village developed area is at the foot of Lake McDonald, and the Lake McDonald developed area is on its northeast shore. The monitoring program determined that Lake McDonald has extremely good water quality with no measurable pollutants and few dissolved solids (Ellis et al. 1990). Since the lake is very low in nutrients and productivity because of low phosphorus, it would be extremely sensitive to phosphorus loading. The lake is also low in dissolved solids. A 1987-1988 water quality study of Lake McDonald detected increased fluorescence readings in specific areas along the lake's shoreline, indicating possible septic leachate entering the lake.

The Rising Sun developed area is on the northwest side of St. Mary Lake, in the St. Mary drainage. It is immediately adjacent to Rose Creek, which flows into the lake. The results of the monitoring program indicated that water quality in St. Mary Lake is extremely good, and no measurable pollutants were detected (Ellis et al. 1990). The lake, which contains few dissolved solids and is also very low in nutrients and productivity, would be sensitive to phosphorus loading.

The Two Medicine developed area is located near the foot of Two Medicine Lake. The monitoring program (Ellis et al. 1990) determined that the lake has extremely good water quality with no measurable pollutants. Two Medicine Lake contains few dissolved solids because of the low dissolution rates of the underlying bedrock. It has very little buffer capacity and is extremely sensitive to acidic deposition. It is very low in nutrients and productivity because of low phosphorus and would be extremely sensitive to phosphorous loading.

The Many Glacier and Swiftcurrent developed areas are located in the Swiftcurrent Creek drainage. The Many Glacier developed area is located on the east shore of Swiftcurrent Lake near its outlet. The Swiftcurrent developed area is located north of Swiftcurrent Creek, which flows into Swiftcurrent Lake. Results of the monitoring program (Ellis et al. 1990) indicated that water quality in Swiftcurrent Lake is extremely good. Swiftcurrent Lake contains few dissolved solids, is low in nutrients and productivity, and would be sensitive to phosphorus loading.

FLOODPLAINS

Floodplains form along the banks of mid-sized streams and larger rivers. They are low-lying areas where heavy water flows are caused by streams and rivers spilling over and flooding the land. This flooding usually occurs in early spring when the snow melts or when an unusually large amount of rainfall is concentrated locally in a few hours or days. Mountain rains that fall a number of miles away also can cause flooding, where water cascades down small mountain creeks and gathers at larger streams and rivers.

A contractor conducted floodplain literature reviews (Land & Water Consulting, Inc. 2002) for the six developed areas during the fall of 2001 to determine where floodplains are known to occur and to what extent they would occur in the six developed areas (Apgar Village, Lake McDonald, Rising Sun, Two Medicine, Many Glacier, and Swiftcurrent). All of these areas are adjacent to streams or lakes, and existing facilities may be located in the 100-year floodplain. The literature review determined that little credible information exists on floodplains in each of these areas. Floodplain surveys were conducted of the six developed areas in July 2002 by the National Park Service Water Resources Division (NPS 2002b). Much of the information below is from this most recent report.

Going-to-the-Sun Road Corridor Area

The Apgar Village developed area is bordered by Lake McDonald to the north and Lower McDonald Creek to the west. Lake McDonald is emptied by Lower McDonald Creek, which in turn empties into the Middle Fork of the Flathead River. The U.S. Department of Interior has included Lower McDonald Creek in the 100- and 500-year floodplains. The entire Apgar development area is outside the 100-year floodplain and may be within the 500-year floodplain.

The Lake McDonald developed area is on the west shore of Lake McDonald, and Snyder Creek flows through the development. Snyder Creek is a very dynamic stream in this area. Documentation from the U.S. Army Corps of Engineers indicates that the slope of Snyder Creek through the developed area averages 5 to 6%, which is a supercritical flow. This type of flow can move yards of rock and other debris, causing the relocation of the creek channel. If the historic Lower Snyder Creek bridge, located in the developed area, becomes clogged with debris, the floodwaters would extend over a very large area.

Snyder Creek drains an approximately 6.4-square-mile drainage area. The creek passes under three bridges in the subject reach, under the Going-to-the-Sun Highway, under an access road just upstream from the lodge, and under a pedestrian bridge just upstream from confluence with Lake McDonald. The reach from just upstream of the Going-to-the-Sun bridge down to just above the pedestrian bridge (including the access road bridge) was surveyed and simulated using a computer model. It was found that this bridge can pass up to about a 30-year flood (1,800 cfs) if the bridge opening is unobstructed by debris. The lower bridge can only pass up to about a 15-year flood (1,100 cfs). Should woody debris collect in the bridge openings, less capacity would be realized. Sediment deposits do not seem to be a large issue in this reach of Snyder Creek. Should the lower bridge become obstructed, the

likelihood of flooding in the developed area increases. The buildup on the left bank of Snyder Creek in the developed area is within the 100-year floodplain. The lodge is outside the floodplain as long as the lower bridge does not become blocked.

The Rising Sun developed area is located to the north of St. Mary Lake and the Going-to-the-Sun Road. Rose Creek flows through the developed area. Two areas have the potential for floodplains: a 100-year floodplain potentially occurs south of the Going-to-the-Sun Road where the road acts as a barrier. The second area is north of the road where Rose Creek flows through the developed area. This creek can be overloaded, and the flood boundaries are difficult to predict (NPS 2002b). The area where the General Store/Motel/Dormitory at Rising Sun is located is within a less-than-100-year floodplain. The Power House Dormitory is at immediate risk from flooding due to likely failure of the adjacent embankment during a large flood event. Flooding in the Rising Sun developed area could occur more frequently than previously thought.

Two Medicine Area

The Two Medicine developed area is located along the east shore of Two Medicine Lake with Appistoki Creek running through it. The National Park Service computed the 100-year interval flow rate using a model of Appistoki Creek, and several cross sections were surveyed across the creek to help determine potential risks to the present and proposed structures in the developed areas. Some evidence suggests that the area is subject to delta flooding.

Appistoki Creek drains an area of approximately 2.6 square miles and flows along the access road and near the historic Two Medicine General Store just before entering Two Medicine Lake. No gaging record is available for the creek. Inspection of the local U.S. Geological Survey quadrangle (Squaw Mountain, MT) indicates that as of the date of the map, 1995, Appistoki Creek followed a more southerly alignment, flowing to the south of the store. Presently, the creek flows under a bridge upstream of the store area and enters the lake north of the store. It appears that the channel has been realigned by excavation to its present alignment. The channel is unnaturally straight and has obviously been manipulated with heavy equipment in the past. Following a flooding episode in the past, the channel was intentionally realigned to be less threatening to the General Store/Boat House area downstream.

The Appistoki Creek bridge is capable of passing a 25-year flood before being overtopped. If the bridge is overtopped, it is assumed that flow would travel down the existing creek alignment and not threaten the historic store area or the ranger station. However, flood risk should still be considered a factor in this area. The newly (in geologic terms) constructed channel is not fully adjusted to its setting as evidenced by erosion and deposition processes that are present. It is likely that at some time during a large flood, the channel will try to reclaim its former alignment and could threaten the store area. The possibility of sediment and woody debris accumulation at and upstream of the bridges could cause more widespread flooding than predicted by our model, and failure of the bridge at lower flows than predicted. The source of sediment and wood is the active erosion of the channel that is occurring upstream as it attempts to establish characteristics consistent with its environment (NPS 2002b).

Many Glacier Area

The Many Glacier developed area is located on the east shore of Swiftcurrent Lake. The U.S. Geological Survey maintains a continuous gaging station at the lake's outlet. Flood-frequency analyses have identified 100- and 500-year flood flows. It is estimated that the Many Glacier Hotel lies within the 100-year floodplain of Swiftcurrent Lake.

The Swiftcurrent developed area consists of a campground, Restaurant/Store and parking lot, and various overnight accommodations. Two streams join in the area and flow into Swiftcurrent Lake immediately downstream of the developed area. The overnight facilities and the Restaurant/Store and parking lot are not at threat from the main river, but rather from Wilbur Creek upstream of the confluence. However, these facilities are located on high terraces and/or are behind large topographic features, which provide protection from all but extreme flood events. It appears that the motel area is out of the 500-year floodplain, and the store is out of the 100-year floodplain. Portions of the campground may be in the 100-year floodplain, but there are no surveys or modeling of the reach. The geomorphic floodplain of Swiftcurrent Creek is on the opposite bank from the campground and most, if not all floodwaters will occur on that side of the river during all but extremely large floods. National Park Service policy permits campgrounds in non-flash flood areas to be located in the 100-year floodplain, provided that warning and evacuation can be used to protect humans (NPS 2002b).

SOILS

The soils in Glacier National Park are characterized by a variety of parent materials, climates, topography, vegetation and ages. Land and Water Consulting completed a summary of their previous parkwide soil surveys in January 2001 (Dutton 2001). The report contains information about the general characteristics, distribution and management of park soils. Because a comprehensive description of all Glacier National Park soils is provided in the report, this section describes only soils for the Apgar Village, Lake McDonald, Rising Sun, Two Medicine, Many Glacier and Swiftcurrent developed areas. For additional soils information, refer to "Soils of Glacier National Park," prepared by Barry Dutton (2001), which is on file in the Glacier National Park library.

Table 3-1 lists management interpretations for the soils (USDA 1993a, 1993b, 1998).

Table 3-2 below lists soil mapping units and characteristics at the developed sites (Dutton 2001).

Most of the developed sites are dominated by deep soils with sandy textures and high rock contents. Some small areas at several sites are subject to flooding by streams or lakes, and some small areas have wet soils with seasonal or permanent shallow water tables. Except for the flooded parts of these sites, the soils (due to their sandy texture and high rock content) are well suited for many development activities, including foundations, roads and trails.

TABLE 3-1. SOIL MANAGEMENT INTERPRETATIONS BASED ON HIGH, MEDIUM OR LOW POTENTIAL

SOIL/PARENT MATERIAL	PRODUCTIVITY/ REVEGETATION	ROADS	TRAILS	WEED INVASION	EROSION	WASTE DISPOSAL
ALLUVIAL SOILS						
Floodplain Soils	L	L	L	H	M	L
Alluvial Grassland Soils	M-H	H	H	H	M	M
Alluvial Forest Soils	M-H	H	H	H	M	M
Sandy/Cobbly Alluvial Forest Soils	M-H	H	H	H	H	M
Beach Soils	L-M	H	H	M	M	L
WET SOILS						
Wet Soils	H	L	L	M	L	L
GLACIAL SOILS						
Glacial Till Soils-Loam	M-H	M	M	M	H	H
BEDROCK SOILS–QUARTZITE & ARGILLITE						
Deep QA Colluvial Forest Soils	M	L	L	M	H	M
Colluvial Grassland Soils	M	H	H	H	M	M
Limestone Rock	L	L	L	L	L	L
Shallow Limestone Soils	L	L	L	L	M	L

L=low M=medium H=high

TABLE 3-2. SOIL MAP UNITS AND CHARACTERISTICS AT THE SIX DEVELOPED SITES

UNIT NAME	LOCATION	SOIL COMPONENTS	CLASSIFICATION OF MAJOR SOILS
ALLUVIAL SOILS			
FLOODED SOILS	Floodplains and low terraces	Well to poorly drained sandy and gravelly soils formed in alluvium from mixed rock sources.	Cryofluvents, Cryaquents
ROCKY/SANDY ALLUVIAL GRASSLAND SOILS	Alluvial fans, high stream terraces and glacial outwash terraces	Well-drained sandy and gravelly soils formed in alluvium from mixed rock sources.	loamy-skeletal, mixed Typic Haplocryolls
ROCKY/SANDY ALLUVIAL FOREST SOILS	Alluvial fans, high stream terraces and glacial outwash terraces	Well-drained sandy and gravelly soils formed in alluvium from mixed rock sources.	loamy-skeletal, mixed Typic Dystocryepts, sandy-skeletal Typic Dystocryepts
MIXED ALLUVIAL FOREST SOILS	Alluvial fans, high stream terraces and glacial outwash terraces	Well-drained sandy and gravelly soils formed in alluvium from mixed rock sources. Some profiles have rock-free sandy surface layers.	loamy-skeletal, mixed Typic Dystocryepts, sandy-skeletal Typic Dystocryepts
LAKESIDE BEACH SOILS	Along shores of the larger lakes	Well-drained sandy and gravelly soils formed in beach deposits of uniform-size gravel.	Typic Cryorthents, Typic Dystrocryepts
WET SOILS			
WET SOILS	Potholes, floodplains, lake margins, seeps	Somewhat poorly to very poorly drained mineral soils.	Cryaquolls, Cryaquepts
GLACIAL, LANDSLIDE AND MIXED SOILS			
SANDY GLACIAL TILL SOILS	Ground moraines with silty clay	Well-drained soils with silt loam or loam surface layers high in volcanic ash over sandy loam glacial drift subsoils.	loamy-skeletal, mixed Typic Haplocryepts
BEDROCK SOILS - QUARTZITE AND ARGILLITE			
DEEP AND MODERATELY DEEP COLLUVIAL FOREST SOILS	Cirque basins and lower glaciated trough walls	A complex of deep and moderately deep, well-drained soils with loam or silt loam surface layers high in volcanic ash and very gravelly to extremely gravelly loam or sandy loam subsoils.	loamy-skeletal, mixed Typic Haplocryepts and Dystrocryepts
BEDROCK SOILS - LIMESTONE			
ROCK OUTCROP AND SHALLOW SOILS ON LIMESTONE	Mountain tops, ridges and upper slopes	A complex of rock outcrop and shallow, well-drained soils with very to extremely gravelly loam or sandy loam textures throughout.	mixed Lithic Eutocryepts

Going-to-the-Sun Road Corridor

The McDonald Valley bottom on the west side of the Going-to-the-Sun Road corridor is mainly silty clay loam, glacial forest soil. The far west end of the corridor contains several soil types, including mixed glacial forest soils, deep colluvial forest soils, sandy over gravelly alluvial soils and small areas of rock outcrops. As the elevation rises in the middle section of the Going-to-the-Sun Road corridor, soils are mostly bedrock, including rock outcrops and talus, and colluvial forest soils.

The Apgar developed area is mainly beach soils by the lake, with small sections of flooded soils along Lower McDonald Creek and small sections of sandy over cobbly alluvial soils in the southern part of the area (Dutton 2001, Nimlos 1979). The lakeside beach soils are mainly sandy soil textured and usually contain over 70% uniform-sized gravels. These soils were originally deposited as alluvium,

then reworked by wave action along the Lake McDonald shoreline. They show little profile development and are very porous. They have very low water and nutrient-holding capacities and low to moderate productivity. These soils are rated high for roads and trails due to their sandy texture and high rock content. They are rated moderate for weed invasion and erosion potential. Waste disposal is rated low on these soils since they are too porous to provide adequate treatment and wastes move rapidly through them to the surface or groundwater. Portions of these soils have flooded in the past during very high lake levels caused by unusual runoffs.

The flooded soils along Lower McDonald Creek have also mainly sandy textures and high rock content. They are flooded on a regular basis with soil material either eroded or deposited during each event. They also show little profile development, are very porous, and have very low water and nutrient holding capacities and low productivity. These soils are rated low for roads and trails due to flooding. They are rated high for potential weed invasion due to regular disturbance by floods that cause bare soil readily invaded by weeds. Erosion potential is moderate for these soils. Waste disposal is rated low due to flooding, shallow groundwater and sandy, porous textures.

The sandy over cobbly alluvial soils are mainly sandy textured and have high rock content in the lower layers. They have a surface layer of sandy loam, loam, or silt loam with few rocks (Dutton 1989). The lower layers were deposited by stream action, but the upper layer was deposited in a larger Lake McDonald near the end of the ice age. These soils are rated as moderate to high for productivity due to the high nutrient and water-holding capacity of the surface soil. They are rated high for roads and trails due to their sandy and rocky subsoil. They are rated high for weed invasion because of their climate and sandy subsoil texture. Although these soils are rated high for potential erosion, they are protected from erosion by a layer of partially decomposed plant litter. They are rated moderate for waste disposal due to porous subsoil that provides limited treatment.

The Lake McDonald Lodge developed area is dominated by rocky and sandy alluvial forest soils with small sections of flooded soils along Snyder Creek. The entire site is on an alluvial fan of Snyder Creek. These alluvial forest soils have a surface layer of loam or sandy loam with sandy textures below. The soil is rocky throughout and rock content increases with depth. Except for the flooded parts of this site, the soils are well suited for many development activities, such as foundations, roads and trails because of their sandy texture and high rock content. They are rated moderate to high for productivity and high for roads and trails. They are also rated high for potential weed invasion because of their sandy texture. Erosion potential is rated moderate, but the soils are protected from erosion by a layer of partially decomposed plant litter. Waste disposal is rated moderate due to porous subsoil, which may not provide adequate treatment and may allow wastes to move rapidly to surface or groundwater.

The St. Mary River Valley to St. Mary Lake is dominated by mixed glacial forest soils. The higher elevations on the east side of the Going-to-the-Sun Road corridor are mainly rock outcrops, shallow soils, colluvial soils and ice-patterned soils with mixed glacial and colluvial soils in the valleys. The St. Mary Valley floor is mainly mixed conifer and aspen forest soils, and contains small areas of rocky and sandy alluvial forest and grassland soils scattered along the lake.

The Rising Sun developed area is situated on an alluvial fan of Rose Creek. The major soils in the area are rocky and sandy alluvial grassland soils. In addition, small sections of flooded soils are present along Rose Creek. These alluvial grassland soils have a dark surface layer with a loam or sandy loam texture and a sandy texture below. The soil is rocky throughout and rock content increases with depth. Sand content decreases and clay content increases on the eastern border of this site. The rocky and sandy alluvial grassland soils are well suited for many development activities due to a high subsoil

rock content and good drainage. The productivity and revegetation potentials for these soils are moderate to high overall, but decreasing in the subsoil due to higher rock content and lower water and nutrient holding capacity. The soil is highly susceptible to weed invasion because of its sandy texture, grassland climate and frequent disturbance by burrowing animals. Erosion potential is rated moderate on these soils. Waste disposal is moderate because the subsoils have rapid permeability and provide poor wastewater filtration.

Two Medicine Area

Soils in the Two Medicine area vary throughout. The area is mainly rock outcrops, shallow soils and talus at higher elevations and mixed glacial and colluvial soils toward the valleys. The entire east side of the area is dominated by mixed conifer and aspen forest soils intermixed with small areas of deep, rocky colluvial and landslide soils as well as clay-rich grassland soils.

The Two Medicine developed area has mostly rocky and sandy alluvial forest soils with small areas of flooded soils along Appistoki Creek. The entire site is on the edge of an alluvial fan deposited by Appistoki Creek. The soils at this site are marginally similar to the rocky and sandy grassland soils, but mostly are similar to the rocky and sandy alluvial forest soils. These alluvial forest soils have a surface layer of loam or sandy loam with sandy textures below. The soil is rocky throughout and rock content increases with depth. Except for the flooded portions of this site, the soils are well suited for many development activities, such as foundations, roads and trails because of their sandy texture and high rock content. They are rated moderate to high for productivity and high for roads and trails. They are rated high for potential weed invasion due to their sandy texture. Erosion potential of these soils is rated moderate, but they are protected from erosion by a layer of partially decomposed plant litter. Waste disposal is rated moderate due to porous subsoil, which may not provide adequate treatment and may allow wastes to move rapidly to surface or groundwater.

Many Glacier

Changing glaciation in the Many Glacier Valley has created diverse soil types in the area. Rock outcrops and shallow soils dominate the area along the Continental Divide and a small section in the northeast. Rock outcrops, shallow soils and ice-patterned soils, as well as mixed glacial and colluvial soils dominate the high to middle elevations away from the Continental Divide. The valley floor is mainly mixed conifer and aspen forest soils with small pockets of deep, rocky colluvial and landslide soils and clay-rich grassland soils.

The Many Glacier developed area is mainly limestone rock outcrop and shallow limestone soils (LC1/LC4). The rock outcrop (LC1) is limestone of the altyn formation (Whipple 1992). The shallow limestone soils (LC2) have loam or sandy loam surfaces with high rock content. There is fractured bedrock at 1 to 2 feet, but small sections occur where the soil is deeper. Productivity is low. The shallow bedrock restricts most uses — road and trail construction is rated low due to the difficulty of excavating level surfaces. However, trails function well if deep excavation is not required. Foundations may require blasting, but are stable if built in bedrock. Dry site conditions make the potential weed invasion high. The erosion potential is moderate. Waste disposal is rated low on this soil due to the shallow bedrock.

There is a different soil profile at the northwest and southwest corners of the site, which have deeper soils with less severe soil management limitations. These deep glacial soils have moderate to high productivity, moderate road and trail potential and moderate potential weed invasion. Erosion potential is high due to the loam or silt loam surface texture, but there is protection from erosion by a layer of

partially decomposed plant litter. Waste disposal potential is high since the soils are deep, well drained, not flooded and have moderate permeabilities.

Soils at the Swiftcurrent area are a complex of glacial and bedrock soils along with alluvial, wet and other soils (Dutton 2001). However, the Swiftcurrent developed area is actually mainly rocky and sandy alluvial forest soils (Dutton 1989). The site occupies an alluvial terrace of Swiftcurrent Creek. The soils have a surface layer of loam or sandy loam with sandy textures below. The soil is rocky throughout and rock content increases with depth. Due to their sandy texture and high rock content, these soils are well suited for many development activities, including foundations, roads and trails. They are rated moderate to high for productivity and high for roads and trails. They are rated high for potential weed invasion due to their sandy texture. Erosion potential is rated moderate, but these soils are protected from erosion by a layer of partially decomposed plant litter. Waste disposal is rated moderate due to porous subsoil, which may not provide adequate treatment and may allow wastes to move rapidly to surface or groundwater.

Goat Haunt-Belly River

There are diverse soil types in the Goat Haunt-Belly River area. Rock outcrops, talus and deep colluvial forest soils dominate the soils along the Continental Divide, the ridges of the Livingston Range, and ridges of the Lewis Range in the area. Bands in the middle elevation throughout the area are mainly rock outcrops, shallow soils, talus and deep colluvial forest soils. The southwest part of the area is mainly colluvial soil, and shallow and alpine meadow soil. Valley bottoms in the area are generally mixed glacial and colluvial soils. The Goat Haunt Valley is mainly mixed glacial forest soils, and the Belly River Valley is dominated by mixed conifer and aspen forest soils and deep, rocky colluvial and landslide soils.

Middle Fork

The Middle Fork area contains a mosaic of soil types. The higher elevations are dominated by bedrock soils, mostly rock outcrops, shallow soils, talus and colluvial soils. The valley bottoms are composed predominantly of mixed glacial and colluvial soils and loamy glacial forest soils with a portion in the northwest dominated by silty clay loam glacial forest soils and small areas on the west side with mixed alluvial forest soils.

VEGETATION

The vegetation of Glacier National Park falls into four broad geographic patterns: arctic-alpine, northern coniferous forest (boreal), western montane (cordilleran) and Great Plains (Lesica 2002). In the northern Rockies, the Continental Divide is the boundary between the semi-arid continental climate of the Great Plains and the temperate maritime climate of the northern Rocky Mountains to the west. Glacier National Park is located along the main chain of the Rocky Mountains in the middle of the western montane region and just southwest of the northern coniferous region, and the park's vegetation is dominated by species typical of those regions. Western montane species are found at all elevations in all habitats, while northern coniferous species are in forests and wetlands, and arctic-alpine plants occur mainly above treeline. There are only a few Great Plains species along the east edge of the park where the sharp rise of

the mountains brings more precipitation. The meeting of the four regions causes many species to be at the limits of their distribution in the park.

The park supports over 1,100 species of vascular plants (Lesica 2002) and at least 870 non-vascular plants (DeBolt and McCune 1993, Hermann 1969, Elliott 1987). Large-scale climatic influences and the variety of environmental conditions in the park promote vegetation diversity. In addition, local climate that changes with elevation and proximity to mountain ridges or large bodies of water affects vegetation. The steep, variable terrain, ranging from approximately 3,200 to 10,500 feet, has clear contrasts in temperature and precipitation over relatively short distances. Fire, glaciation and other geologic processes have also influenced the distribution of vegetation and led to the isolation of some species.

Types of vegetative land cover 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 areas (334,943 acres); coniferous forest and open dry areas (160,744 acres); and barren rock, snow and ice (298,357 acres).

Major types of vegetation community are grasslands (dry herbaceous), pine or woodland savannahs (open, dry coniferous and deciduous), bottomland forests (mesic herbaceous and deciduous), ponderosa pine/Douglas fir (*Pinus ponderosa/Pseudotsuga menziesii*) forests (open, dry coniferous), western redcedar/western hemlock (*Thuja plicata/Tsuga heterophylla*) forests (dense, mesic coniferous), spruce/fir forests (dense, mesic coniferous land cover) and alpine communities (mesic herbaceous and barren). Other communities include marshes, swamps and lakes, and barren, rocky talus slopes (Habeck 1970). Although these latter habitats cover only a small area in the park, they are an important component of the park's diversity and contain many species of special concern.

The vegetation of Glacier National Park also includes nearly 130 species of exotic plants (Lesica 2002), or 10% of the park’s flora, that have been intentionally or inadvertently introduced. A number of these species are increasing in area and density. They are consequently threatening the perpetuation of native plant communities and impacting habitat for wildlife in the park. Exotic plants are also spreading into backcountry areas, affecting the park's pristine quality and consequently the enjoyment of wildlife and recreation. Exotics occur in disturbed areas, such as roadsides, construction projects, old homesteads, grazed fields, trails, burns, floodplains and utility sites. Spread occurs when visitors, construction equipment, animals, wind and water transport seeds.

Maintained lawns and flower gardens in developed areas in the park have also been a source of non-native species. While the park encourages the use of native plants in gardens and landscaping, many ornamentals were introduced in the past. Some non-native annuals and perennials are still used in certain concession areas and other cultivated areas.

Going-to-the-Sun Road Corridor

On the west side of the Going-to-the-Sun Road corridor, the vegetation in the Lower McDonald Valley is dominated by several successional stages of the moist western redcedar-western hemlock forest type. McDonald Valley is the easternmost location with this forest type, indicating a Pacific maritime climate influence. Since redcedar and hemlock do not establish quickly in recently opened stands, areas that have had more recent fires are comprised mostly of pioneering species, such as lodgepole pine, western larch, aspen, paper birch and black cottonwood. As the forests mature, Douglas fir, western larch, Engelmann spruce and western white pine begin to dominate the overstory

in different proportions. Western hemlock and western redcedar mostly grow in late seral and old growth stands that are often centuries old. Subalpine fir grow in several successional stages, while scattered grand fir grow only in later-seral forests. Common understory species in these forest types include huckleberry, spiraea, snowberry, twinflower, beargrass, mountain lover, round-leaved violet, heartleaf arnica, pinegrass, prince's-pine and queencup beadlily. While most of these forest communities are the western redcedar/queencup beadlily habitat type, several sections are in the more rare western redcedar/devil's club and western hemlock/queencup beadlily habitat types. These habitats are the result of the topography, elevation, slope and climate around Lake McDonald. There are also scattered Douglas fir habitat types in this area.

Also in the McDonald Valley, riparian vegetation dominates bottomland areas along lakes, rivers and streams. Western redcedar, Engelmann spruce and white spruce are often found with black cottonwood. Understory species include red-osier dogwood, willow, alder, mountain maple, chokecherry, horsetail, false starry Solomon's-seal, cow parsnip, sweet cicely and various sedges and grasses. Other moist forests are mainly comprised of Engelmann spruce and subalpine fir with similar understory species. Wetlands, including wet meadows, swamps, marshes and fens are also scattered throughout the McDonald Valley, particularly above Lake McDonald and along the Camas Road. Bluejoint reedgrass, willows and alders are the typical vegetation of wet meadows and swamps, while beaked sedge, slender sedge and horsetail are typical of marshes and fens. Many of these areas also support a number of species of concern.

On the east side of the Going-to-the-Sun Road corridor, the vegetation in the St. Mary Valley is a mix of coniferous forest, deciduous forest and grassland. Along the eastern border of the valley, aspen groves and grasslands form extensive parklands. Aspen, sometimes mixed with black cottonwood, Engelmann spruce, lodgepole pine and Douglas fir, extends along the lowslope and toeslopes above St. Mary Lake, particularly along the eastern end. The understory of these groves is comprised of snowberry, serviceberry, red-osier dogwood, prickly rose, cow parsnip, western sweet-cicely, showy aster, arnica, western meadowrue and various grasses. Alluvial fans, interspersed in the aspen groves, are dominated by fescue grasslands. The vegetation includes grasses such as Idaho fescue, rough fescue, bluebunch wheatgrass, oatgrass, needlegrass and sedges. Dominant forbs include silky lupine, slender cinquefoil, yarrow and balsamroot. These grasslands also occur as dry outcrops along the mountain slopes.

At lower elevations in the St. Mary Valley, Douglas fir usually grows in the warm, dry exposures, forming a mosaic pattern of vegetative communities with Engelmann spruce-subalpine fir. Douglas fir forests are on the dry mid-slopes, often mixed with lodgepole pine, subalpine fir, Engelmann spruce and limber pine. The understory also tends to be dry, and is comprised of species often found in the nearby grasslands, as well as common juniper and kinnikinnick. Moister areas contain snowberry, spiraea, arnica and pinegrass. Engelmann spruce and subalpine fir grow on the lower moist slopes above St. Mary Lake, often with lodgepole pine and sometimes with black cottonwood and aspen. Drier spruce/fir forests usually grow in the subalpine fir/dwarf huckleberry or /twinflower habitat types, while moist spruce/fir forests are generally subalpine fir/queencup beadlily or /grouse whortleberry habitat types. The wettest areas along the lake and in the Red Eagle drainage contain moist aspen groves, spruce/horsetail forests and wetlands dominated by shrub and sedge. Riparian and wetland vegetation also grows along Divide Creek and other creeks throughout the valley.

At increased elevations in both valleys, subalpine fir, Engelmann spruce and lodgepole pine dominate forest communities. On the east side of the park, whitebark pine is a significant presence in treeline communities along south-facing slopes, and alpine larch is sometimes scattered on north-facing slopes. Lower subalpine forests, particularly west of the Continental Divide, may still have Douglas fir,

western larch and western white pine. Common understory species for these subalpine forest communities include fool's huckleberry, thimbleberry, mountain ash, spiraea, huckleberry, arnica, twinflower, queencup beadlily, grouse whortleberry, arrow-leaved groundsel and beargrass. Higher elevation forests support beargrass, glacier lily, mountain-heather and woodrush in the understory. Areas that have had more recent fires have more paper birch, quaking aspen, lodgepole pine, western larch and scattered Douglas fir. Areas that have continued disturbance, such as avalanche chutes along steep mountain slopes, are mainly comprised of tall shrubs, such as green alder, serviceberry, thimbleberry, elderberry, fireweed and cow parsnip. In still higher elevation near Logan Pass, the subalpine fir and Engelmann spruce take on wind- and frost-stunted, shrubby forms, called "krummholz." Beyond these areas there are diverse alpine meadows, turf communities, wet meadows, talus slopes and fellfields that support a number of rare plants.

The area surrounding Granite Park Chalet is dominated by dispersed krummholz of subalpine fir. Ground cover is composed of glacier lily, groundsel, mountain sorrel, monkey flower, Brewer's miterwort and alpine timothy. South and east of the ridge where the chalet is located there is a broad, marshy valley mainly comprised of interspersed subalpine fir and Engelmann spruce, huckleberry, elderberry, beargrass, alpine willow herb, false hellebore, glacier lily and numerous rushes and sedges. Below and north of the chalet, there are denser stands of subalpine fir, Engelmann spruce and other conifer species.

The area around Sperry Chalet has a variety of vegetation community types. Vegetation includes forest of subalpine fir/Engelmann spruce/hellebore, meadow of hellebore/groundsel/sedge, rock outcropping of rush/penstemon, forest of dry subalpine fir/mock hazel and rocky ledge subalpine fir krummholz/ beargrass/penstemon.

Populations of noxious weeds (plants that grow invasively to the detriment of other plants) in the Going-to-the-Sun Road corridor vary from individual occurrences to large infestations. In the McDonald Valley (including the Camas Road), state-listed noxious weeds infest approximately 245 acres (NPS 2001a). Weeds include spotted knapweed, oxeye daisy, Canada thistle, houndstongue, leafy spurge, orange hawkweed, St. Johnswort, Dalmatian toadflax, sulfur cinquefoil and common tansy. Ninety-seven acres, or 40%, are in the backcountry. There are approximately 310 acres of noxious weed infestation in the St. Mary Valley, the highest of any area in the park. Most of this infestation is in the frontcountry along the Going-to-the-Sun Road, in development areas, and in the fescue grasslands adjacent to the road. Only approximately 4 acres, or 1.3%, are in the backcountry zone. Weeds in the St. Mary Valley include spotted knapweed, oxeye daisy, Canada thistle, houndstongue, St. Johnswort, orange hawkweed, leafy spurge and common tansy.

The Apgar area is heavily forested and relatively flat in comparison with the surrounding area. The most common habitat type (for potential or "climax" vegetation) in this area is western redcedar or western hemlock/queencup beadlily. Because the area burned in a 1929 fire, a large portion of the present vegetation in the Apgar area is an early successional forest. Lodgepole pine and a few scattered western larch create a dense overstory with a large amount of Engelmann spruce regenerating in the understory. Other trees regenerating in the understory include western redcedar, western hemlock, western white pine and Douglas fir. Black cottonwood and paper birch grow in forest openings. Common understory species in this area include twinflower, prince's-pine, queencup beadlily, spiraea, bunchberry dogwood and thimbleberry.

In spite of past disturbance, the forest that is closer to the buildings in the Apgar Village area is a mid-seral western redcedar/western hemlock community. There are large clusters of western redcedar scattered around the buildings, mixed with larger Douglas fir, Engelmann spruce, lodgepole pine and

western white pine. Black cottonwood, paper birch and lodgepole pine only dominate in areas that have had the heaviest use. Understory species are similar to those listed above, but there is more maintained lawn near the structures that are dominated by non-native grasses.

A strip of land along Lake McDonald and Lower McDonald Creek supports riparian vegetation. While western redcedar and Engelmann spruce are still common, there is more black cottonwood and paper birch in the overstory. Willows, alder and sedges dominate the understory.

Forest buffers between the Lake McDonald developed area and Going-to-the-Sun Road have been preserved.

There are approximately 2 acres of noxious weeds in the Apgar Village developed area. These weeds include spotted knapweed, oxeye daisy and common tansy.

The Lake McDonald developed area is also in a western redcedar/queencup beadlily habitat type. A mature, 230-year old forest surrounds the area (Barrett 1997) and is dominated by very large western redcedar (16 to more than 22 inches in diameter at breast height) mixed with large western larch, western white pine and Douglas fir. The midstory contains mainly pole- and sapling-sized western hemlocks. The low-growing open understory includes twinflower, sidebells wintergreen, queencup beadlily, round-leaved violet, foam flower, snowberry, prince's-pine, northwest sedge, roughleaf ricegrass and beargrass. There are numerous old-growth black cottonwood trees (20 to 30 inches diameter at breast height) on the edge of this forest near the southern access road. An example of this forest type is south of Snyder Creek between Going-to-the Sun Road and the southern access road, and incorporates the Jammer Dormitory area.

Forest buffers between the Lake McDonald developed area and Going-to-the-Sun Road have been preserved. East of the Post Office, the forest is mainly western larch with scattered lodgepole pine, Douglas fir and Engelmann spruce. Numerous pole- and sapling-sized western hemlock and western redcedar saplings are in the understory. Other understory species include beargrass, snowberry, queencup beadlily, twinflower, round-leaved violet and prince's-pine. Near the Post Office, there are more black cottonwood and paper birch trees, as well as more non-native grasses in the understory at the edge of the forest.

Snyder Creek and the shoreline of Lake McDonald support riparian vegetation. Along the creek, overstory trees are large western redcedar, black cottonwood and paper birch. Saplings and pole-size trees of all three species are regenerating along the creek edge. Common understory plants include mountain maple, red-osier dogwood, alder and willow. Similar trees grow along the shoreline of Lake McDonald, and there are also Douglas fir, Engelmann spruce and a few subalpine fir seedlings. Vehicle traffic and human trampling have generally denuded the area's understory vegetation. Species that do exist include snowberry, serviceberry, mountain maple and red-osier dogwood.

Trees of various species are sparsely scattered around the Lake McDonald buildings. They include black cottonwood, paper birch, western redcedar, western hemlock, Engelmann spruce, western larch, western white pine, lodgepole pine and subalpine fir. Clearings around the lodge buildings and roads have lawns or artificially maintained open space that support many non-native species, such as Kentucky bluegrass, orchardgrass, quackgrass, clover, spotted knapweed, oxeye daisy and St. Johnswort. Spotted knapweed, oxeye daisy and St. Johnswort are state-listed noxious weeds that infest nearly 10 acres in the Lake McDonald developed area. Overstory trees are sparse in these areas, and include mostly black cottonwood, paper birch and western redcedar.

The vegetation around the Rising Sun developed area is a mosaic of dense forest, open forest, riparian vegetation and fescue grassland. The developed area mainly includes Douglas fir community types. The overstory is a mix of Douglas fir, lodgepole pine and limber pine with some subalpine fir and Engelmann spruce regeneration in the understory. The overstory is dense throughout the campground and north of the Rising Sun General Store/Motel with very mature Douglas fir trees and a few remnant western larch, but it tends to be open along Going-to-the-Sun Road and near the boat dock. Fescue grasslands grow east of Rising Sun along both sides of Going-to-the-Sun Road. Lodgepole pine and Douglas fir have started to invade the meadows along their western front. Grassland vegetation also dominates the understory in the open-canopy Douglas fir/limber pine areas. The upper slopes above the campground have similar vegetation.

The shoreline vegetation of St. Mary Lake is mostly the Engelmann spruce/subalpine fir forest type, although scattered black cottonwood and lodgepole pine also grow there. Willow and alder are most common along the rocky shoreline. Riparian vegetation can also be found along Rose Creek. The creek bed is very rocky, but black cottonwood, Engelmann spruce and some lodgepole pine are scattered in the floodplain. Willows and alder also grow here.

There are approximately 36 acres of noxious weeds in the Rising Sun developed area. They grow throughout the campground, structures, picnic area and boat dock area. Weed species include spotted knapweed, oxeye daisy, Canada thistle, houndstongue and St. Johnswort.

Two Medicine

At lower elevations, most of the Two Medicine Valley is dominated by coniferous forest that includes lodgepole pine, subalpine fir, Engelmann spruce and Douglas fir. Limber pine grows occasionally in more open stands. These areas are in various subalpine fir habitat types at several stages of succession. Understory species include beargrass, huckleberry, false huckleberry, spiraea, alder, thimbleberry, twinflower, queencup beadlily and arnica. The slightly moister phases of this forest type can also contain Solomon's-seal, pathfinder and various fern species. Quaking aspen stands, often mixed with black cottonwood, are the dominant vegetation near the eastern border of the park along Two Medicine Lake and are sometimes interspersed in the coniferous forest. Understory species here include red-osier dogwood, alder, sweet cicely, cow parsnip, false hellebore and various grasses. Small fescue grasslands and mixed shrublands are scattered throughout the montane zone. Rough fescue generally dominates the grasslands, while alder, mountain ash and mountain maple are common in low elevation shrublands.

Riparian vegetation is common in low elevations along Two Medicine Creek, Appistoki Creek and along the various lakes and smaller streams. Overstory trees in these areas are mainly Engelmann spruce, black cottonwood, quaking aspen and paper birch. Understory species include willows, alders, red-osier dogwood, mountain maple, cow parsnip, Solomon's seal, sweet cicely, asters and various sedges and grasses. Wetlands, often dominated by willow and sedges, occur in depressions near streams and at lake inlets.

Vegetation along the upper slopes is subalpine fir, Engelmann spruce, lodgepole pine and whitebark pine, with occasional Douglas fir and quaking aspen. Most of the upper slopes do not have dense overstory canopies, but are open with shrubby understories. Common understory species here include huckleberry, false huckleberry, green alder, beargrass, gooseberry, juniper, grouse whortleberry, Sitka valerian, arrowleaf groundsel, elk sedge and woodrush. Mixed shrubfields are scattered in the forested areas in avalanche chutes. Dominant species include alder, false huckleberry, mountain maple,

chokecherry, thimbleberry and fireweed. Idaho fescue/wheatgrass grasslands also grow on rock outcrops or terraces. Closer to the Continental Divide, krummholz subalpine fir forests dominate along with alpine meadows, turf communities, talus slopes and fellfields. These areas mainly consist of numerous sedges, alpine grasses and forbs.

Noxious weeds have invaded approximately 30 acres in the Two Medicine Valley (NPS 2001a). These species include spotted knapweed, oxeye daisy, Canada thistle, houndstongue, Dalmatian toadflax, sulfur cinquefoil and common tansy. Only spotted knapweed, oxeye daisy and Canada thistle have invaded approximately 1 acre, or 3.3% of the backcountry.

Vegetation in the Two Medicine developed area is comprised mainly of subalpine fir forest types. Parts of this area, particularly east of the ranger station and south of Appistoki Creek, are dense forest dominated by subalpine fir, lodgepole pine, Engelmann spruce with occasional Douglas fir, limber pine and whitebark pine. Common understory species include snowberry, serviceberry, spiraea, huckleberry, false huckleberry, beargrass, Utah honeysuckle, arnica and elk sedge.

Much of the area near the campground, picnic area and other structures supports an open canopy forest because of these developments. Lodgepole pine, subalpine fir, Engelmann spruce, black cottonwood and aspen are only scattered throughout the area. Understory species include those listed above, although some areas near the ranger station, campground, picnic area and General Store have either been converted to lawn or support exotic species.

Appistoki Creek, south of the picnic area, is mostly a disturbed gravel bar because of previous flooding and human diversion of the creek bed. Most of the area not vegetated, although there are scattered willows and grass species in the gravel bar. There is also riparian vegetation by the shore of Two Medicine Lake that includes alder, willow and various forbs, grasses and sedges.

A small fescue grassland on the northeast side of Pray Lake near the campground includes mostly Idaho fescue, rough fescue, oatgrass, woodrush, buckwheat, pussytoes and mountain sandwort. Lodgepole pine is slowly moving into the meadow.

Noxious weeds in the Two Medicine developed area include spotted knapweed, common tansy and Canada thistle. Weeds have invaded approximately 4 acres.

Many Glacier

The changing glaciation in the Many Glacier Valley has created diverse vegetation in the area. On the valley floor, subalpine fir habitat types, or climax forests, generally dominate the lower montane forest. The current overstory is a mix of subalpine fir, Engelmann spruce, lodgepole pine and occasional Douglas fir. There are wetter pockets of aspen and black cottonwood throughout this area, and moist Engelmann spruce forests in depressions. Common understory species include huckleberry, dwarf huckleberry, alder, false huckleberry, beargrass, queencup beadlily, thimbleberry and cow parsnip. Solomon's-seal, asters, false hellebore and bluejoint reedgrass are more common in wetter areas.

Fescue grasslands are interspersed throughout the montane forest and on the north-facing slopes at middle elevations. Species mainly include rough fescue, Idaho fescue, wheatgrass, needlegrass, lupine, cinquefoil, shrubby cinquefoil and kinnikinnick. There are also a number of shrublands on the middle elevation slopes. They are dominated by serviceberry, beargrass and thimbleberry. Riparian areas are

also scattered throughout the montane zone. Vegetation includes Engelmann spruce/willow, willow/alder, and herbaceous wetlands consist of sedges, bulrush, cattails and bluejoint reedgrass.

At higher elevations, lodgepole pine, subalpine fir, Engelmann spruce and some aspen dominate the overstory. Near the treeline and along ridges, whitebark pine is also common. The understory is generally comprised of huckleberry, false huckleberry, beargrass, spiraea, thimbleberry, elk sedge and queencup beadlily. Alpine meadows and shrubfields are scattered in forest openings and above the treeline. They contain tall shrub areas in avalanche chutes comprised of green alder, serviceberry, thimbleberry, chokecherry and mountain maple, as well as herbaceous meadows that are dominated by beargrass, huckleberry, fireweed, Sitka valerian, glacier lily, buttercup, shootingstar and paintbrush. Talus and scree slopes, composed of both limestone and quartzite/argillite rock outcrops, are at the highest elevations. There are some dispersed subalpine fir and whitebark pine, but the vegetation is mostly lichens, spotted saxifrage, arrowleaf groundsel, buckwheats, cinquefoil and alpine dryad.

Noxious weeds infest approximately 98 acres in the Many Glacier Valley (NPS 2001a). State-listed noxious weeds include spotted knapweed, oxeye daisy, Canada thistle, houndstongue, leafy spurge, Dalmatian toadflax, and sulfur cinquefoil.

Most of the vegetation around the Many Glacier Hotel and associated outbuildings is lodgepole pine and subalpine fir with scattered Engelmann spruce, black cottonwood and aspen in the overstory. The understory is generally a subalpine fir/queencup beadlily habitat type, or climax forest. The forest near the developments tends to be denser east and south of the hotel. There are only a few scattered trees to the north of the hotel, with mainly young black cottonwood in the overstory. Most of the understory around the buildings is lawn that contains a number of exotic grasses and forbs. In nearby forested areas, the understory includes huckleberry**,** snowberry, queencup beadlily, beargrass, buffaloberry, spiraea and serviceberry.

Southeast of the hotel, small aspen groves grow with a moister understory. There are more aspen groves and fescue-kinnikinnick meadows near the rocky ridge east of the hotel. Wetland and riparian vegetation grows on the shores of Swiftcurrent Lake and Governor's Pond. Lodgepole pine and Engelmann spruce tend to dominate the overstory, while willows, alder, cattail and sedges are common understory species.

Noxious weeds have infested approximately 13 acres around the Many Glacier Hotel and outbuildings (NPS 2001a). These weeds include spotted knapweed, houndstongue and Canada thistle.

The majority of the Swiftcurrent developed area is a dense wood of seral lodgepole pine, interspersed with black cottonwood, quaking aspen, subalpine fir, Engelmann spruce and Douglas fir. The understory is mostly beargrass with scattered snowberry, false huckleberry, serviceberry, buffaloberry, willow, Utah honeysuckle, chokecherry, queencup beadlily and arnica. Like the Many Glacier developed area, this forest can be classified as subalpine fir/queencup beadlily habitat type. Much of the understory near structures in this area has been converted to lawn or is dominated by exotic species.

Along Wilbur Creek, the vegetation is mainly lodgepole pine and quaking aspen with some scattered subalpine fir. Species in the understory include bluejoint reedgrass, Solomon's-seal, thimbleberry, green alder, willow and red-osier dogwood. Open areas scattered in the moist forest have wet meadows that are mainly bluejoint reedgrass.

Noxious weeds have invaded approximately 14 acres in this area, including the Many Glacier Campground (NPS 2001a). State-listed noxious weeds here include spotted knapweed, oxeye daisy, Canada thistle and sulfur cinquefoil.

Goat Haunt-Belly River

The Goat Haunt Valley is mainly coniferous forest, most of which is in the subalpine fir/queencup beadlily habitat types. Subalpine fir and Engelmann spruce dominate later seral forests, while lodgepole pine, Douglas fir, Engelmann spruce, western larch, black cottonwood, quaking aspen and paper birch are components of younger forests. Common understory species include queencup beadlily, huckleberry, false huckleberry, arnica, beargrass, thimbleberry, snowberry, serviceberry and pinegrass. Moister sections are generally dominated by Engelmann spruce and subalpine fir and may also include wild sarsaparilla, alder, starry Solomon's seal, twinflower, red-osier dogwood and bluejoint reedgrass in the understory. Wetter spruce forests along lakes and streams and dry Douglas fir dominated areas on steep rock outcrops are interspersed in the spruce/fir forest. Large and small wetlands, dominated by sedges and willows, occur throughout the valley.

In contrast, the Belly River Valley is a mix of deciduous forest, coniferous forest, grassland and riparian communities. On the eastern border, the vegetation is mainly a mixed aspen/conifer forest. Quaking aspen and lodgepole pine dominate the overstory with scattered Engelmann spruce and subalpine fir. Common understory species include thimbleberry, snowberry, Wood's rose, cow parsnip, false hellebore, fireweed, sweet-cicely, angelica and bluejoint reedgrass. Occasional wet areas support willow and other wetland vegetation.

Willows dominate along the Belly River floodplain, sometimes mixed with black cottonwood, spruce and aspen. Alluvial terraces, just above the river, are mainly fescue grassland. Rough fescue, Idaho fescue, sedge, needlegrass, oatgrass and wheatgrass are common grasses in this area, while shrubby cinquefoil, yarrow, strawberry, bedstraw, smooth aster, geranium and cinquefoils are common forbs and shrubs. Timothy and Kentucky bluegrass, exotic grasses, are common in some of these areas due to past disturbance.

Moist coniferous forest throughout the rest of the Belly River Valley generally dominates the area with lodgepole pine, Engelmann spruce, subalpine fir and Douglas fir in the overstory. Most of the forest is a mosaic of several subalpine fir habitat types at different stages of maturity. Black cottonwood, aspen and paper birch are in younger forests, and along larger streams and lakes throughout the valley. Huckleberry, false huckleberry, spiraea, snowberry, beargrass, queencup beadlily, arnica, elk sedge and pinegrass are common in the understory.

In both valleys, as elevation increases, subalpine fir, Engelmann spruce, lodgepole pine, whitebark pine and sometimes limber pine and alpine larch dominate the forests. Understory species includes huckleberry, grouse whortleberry, juniper, beargrass, elk sedge, pinegrass, Sitka valerian and arnica. Shrubs in avalanche chutes are mainly species such as green alder, chokecherry, serviceberry, thimbleberry and Rocky Mountain maple. As in other high elevation areas of the park, stunted krummholz forests grow near the treeline, mixed with alpine meadows, talus slopes, turf communities and fellfields. Species in these areas include subalpine fir, whitebark pine, alpine dryad, woodrush, beargrass, moss campion and cinquefoil, as well as various species of grasses, rushes, sedges.

Noxious weeds infest approximately 20 acres in the Goat Haunt-Belly River Valleys (NPS 2001a). State-listed noxious weeds include spotted knapweed, oxeye daisy, Canada thistle, orange hawkweed and sulfur cinquefoil. Almost 12 acres, or 60%, are in the backcountry.

Middle Fork

The Middle Fork area is covered mostly with a dense forest of even-aged stands initiated by fire, which consist of lodgepole pine and western larch (Barrett 1986). The potential climax species in this area are Engelmann spruce and subalpine fir, but frequent fires have limited their distribution. Consequently, they are only scattered in the overstory or regenerating in the understory. There are pockets of western redcedar-western hemlock habitat types in cool, moist sites along tributaries of the Middle Fork between Lincoln Creek and Nyack Creek. Douglas fir, black cottonwood and paper birch are also scattered throughout the area. Understory vegetation in these lower montane forests includes huckleberry, false huckleberry, buffaloberry, queencup beadlily, Oregon grape, pinegrass, arnica, beargrass, twinflower and elk sedge.

The vegetation at higher elevations is a cooler coniferous forest with an overstory of subalpine fir, Engelmann spruce, lodgepole pine and occasional Douglas fir and whitebark pine. Common understory species include false huckleberry, huckleberry, grouse whortleberry, spiraea, beargrass, woodrush, arrowleaf groundsel and Sitka valerian. Closer to the treeline, the trees become stunted, forming krummholz forests with more open overstories. Some areas contain mainly subalpine fir, spruce and whitebark pine, while others contain stunted lodgepole pine. These treeline communities often have shrubby understories, or large herbaceous meadows interspersed throughout the area. The forests eventually transform into talus slopes, scree slopes, wet meadows, turf communities and fellfields along upper slopes and ridges that are dominated by alpine forbs, grasses and sedges.

Riparian and wetland vegetation grows along the Middle Fork of the Flathead River, numerous lakes in the Middle Fork Valley, and streams and creeks. Vegetation mainly includes black cottonwood, Engelmann spruce, paper birch and aspen in the overstory and willow, alders, red-osier dogwood, mountain maple and horsetail in the understory. A number of small wetlands occur throughout the valley.

Noxious weeds infest 399 acres in the Middle Fork (NPS 2001a). State-listed noxious weeds include spotted knapweed, oxeye daisy, Canada thistle, orange hawkweed, St. Johnswort and sulfur cinquefoil. Nearly 387 acres, or 97%, are in the backcountry.

WILDLIFE

Over 300 species of terrestrial wildlife occupy Glacier National Park, either seasonally or year-round. The vegetation descriptions above also describe wildlife habitat in the park. Riparian areas, travel routes, avalanche chutes, shrubfields, wetlands, meadows, bogs, snags, recently burned areas, aspen parklands, old-growth forests, floodplains, mineral licks, nesting colonies, birthing grounds, hibernacula, den sites, ecotonal areas, roosts, caves and cliffs are especially significant to many species of wildlife.

USFWS Photo by Milo Burcham

The earliest park records suggest that wildlife composition of mammals and birds has changed little since Glacier National Park was established. Many species, particularly those with large home ranges, must leave the park in order to find suitable habitats to meet their seasonal needs. This movement across boundaries makes some species vulnerable to poaching, habitat loss and regulated hunting outside of the park. Two native

ungulate species, the mountain bison (*Bison bison*) and the woodland caribou (*Rangifer tarandus*) disappeared from the area by the 1930s (Martinka 1978). The swift fox (*Vulpes velox*) was historically common throughout the Great Plains and along the eastern border of Glacier National Park (Bailey and Bailey 1918). By 1969, the species was declared extinct in Montana. Several species were also introduced to the park. Known exotic or non-native terrestrial and avian species in the park include the raccoon (*Procyon lotor*), ring-necked pheasant (*Phasianus colchicus*), "wild" turkey (*Meleagris gallopayo*), rock dove (*Columbia livia*), European starling (*Sturnus vulgaris*) and house sparrow (*Passer domesticus*). All species are rare except the starling, and none are widely distributed.

Going-to-the-Sun Road Corridor

The McDonald Valley is unique because it is the widest and deepest valley of any tributary on the west side of the park, and Lake McDonald is the largest lake in the park. Although the climate of this area is a modified north Pacific coast type, topographical influences, including valley-ridge configurations, elevation, lake effect, aspect and exposure, combine to create extreme variations in weather over short distances and consequently, a variety of wildlife habitats (Kuchel 1974). There is ungulate winter range in the McDonald Valley and along the Middle Fork of the Flathead River. Wolves from the North Fork occasionally range into the McDonald Valley, and in 2001, resident wolves successfully denned adjacent to Lake McDonald. This new information indicates an expansion of occupied wolf habitat in Glacier National Park. There is year-round habitat for many species of wildlife in the valley, including moose, elk, mule and white-tailed deer, black and grizzly bear, cougar, lynx, fisher, wolverine and marten. The McDonald Valley contains nesting habitat for bald eagles, golden eagles, osprey, pileated woodpeckers and barred owls. Upper McDonald Creek, above the inlet of Lake McDonald, has been identified as the single most important harlequin duck-breeding stream in Montana (Ashley 1998).

There is a major wildlife travel corridor between Apgar and West Glacier. Black bear, grizzly bear, elk, deer, mountain lion, lynx and pine marten have all been observed in this area. Elk use the Apgar area in spring for calving and foraging. Muskrat, beaver, mink, river otters, raptors and waterfowl use the highly productive aquatic and riparian habitats along Lower McDonald Creek. The inlets of Lake McDonald and adjacent areas provide breeding, foraging, roosting and wintering habitat for resident and migrant bald eagles. The outlet of Lake McDonald is an important bald eagle wintering and roosting area. These areas are particularly important in years when the lake surface freezes, because they may still provide open water for eagle foraging (Crenshaw 1985, Crenshaw and McClelland 1989, Yates 1989, McClelland et al. 1994). Lake McDonald is also a staging area for harlequin ducks, common loons and numerous other waterfowl.

The mountain goat is the most common large mammal in the area of Sperry Chalet. Mountain goats have become habituated to visitor activity at the chalets and often wander among the guests and facilities. Columbian ground squirrels, red-tailed chipmunks, red squirrels, deer mice, snowshoe hares and mule deer are also common in the area. During the summer, grizzly bears are often attracted to the riparian habitat along Sprague Creek approximately one-half mile below Sperry Chalet, in addition to other areas around the chalet.

Black bears and grizzly bears often feed in the marshy valleys surrounding Granite Park Chalet. Mountain goats and bighorn sheep are also frequently seen along the trail leading from Logan Pass to the chalet and occasionally in the immediate vicinity of the chalet facilities. Other mammals that are common to the area include Columbian ground squirrels, hoary marmots, mule deer, golden-mantled ground squirrels, red-tailed chipmunks and red squirrels. Wolverine, mountain lion, lynx and marten also occur in the general area of Granite Park Chalet.

Wildlife habitat along the east front is particularly diverse because the east side of Glacier National Park is in a transition zone between the Northern Rocky Mountain and Northern Great Plains ecosystems, and between the sharply different Pacific Maritime and Continental climates. The St. Mary Valley, including the Rising Sun developed area, provides excellent forage and cover for a variety of wildlife species, including grizzly and black bears, mountain lions, lynx, wolverine, coyotes, gray wolves, bald and golden eagles, fisher, marten and all six ungulate species found in the park. Bald and golden eagles, northern goshawks, harlequin ducks, Cooper's hawks and pileated woodpeckers all nest in the valley. The east side of the park provides excellent winter range for bighorn sheep and mountain goats because the strong winds and sparse vegetation leave the south facing slopes relatively free of snow in winter. Bighorn sheep and mountain goats winter in the St. Mary Valley in the vicinity of Rising Sun, often foraging above the Going-to-the-Sun Road. Important elk calving areas border the St. Mary Campground and the Rising Sun developed area.

The St. Mary elk herd, the largest elk herd in the park, has historically spent most winters (excepting the harshest) inside the park in the St. Mary Valley. More recently, elk have been leaving the St. Mary Valley in late fall to winter on the plains east of the park because of increasing habitat security on the Blackfeet Reservation. An important spring elk calving area is just east of the St. Mary Campground, and each year the Blackfeet Tribal Fish and Game Department closes access to the area to protect the elk from human disturbance at this sensitive time. Elk calving also occurs in the park between Rising Sun and the St. Mary Campground. In summer, the St. Mary elk herd disperses along the east side of the park from Marias Pass north to the Canadian border. Wolves have been detected in the St. Mary Valley in winter. Denning has not been documented since wolves were eradicated from the St. Mary Valley in the late 1800s, but pack activity has been observed in recent years.

In the Apgar Village developed area, Lower Lake McDonald is an important area for wildlife diversity. The outlet of Lake McDonald is a very important area for bald eagle winter foraging and roosting. It is also an important area for harlequin ducks, common loons and numerous other waterfowl. Several species of wildlife use the area just south of the Apgar Village developed area as a travel corridor. Species such as black bear, grizzly bear, lynx, gray wolf, elk, white-tailed deer and wolverine, are known to travel through this area.

Many areas in and around the Lake McDonald developed area are used by wildlife. This locale contains several bald eagle roosting and foraging areas. Many waterfowl species, including common loons and harlequin ducks use Lake McDonald as an important staging area. Harlequin ducks are also frequently seen during spring along the lower portion of Snyder Creek. There is a grizzly bear travel corridor immediately east of the developed area across Going-to-the-Sun Road. Going-to-the-Sun Road crosses the Continental Divide at Logan Pass (elevation 6,646 feet), and the alpine and subalpine habitats traversed by Going-to-the-Sun Road are important for grizzly bears, lynx, golden eagles, bighorn sheep, mountain goats and wolverines.

Two Medicine

The Two Medicine area provides year-round habitat for grizzly bears and a wide range of other wildlife from elk, moose and deer to forest predators such as wolverine, marten, black bears, northern goshawks and lynx. Avalanche chutes, stream bottoms, wet meadows and burns are very productive areas that provide essential spring and fall grizzly bear habitat.

The Two Medicine drainage also contains critical fall, winter and spring habitat for bighorn sheep, mountain goats and other ungulates. There is nesting habitat in the area for bald eagles, golden eagles,

common loons, harlequin ducks and other rare and sensitive bird species. Lynx have been frequently sighted in the valley and family groups have been observed on several occasions. Habitat diversity in the Two Medicine area is quite high due to the combination of grasslands, aspen parklands, conifer forest, riparian woodlands, subalpine shrublands and alpine plant communities. Wolves have been observed in the area, but denning has not been documented.

A study of grizzly bear habitat use in the Two Medicine drainage indicates that visitor activities overlap significantly with grizzly bear use (Baldwin et al. 1985). Trails and campgrounds in the drainage are located in habitats that are of the highest value to grizzly bears, such as lakeshores and riparian corridors. Although grizzly bears concentrate their activity in these essential habitats when human use is lowest (during the early morning, evening and night), encounters between bears and humans frequently occur (Baldwin et al. 1985). An important grizzly bear and bighorn sheep travel corridor is at the foot of Two Medicine Lake adjacent to the developed area and campground.

Many Glacier

The Many Glacier area is a crossroads for wildlife because it is located where three valleys meet and contains outstanding year-round habitat for numerous wildlife species, including grizzly bears, lynx, wolverine, bighorn sheep, mountain goats, elk, moose, white-tailed deer, mule deer and golden eagles. Endangered gray wolves use the area during spring and fall and less frequently during summer and winter. Wolf denning has not been documented in the area. Numerous avalanche chutes and shrubfields provide important grizzly and black bear habitat in spring, summer and fall. Highly productive riparian woodlands, sedge meadows and other wetlands are habitats for countless species in the area, including bears, moose, deer, small mammals, songbirds, fisher, marten, mink, beaver, bats, amphibians and raptors. The drainage contains critical winter and spring range for bighorn sheep as well as lambing and rutting grounds. Several bighorn sheep migration corridors that have probably been in continual use for over 4,000 years go across the drainage, providing connectivity between seasonally important habitats.

The Many Glacier area's remoteness and relative lack of human activity during the winter provides undisturbed habitat for uncommon species, such as lynx, marten, wolves, fisher and wolverine. These five species are at low densities and are difficult to observe and study in summer. Consequently, very little is known about their specific summer habitat use and requirements. There has been documentation of family groups of both lynx and wolverine in the Many Glacier drainage in recent years. Available denning habitat, diverse and healthy ungulate populations and much terrain that is inaccessible to humans (especially in winter and late spring) make the Many Glacier drainage a highly suitable wolverine habitat.

Large parts of the drainage are in the alpine zone and contain steep talus fields and cliff bands. The areas provide habitat for mountain goats and cliff-nesting raptors, such as golden eagles and prairie falcons. Isolated, forested mountain ridges provide secure habitat for large herds of elk throughout the spring, summer and fall. Bald eagles frequent the lakes in the drainage, and one nest was found in 2003. The Sherburne Dam, built in 1919, inundated several small lakes, the reaches of Swiftcurrent Creek and highly productive riparian/wetland areas. Today, the area surrounding Lake Sherburne Reservoir supports little vegetation because of fluctuating water levels.

Several documented wildlife corridors cross the developed area at Many Glacier. Wolverine, grizzly bears, gray wolves and lynx, among other wildlife, use these corridors. A bighorn sheep route crosses directly behind the Many Glacier Hotel and is often used by bighorn sheep in the fall and spring to reach secure lambing and rutting areas. In addition to being an important wildlife movement corridor,

the Many Glacier developed area has critical bighorn sheep winter range. The lack of human activity in the winter at Many Glacier encourages shy species like lynx, marten, fisher and wolverine to use habitat in the developed area during that time. Very little is known about their specific habitat use and requirements in the area in summer. Grizzly bears are known to use the developed area for travel and foraging.

The Many Glacier Valley floor is narrow and contains several large lakes. There is north-south movement of many species of wildlife in the limited forested areas between the lakes, including the Swiftcurrent developed area. Grizzly bears, bighorn sheep, lynx, wolverine, elk and moose are known to use the wildlife corridors in and around the Swiftcurrent developed area. The open grassland slopes of Mt. Altyn are important fall, winter and spring range for bighorn sheep and mountain goats. Sheep lambing also occurs in the area. Grizzly bears use all of the Many Glacier Valley during spring, summer and fall, including parts of the Swiftcurrent developed area. Numerous lynx and wolverine have been documented in and around the developed area year-round. Golden eagles nest on cliffs next to the developed area, and northern goshawks have been documented in the area.

Goat Haunt-Belly River

The Goat Haunt-Belly River area contains habitat for large populations of elk, moose, bighorn sheep and deer. Mountain goats are common in the higher elevations, and raptors, including golden eagles and prairie falcons, regularly nest in cliffs throughout the area. Bald eagles also nest in old-growth vegetation next to lakes in both the Waterton and Belly River drainages. The last wolf pack to den in Glacier National Park, prior to the eradication of the species in the early part of the 20th century, denned in the Belly River Valley. There is regular pack activity in the area, but denning has not been confirmed. The area has habitat for grizzly and black bears, mountain lions, lynx, wolverine, fisher and marten. Common loons and harlequin ducks have historically nested in the area.

North Fork

The North Fork area provides critical winter range for most ungulate species in the park except for bighorn sheep. The year-round presence of diverse ungulate populations in the valley makes the North Fork an ideal place for large and mid-sized carnivores, including gray wolves, grizzly bears, black bears, mountain lions, bobcats, coyotes and lynx. The first documented denning of wolves in Glacier National Park in 50 years took place in the North Fork Valley in 1986 (Ream et al. 1991). Most large lakes in the North Fork support nesting pairs of bald eagles, osprey and common loons. Common loons in the North Fork have the highest reproduction rate of loons anywhere in the park. Wide-ranging wildlife species such as grizzly bears, wolves and elk, often leave the park and fulfill many of their needs on land managed by other entities, including the Flathead National Forest, the State of Montana, British Columbia's Provincial government and private landowners. This movement across boundaries may expose the species to poaching, habitat loss and regulated hunting outside of the park.

Middle Fork

Due to remote access, there is limited information about wildlife use in the Middle Fork area. Wildlife use of areas along U.S. Route 2 and the Middle Fork of the Flathead River is better understood. A prominent mineral lick along the Middle Fork of the Flathead near Walton draws mountain goats from a wide geographic area, especially in spring and early summer. The Belton Hills near West Glacier have important winter range for large numbers of deer and elk. Other winter ranges for elk and deer are on south-facing slopes in the Middle Fork. A pair of bald eagles has nested successfully near Nyack Creek, and forage along the corridor of the Middle Fork of the Flathead River where float trips occur. Lynx were historically present throughout the Middle Fork, but systematic surveys have only

recently detected this uncommon carnivore in the area. However, surveys on the nearby Flathead National Forest have documented evidence of continued occupation by lynx. Grizzly bears, mountain lions, wolverine and gray wolves also occupy the Middle Fork, indicating the presence of healthy ungulate populations in the area. Harlequin ducks breed in streams in the Middle Fork.

USNPS Photo

AQUATIC RESOURCES

The headwaters of three continental drainages start in Glacier National Park. The Columbia River basin, the area west of the Continental Divide, is a complex network of unique streams and lakes with high water volumes, low productivity, cold temperatures and high clarity.

The Missouri River drainage, in the southeast part of the park, has low productivity lakes and streams and a significantly different fish species make-up 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 and longnose suckers are known to be indigenous to the drainage.

The Saskatchewan River drainage flows north to Hudson Bay. The headwaters, which are in the northeast area of the park, are low in productivity. Both native and non-native species occupy the lakes and streams of this drainage.

The aquatic ecosystem in Glacier National Park has 17 native and seven non-native fish species. The natural aquatic systems and associated indigenous fisheries of the park were dramatically altered in the last century by the introduction and invasion of non-native fish, such as lake trout, eastern brook trout and rainbow trout. Although all of the native species are still in the park's lakes and streams, species composition and their relative numbers have changed significantly. The stocking of non-native sport fish in park waters began in 1912, peaked between 1920-1955, and stopped in 1972. During that time, several species of non-native salmonids became established in park waters.

The altered fish communities' effects on their associated amphibian, aquatic invertebrate and terrestrial vertebrate populations are not easily described due to a lack of historic data. Park managers are concerned that changes in the abundance of native fish may negatively affect the native predators that depend on them (e.g. bald eagles, river otters, osprey, etc.). Although fish are not currently stocked in the park's waters, the introduction and invasion of non-native fish species have seriously compromised the park's aquatic systems (Marnell 1988). As aquatic and terrestrial habitats outside the park become more degraded, and as inbreeding with non-native species becomes more prevalent, headwater parks like Glacier National Park become increasingly important as refuge for pure genetic stocks of fish.

In addition to the ichthyofauna of the park's lakes and streams, the park is also home to many amphibious and aquatic invertebrates, vertebrates and macroinvertebrates. Long-toed salamanders (*Ambystoma macrodactylum*), tailed frogs (*Ascaphus truei*), boreal toads (*Bufo boreas*), Pacific tree frogs (*Pseudacris regilla*), Columbia spotted frogs (*Rana luteiventris*) and painted turtles (*Chrysemys picts*) are all closely associated with the park's aquatic systems. Also, U.S. Geological Survey researchers found a new frog species, the boreal chorus frog *(Pseudacris maculata)* in the park near East Glacier in 2001. The introduction of non-native sport fish has been implicated in the decline of

several amphibian species in North America. Sport fish have been introduced in numerous, formerly fishless lakes in Glacier National Park, but the impact on native amphibians in the park is not well understood due to the lack of historic distribution data (Marnell 1997). The absence of amphibian breeding sites in waters with fisheries suggests that fish introductions may have locally impacted park amphibian populations (Marnell 1997). In the last ten years, extensive amphibian surveys have been conducted throughout the park's backcountry by U.S. Geological Survey researchers. Current distributions are fairly well understood, but population status and trends are not. Amphibian habitat in the park's developed areas has not been surveyed well. Although primary surveys on amphibians and localized studies of macroinvertebrates have been done, comprehensive information on these organisms is not currently available.

Going-to-the-Sun Road Corridor

In the Going-to-the-Sun corridor there are 11 known native fish species, six known non-native fish species and many aquatic invertebrate, vertebrate, or macroinvertebrate species. The half of the Going-to-the-Sun Road corridor that is on the west side of the Continental Divide is in the Columbia River basin. This area has 11 native fish species (westslope cutthroat trout, bull trout, mountain whitefish, pygmy whitefish, redside shiner, peamouth, northern pike minnow, longnose sucker, largescale sucker, slimy sculpin and shorthead sculpin) and six non-native fish species (rainbow trout, eastern brook trout, Yellowstone cutthroat, kokanee salmon, lake whitefish and lake trout). The area also has long-toed salamanders, tailed frogs, boreal toads, Pacific tree frogs, Columbia spotted frogs and painted turtles. The half of the Going-to-the-Sun Road corridor that is on the east side of the Continental Divide is in the South Saskatchewan River drainage. There are 10 native fish species (westslope cutthroat trout, bull trout, mountain whitefish, lake whitefish, lake trout, longnose sucker, spoonhead sculpin, burbot, northern pike and trout perch) and two non-native fish species (brook trout and Yellowstone cutthroat trout) in the Going-to-the-Sun Road corridor east of the Continental Divide in Glacier National Park.

The Apgar Village area is at the foot of Lake McDonald in the McDonald Creek drainage of the Columbia River basin. In the aquatic ecosystem of Lake McDonald, there are 11 native and five non-native species of fish. Native species include westslope cutthroat trout, bull trout, mountain whitefish, pygmy whitefish, redside shiner, peamouth, northern pike minnow, longnose sucker, largescale sucker, slimy sculpin and shorthead sculpin; non-native species include rainbow trout, eastern brook trout, kokanee salmon, lake whitefish and lake trout. The natural aquatic system and associated indigenous fish make-up of Lake McDonald has been seriously changed in the last century by the introduction and invasion of non-native fish, such as lake trout and lake whitefish. Although all of the native species are still in the lake and Lower McDonald Creek, species composition and relative numbers have changed dramatically. Stocking of non-native species in Lake McDonald began around 1912 and ended in the late 1960s.

The Lake McDonald drainage area also contains many amphibious and aquatic invertebrates, vertebrates and macroinvertebrates. Amphibian habitat in the Apgar Village developed area has not been surveyed well and although there have been primary surveys on amphibians and localized studies of macroinvertebrates, comprehensive information on them is not currently available. Long-toed salamanders, tailed frogs, boreal toads, pacific tree frogs, Columbia spotted frogs and painted turtles have all been found in the area.

Like the Apgar Village area, the Lake McDonald developed area is located on Lake McDonald in the McDonald Creek drainage of the Columbia River basin. See the Apgar Village area discussion above for a description of the aquatic ecosystem of Lake McDonald.

The Lake McDonald developed area is also home to many amphibious and aquatic invertebrates, vertebrates and macroinvertebrates. There is not a complete survey of the amphibian habitat in the Lake McDonald developed area. Although there have been primary surveys on amphibians and localized studies of macroinvertebrates, comprehensive information on the organisms is not currently available. Long-toed salamanders, tailed frogs, boreal toads, pacific tree frogs, Columbia spotted frogs and painted turtles have all been found in the area.

The Rising Sun developed area is located immediately next to Rose Creek in the St. Mary drainage. In the aquatic ecosystem of Rose Creek, there are no known native fish and two non-native fish species (eastern brook trout and cutthroat trout). Because of the numerous natural waterfalls and cascades on Rose Creek, most of the drainage, including Otokomi Lake, was historically fishless. Although there are no records indicating that native fish used the lower reaches of Rose Creek, it is likely that some native fish from St. Mary Lake used them for spawning and rearing juvenile fish. Between 1923 and 1935, cutthroat trout were stocked in Otokomi Lake and still inhabit the lake today. Stocking non-native fish in Otokomi Lake has probably had an impact on the aquatic life in this system; however, no research has been done to document the effects of this introduction.

Many amphibious and aquatic invertebrates, vertebrates and macroinvertebrates also inhabit the St. Mary drainage area. Amphibian habitat in the Rising Sun developed area has not been surveyed well. Although primary surveys on amphibians have been done, comprehensive information on these organisms is not currently available. Columbia spotted frogs, boreal toads and long-toed salamanders have all been found in the St. Mary drainage.

Two Medicine

The Two Medicine area is in the Missouri River drainage. Much of this drainage in the park is thought to have been originally fishless, although westslope cutthroat trout, mountain whitefish and longnose sucker are known to be indigenous to the drainage. Ichthyofauna, Columbia spotted frogs, tailed frogs and boreal toads have been found in the Missouri River drainage in the park.

The Two Medicine developed area is near the foot of Two Medicine Lake in the Two Medicine Creek drainage, which is believed to have been historically fishless. There are no known native fish species present. Stocking records indicate that non-native fish introductions began in 1914 in Upper Two Medicine Lake and in 1919 in Two Medicine Lake, where it continued until 1969. Three non-native fish species currently inhabit Two Medicine Lake (eastern brook trout, rainbow trout and sculpin).

The Two Medicine Lake area also has many amphibious and aquatic invertebrates, vertebrates and macroinvertebrates. Amphibian habitat in the Two Medicine developed area has not been surveyed well. Although primary surveys on amphibians and localized studies of macroinvertebrates have been done, there is presently no comprehensive information on these organisms. Columbia spotted frogs, tailed frogs and boreal toads have been found in the Missouri River drainage in the park.

Many Glacier

The Many Glacier area is located in the South Saskatchewan River drainage. There are no native fish and two known non-native fish (eastern brook trout and kokanee salmon) in this area in the park. The area also has Columbia spotted frogs, boreal toads and long-toed salamanders.

The Many Glacier developed area is on the east shore of Swiftcurrent Lake in the Swiftcurrent Creek drainage. In the aquatic ecosystem of Swiftcurrent Lake, there are no native fish and two known non-

native fish species (eastern brook trout and kokanee salmon). The Swiftcurrent Creek drainage was historically fishless down to Swiftcurrent Falls at the outlet of Swiftcurrent Lake. The introduction of non-native sport fish such as rainbow and eastern brook trout has seriously changed the natural aquatic system in the last century. Stocking non-native fish in Swiftcurrent Lake began in 1912 and continued until 1966. Stocked species included non-native rainbow, brook and cutthroat trout, grayling and kokanee salmon.

The Swiftcurrent Creek drainage area also has many amphibious and aquatic invertebrates, vertebrates and macroinvertebrates. There is no complete survey of amphibian habitat in the Many Glacier developed area. Although primary surveys on amphibians have been done, comprehensive information on these organisms is not currently available. Columbia spotted frogs, boreal toads and long-toed salamanders have all been found in the Swiftcurrent Creek drainage.

Although the Swiftcurrent developed area boundaries do not include any major streams or lakes, the area is close to a number of important waterways. The Swiftcurrent developed area is bounded by Wilbur Creek to the west and Swiftcurrent Creek to the south. In the aquatic ecosystem of Wilbur and Swiftcurrent Creeks, there are no known native fish and one non-native fish (eastern brook trout). The Swiftcurrent and Wilbur Creek drainages were historically fishless above Swiftcurrent Falls. The impact of years of stocking non-native fishes into the area waters has probably had a major effect on native plants and animals in these waters.

The Swiftcurrent and Wilbur Creek drainages also have many amphibious and aquatic invertebrates, vertebrates and macroinvertebrates. Amphibian habitat in the Swiftcurrent developed area has not been surveyed well. Although primary surveys on amphibians have been done, there is no available comprehensive information on these organisms. Columbia spotted frogs, boreal toads and long-toed salamanders have all been found in the Swiftcurrent and Wilbur Creek drainages.

Goat Haunt-Belly River

The Goat Haunt-Belly River area is in the Hudson Bay drainage. In the aquatic ecosystem of the Hudson Bay drainage, there are nine native fish species (westslope cutthroat trout, bull trout, mountain whitefish, lake trout, longnose sucker, spoonhead sculpin, burbot, northern pike, trout/perch) and six non-native fish species (rainbow trout, eastern brook trout, Yellowstone cutthroat trout, kokanee salmon, lake whitefish, arctic grayling). The natural aquatic system and associated native fishes of the Hudson Bay drainage have been seriously altered in the last century by introduction and invasion of non-native fish, such as rainbow trout and eastern brook trout. Although all of the native species still inhabit various lakes and creeks in the drainage, species composition and relative numbers have changed dramatically. Stocking non-native species in the drainage in the park began around 1912 and ended in the late 1960s.

In addition to the ichthyofauna of the Hudson Bay drainage, this area also has many amphibious and aquatic invertebrates, vertebrates and macroinvertebrates. Long-toed salamanders, Columbia spotted frogs and boreal toads have all been found in the Hudson Bay drainage.

Middle Fork

The Middle Fork area is in the Middle Fork of the Flathead River drainage in the Columbia River basin. There are 11 native fish species in the area (westslope cutthroat trout, bull trout, mountain whitefish, pygmy whitefish, redside shiner, peamouth, northern pike minnow, longnose sucker, largescale sucker, slimy sculpin, shorthead sculpin) and six non-native fish species (rainbow trout,

eastern brook trout, Yellowstone cutthroat trout, kokanee salmon, lake whitefish, lake trout). The natural aquatic system and associated native fishes of this drainage have been seriously altered in the last century by the introduction and invasion of non-native fish such as lake trout and lake whitefish. Although all of the native species still inhabit various lakes and creeks in the drainage, species composition and relative numbers have changed dramatically. Stocking non-native species in the drainage in the park began around 1912 and ended in the late 1960s.

In addition to the ichthyofauna of the Middle Fork drainage, this area also has many amphibious and aquatic invertebrates, vertebrates and macroinvertebrates. Long-toed salamanders, tailed frogs, boreal toads, pacific tree frogs, Columbia spotted frogs and painted turtles all inhabit the Middle Fork of the Flathead River drainage.

THREATENED AND ENDANGERED SPECIES AND SPECIES OF CONCERN

USFWS Photo

According to the Endangered Species Act of 1973, the term "endangered species" means any species that is in danger of extinction throughout all or a significant part of its range. A "threatened species" is any species that is likely to become an endangered species in the foreseeable future throughout all or a significant part of its range.

Species of concern to Glacier National Park are species that are rare, endemic, disjunct, vulnerable to eradication, in need of further research, or likely to become threatened or endangered if limiting factors are not reversed. A species may also be of concern because of characteristics that make it particularly sensitive to human activities or natural events. The species of concern list for Glacier National Park includes species that are listed as "species of special concern" by the Montana Natural Heritage Program, "priority species" by Montana Partners in Flight and "sensitive species" by the Flathead National Forest. Species of concern may also include big game, upland game birds, waterfowl, carnivores and furbearers whose populations are protected in the park but are vulnerable to hunting and trapping outside of the park.

Federally and State Listed Wildlife Species Including Aquatic Species

Five wildlife species listed as threatened or endangered by the Fish and Wildlife Service inhabit Glacier National Park. They are the threatened bald eagle, grizzly bear, lynx and bull trout, as well as the endangered gray wolf. Sixty-five wildlife species have been identified as "species of concern."

Following is a description of each of the five federally listed wildlife species in the park.

- Bald Eagle *(Haliaeetus leucocephalus*)
  The bald eagle was proposed for removal from its threatened status in July 1999, but a final decision and ruling by the Fish and Wildlife Service is pending. If the bald eagle is removed from the threatened species list, it will continue to be closely monitored for a period of five to 20 years and will still be protected under the Migratory Bird Treaty Act (1918) and the Bald Eagle Protection Act (1940).

Bald eagles use parts of Glacier National Park on a year-round basis for nesting and wintering (Yates 1989) and seasonal migration (McClelland et al. 1994, Yates et al. 2001). Glacier National Park is in a major bald eagle migration corridor, and their use of it along the western side of the park has been extensively documented (McClelland et al. 1994). Some eagles stay to forage near Lake McDonald and winter in the area, especially along the Middle and North Forks of the Flathead River.

The *Montana Bald Eagle Management Plan* (Montana Bald Eagle Working Group 1994) provides guidance for conservation and management of bald eagles and their habitat in Montana. It is an extension of the *Pacific States Bald Eagle Recovery Plan* (USFWS 1986) developed by the U.S. Fish and Wildlife Service and furnishes information for landowners and resource managers about the biology of the eagles. It provides general guidelines for use in lieu of site-specific data and for management based on minimal human disturbance. It identifies nest site management zones and recommends various levels of protection in nesting territories. In addition, Glacier National Park's *Bald Eagle Operational Plan and Habitat Management Guidelines* (NPS 1999b) contains site-specific information and outlines actions for habitat management to protect and perpetuate areas used by bald eagles in the park.

The productivity of the park's nesting bald eagle population is generally less than half that of the productivity documented for the rest of Montana (NPS files) and is considered to be extremely low. This productivity is also about half of the level recommended in the *Pacific States Bald Eagle Recovery Plan* (USFWS 1986) for maintaining viable populations of nesting bald eagles. Lower productivity in the park may be caused by severe winter and spring weather, deterioration of native fisheries (and consequently, prey species), and/or human disturbance near nesting and foraging sites.

Nesting habitat characteristics include old-growth forest types near water, where there is some seclusion from human activity. Many nest sites are located near lake inlets where foraging for fish is productive, and bald eagle nesting sites occur primarily along the margins of lakes and along the larger rivers in the park. Vegetative screening provides much of the necessary seclusion for eagles near nesting, roosting, foraging, and feeding areas (Caton et al. 1992). Nest areas are especially critical, because human activity or development may stimulate abandonment of the breeding area, and affect successful completion of the nesting cycle, thereby reducing productivity. Designated nest site management areas help to reduce human disturbance and maintain or enhance nest site habitat suitability.

Designated nest site management areas extend to a 1/4-mile radius of all nest sites that have been active within five years. The bald eagle nesting season in Glacier National Park extends from early March through late September. Human activity is restricted within 1/4 mile of bald eagle nesting, roosting, and primary foraging areas during specific stages of the nesting cycle. Those stages include courtship (late February to mid-April); egg laying and incubation (late March to late May); nestling (mid-May to mid-August); and fledging (early August to late September—the least sensitive period). The potential for nest failure and nestling death due to human disturbance is reduced, but not eliminated, after nestlings reach an age of four weeks (usually early to late June in the park). Nestlings usually fledge at 10 to 12 weeks of age (by mid-August), but young eagles do not migrate from breeding areas until sometime between mid-September and early October (McClelland et al. 1996). Human activity can negatively impact nesting success during this period as well.

Preferred wintering habitat is also usually near open water where fish are available and waterfowl congregate, or near a concentrated food source such as ungulates killed by predators or road accidents. In addition to food, eagles require large trees and freedom from disturbance for feeding and roosting in winter. Lake McDonald is the primary wintering area in the park that is affected by this commercial services plan. Some winter use has also been documented in the Two Medicine Valley, but it may be early nesting activity by resident eagles.

While roosting habitat is usually associated with large trees near a concentrated food source (Keister 1981, Crenshaw 1985), foraging habitat typically consists of lake inlets and outlets, shallow lakes, streams, rivers, wetlands, and meadows or any area where dead prey is available. Roost and foraging areas also provide open flight paths, perches, and security from intrusions and other disturbances. Documented roost areas affected by this plan are located near Lake McDonald (Crenshaw 1985, Crenshaw and McClelland 1989).

Foraging habitat outside of nest site management zones is also important, especially for non-breeding, wintering, and migrant bald eagles (Montana Bald Eagle Working Group 1994). Non-breeding eagles are often excluded from preferred foraging areas by nesting bald eagles, and extensive foraging flights by breeding adults may expand well beyond the 2.5-mile radius, or home range zone as described in the Montana Plan (Yates 1989). The quality, amount, and proximity of foraging habitat influence the overall population of bald eagles, in addition to the breeding adults. Bald eagle foraging and wintering habitats are found throughout Glacier National Park, and are generally associated with large lakes and rivers.

- Grizzly Bear *(Ursus arctos)*
  Glacier National Park is the central recovery area for the threatened grizzly bear in the Northern Continental Divide Ecosystem. A recent study using sign surveys and DNA fingerprinting resulted in a preliminary estimate of 270-320 grizzly bears in Glacier National Park (K. Kendall, U.S. Geological Survey [USGS], pers. comm.). Exact population estimates and trends are difficult to establish due to the lack of intensive population research in the park and the inherent problems of counting the widely distributed and reclusive grizzly bear.

  The *Grizzly Bear Recovery Plan* (USFWS 1993) and the *Glacier National Park Bear Management Plan* (NPS 2000a) are guidelines for the management of grizzly bears in Glacier National Park. The plans outline actions that are required to protect and recover the federally listed grizzly bear. In the Northern Continental Divide Ecosystem Grizzly Bear Management Area, one recovery standard is the population goal, which is based on the annual number of unduplicated observations of females with cubs-of-the-year. In Glacier National Park, the target is 10 females with cubs-of-the-year. Observations in the park are summarized from the park's Bear Information Management System database, and recent counts in the park have been near or below the identified target (GNP files).

  Grizzly bears need large areas of undeveloped habitat (including a mixture of forests, moist meadows, grasslands, and riparian habitats) and have home ranges of 80 to 800 square miles (USFWS 1993). A radio-collared, female grizzly with cubs was documented using 137 square miles as a home range in 1998 and 1999 in the Lower McDonald Valley of Glacier National Park (NPS 1999b). Grizzly bear seasonal movements and habitat use are related to the availability of different food sources. In spring, grizzly bears feed on dead ungulates and early greening vegetation at lower elevations (Martinka 1972). During the summer, some bears move to higher elevations to search for glacier lilies and other roots, berries, and army cutworm moths (*Euxoa auxiliaris*) (White et al. 1998). During the huckleberry (*Vaccinium sp.*) season, bears often

concentrate in the Apgar Mountains (Kendall 1986), Belton Hills, Snyder Ridge, the Many Glacier Valley, the Two Medicine Valley, and other areas. Avalanche chutes are an important source of herbaceous forage for grizzly bears in the early summer and fall (Rockwell 1995). During the winter, grizzly bears hibernate in dens away from human disturbance, usually at higher elevations on steep slopes where there is an accumulation of deep snow (Mace and Waller 1997). Recent evidence indicates that in the North Fork of the Flathead River drainage, some bears do not den for the entire winter or may den for shorter periods than elsewhere. This might be due to an abundance of predator-killed ungulates (Ruth and Gniadek 1996).

Besides diverse foraging habitat, grizzly bears require natural habitat with travel corridors between foraging sites. Examples of these types of travel corridors are found in the McDonald Valley near Apgar and along Lake McDonald, in the Two Medicine Valley adjacent to the campground, and in the Many Glacier Valley near the Swiftcurrent Motor Inn and Many Glacier Hotel. Grizzlies are wide-ranging and require a substantial amount of solitude from human interactions (Brown 1985).

Grizzly bear/human interaction is a management concern that can threaten the safety of visitors as well as that of wild bears. Bears that are familiar with humans may become used to human presence and attracted to visitor use areas. Frequenting human use areas may further accustom bears to the presence of people and will increase the risk of contributing to bear/human encounters. There is a great risk that such habituated bears will become conditioned to food and may aggressively look for human food at developed areas. Habituated bears are usually relocated or hazed from developed areas, and food-conditioned bears are often removed from the population. There is evidence that females with cubs are more susceptible to habituation and food conditioning due to habitat partitioning and the food demands on them (Mattson et al. 1987). Because of this condition, females with cubs are often in the neighborhood of quality habitat nearer developed and human use areas.

- Canada Lynx *(Lynx canadensis)*
  On April 24, 2000, the Canada lynx was listed as a threatened species in the adjacent United States. The U.S. Fish and Wildlife Service concluded that the population was threatened by human alteration of forests, past overexploitation that diminished its numbers, growth of the range of its competitors, and more human access into lynx habitat. To date, critical habitat for the species has not been designated or proposed (USFS and USFWS 2000).

  Lynx habitat is generally described as climax boreal forest with a dense undercover of thickets and windfalls (Ruediger et al. 2000). Lynx often prefer advanced successional stages of forests and dense conifer stands for denning and foraging, respectively. Large amounts of woody debris and minimal human disturbance are important to denning sites (Brittell et al. 1989). Lynx generally forage in young conifer forests, especially where their primary prey, snowshoe hare (*Lepus americanus*), is abundant. Older forests with a dense understory also provide good foraging habitat, and are often more stable sources of snowshoe hares than younger, transitory forests (Ruediger et al. 2000). Travel corridors are thought to be an important factor in lynx habitat because of their large and variable home ranges, generally 10 to 147 square miles (Ruediger et al. 2000). Travel cover includes contiguous vegetation cover over 6 feet tall (Brittell et al. 1989), and lynx usually do not cross openings more than

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330 feet wide (Koehler 1990). Lynx are most susceptible to disturbance during the denning period and while newborns are developing (May–August) (Joslin and Youmans 1999). Potential lynx habitat has not been described in Glacier National Park due to the lack of information about vegetation and snow cover. Deciduous and coniferous forests cover approximately 55% of Glacier National Park, but an unknown percentage of forested habitats could be potential lynx habitat (GNP files).

Simultaneously with the listing process, a national interagency Canada Lynx Conservation Assessment and Strategy was developed to provide a consistent and effective method for conserving the species. All federal land management agencies, including the National Park Service, were participants. This strategy identifies 17 risk factors that could adversely affect lynx mortality, productivity, and movements (Ruediger et al. 2000). In Glacier National Park, the primary risk factors for lynx are: wildland fire management policies that alter the frequency and extent of natural disturbance processes, roads and highways, winter recreational trails, and habitat degradation by non-native invasive plant species. Incidental or illegal shooting and trapping, competition or predation influenced by human activities, and human developments that degrade and fragmented lynx habitat are also risk factors.

Lynx were considered more-or-less common throughout the Glacier Park region during the early 1900s (Bailey 1918). Reported lynx sightings declined after the 1960s, but have increased in recent years, possibly due to increased interest in the species (GNP files). Systematic lynx surveys involving snow tracking and DNA sampling were initiated in 1994 and 1999; lynx were detected in many drainages throughout the park, including the St. Mary, Two Medicine, McDonald, and Many Glacier Valleys, although no estimates of population numbers were made. Remote camera stations and winter tracking have also documented family groups in the Many Glacier and Two Medicine Valleys.

- Bull Trout (*Salvelinus confluentus*)
  The Fish and Wildlife Service under the Endangered Species Act has given threatened status to bull trout in both the Upper Columbia River Basin and the Hudson Bay drainage. Glacier National Park contains a large amount of lake and stream habitat for bull trout in the North Fork and Middle Fork of the Flathead River drainages and parts of the Hudson Bay drainage. River and lake systems in the Missouri River drainage in Glacier National Park do not contain bull trout.

  Bull trout exhibit three distinct life history forms: resident, fluvial, and adfluvial. Resident bull trout spend their entire lives in small tributaries, whereas fluvial and adfluvial forms hatch in small tributary streams and then migrate into larger rivers (fluvial) or lakes (adfluvial). Spawning occurs in late August to early November, depending on water temperatures. Eggs and fry usually over-winter in spawning streams until the following spring. The specific habitat requirements of bull trout include abundant cover for adult fish during spawning, low levels of fine sediment in the incubation environment, cold summer water temperatures and channel stability for juveniles, and open migration routes between habitats that are important for each season (USFWS 1998).

  There has been a large drop in the population of bull trout in the Lake McDonald/Flathead drainage. The major threat to the development of the bull trout population in Lake McDonald and the Flathead system is competition and hybridization with introduced, non-native fish species such as lake trout and eastern brook trout. Other threats include blocked migration routes (Hungry Horse Dam) and past over-harvest by anglers. Present fishing regulations prohibit the taking of any bull trout in both Glacier National Park and the state managed Flathead drainage system.

By the 1950s, wolves were virtually absent from the lower 48 states.

The main threat to bull trout persistence west of the Continental Divide in Glacier National Park is the invasion of non-native lake trout into bull trout habitat. Historic records do not show that lake trout were ever stocked in the Flathead drainage in the park. However, because of immigration from downstream areas as early as 1959, the species became established in most of the park's larger lakes, including Lake McDonald (Fredenberg 2000). When non-native lake trout are introduced into a natural system dominated by bull trout, the lake trout usually displace bull trout because of competition and predation (Donald and Alger 1993). Systematic surveys conducted by the Fish and Wildlife Service in 2000 to assess the population status of bull trout in lakes on the park's west side indicate that bull trout populations have steeply declined. Large increases in lake trout were also noted for most lakes including Lake McDonald. The survey report concludes that most of the bull trout populations in the park's lakes "are currently at high risk of extirpation" due to displacement by lake trout. The survey report recommends restoring bull trout in compromised lakes, possibly through a lake trout eradication program, and protecting remaining pristine lake systems from invasion by lake trout in the future (Fredenberg 2000).

- Gray Wolf *(Canis lupus)*
  Historically common throughout the Rocky Mountains, gray wolves were present but greatly reduced by the time Glacier National Park was established in 1910. Until wolves returned to the park in the 1980s, the park's last known resident wolf pack was removed from the Belly-Waterton River Valleys by a professional Canadian wolfer around 1920. Scattered nomadic pairs and lone wolves were observed throughout the park after 1920, but no resident wolf packs were confirmed (Singer 1975).

  By the 1950s, wolves were virtually absent from the lower 48 states. The exception was a small population less than 1,000 in northeastern Minnesota and northern Michigan (USFWS 1987). Wolves in the Northern Rocky Mountains were listed as endangered under the current Endangered Species Act in 1973.

  By the 1970s, wolf sightings were becoming more frequent in the North Fork of the Flathead River Valley and there was an effort to monitor wolf activity in and around Glacier National Park. The University of Montana's Wolf Ecology Project was initiated in 1978. Then in 1986, the first documented denning of wolves in the western United States in over 50 years occurred in the park (Ream et al. 1991). Wolves have continued to den in the park nearly every year since. Two separate wolf packs with approximately 10-33 wolves maintained home ranges in the North Fork throughout the 1990s. Recent sightings have noted two packs occupying the North Fork and a third pack in the McDonald Valley area.

  In addition to the resident North Fork packs, wolves have been reported in every major drainage in the park in recent years including the Many Glacier, McDonald, Cut Bank, St. Mary, Belly River, and Two Medicine Valleys (NPS files). Wolves denned in 1993 and 1994 in the Belly River area in Alberta, but there has been no verified denning activity east of the Continental Divide in Glacier National Park. According to recent sightings and historic records for the east side of the park, wolves are recolonizing the area. Pack activity has recently been observed in the St. Mary, Many Glacier, and Two Medicine Valleys, but the population dynamics of recolonizing wolves are quite variable. Wolf monitoring in Glacier National Park has been reduced since wolf ecology research concluded in 1996.

Gray wolves are wide-ranging and their distribution is tied mainly to their primary prey (deer, elk, and moose). Important components of wolf habitat are: 1) sufficient numbers of prey year-round, 2) suitable and somewhat secluded denning and gathering sites, and 3) sufficient space with minimal exposure to humans (USFWS 1987). Low elevation river bottoms that are relatively free from human disturbance provide important winter range for ungulates and wolves. Wolves are especially sensitive to disturbance at den and gathering sites during breeding. Human activity near den sites can lead to pack displacement or physiological stress that might cause reproductive failure or pup mortality (Mech et al. 1991). Several diseases, including sarcoptic mange, distemper, parvovirus, and hookworm can be transmitted to wolves from domestic dogs and may have severe impacts on the mortality and recruitment of wolves (Joslin and Youmans 1999).

Glacier National Park is part of the northwest Montana Recovery Zone where the *Northern Rocky Mountain Gray Wolf Recovery Plan* directs the management and recovery of wolves (USFWS 1987). The recovery of wolves in the western U.S. is based on the population goal of maintaining at least ten reproducing packs in each of the three recovery zones for three years. Lack of sufficient prey and a high level of human persecution are the two most important factors limiting wolf distribution and preventing a complete recovery of wolf populations in the Northern Rocky Mountains (USFWS 1987). The park's predominantly natural landscape contains some of the most secure and productive wolf habitat in the northwest Montana Recovery Zone. Even with fluctuating wolf numbers since 1986, the park's established wolf population continues to be a source for natural recolonization in northwest Montana and southern Canada (Boyd-Heger 1997).

The wildlife species of concern found in Glacier National Park are described below. The species of concern list for Glacier National Park includes species that are listed as "species of special concern" by the Montana Natural Heritage Program, "priority species" by Montana Partners in Flight, and "sensitive species" by the Flathead National Forest.

- Northern bog lemming (*Synaptomys borealis*)
  Northern bog lemmings are rare residents of wet meadows, bogs, and marsh borders. They typically inhabit sphagnum bogs and fens, but are also found in mossy forests, wet sub-alpine meadows and alpine tundra. Boreal in distribution, northern bog lemmings occur in North America from near treeline in the north, south to Washington, Idaho, Montana, Minnesota, and New England (Reichel 1995). There are only 16 known populations of bog lemmings in Montana, six of which are located on the west side of the Continental Divide in Glacier National Park, in the McDonald and North Fork drainages (MNHP 2000). The northern bog lemming is rarely trapped and very little is known about its population status and life history. The disjunct nature of Montana's relict populations has generated concern over the viability of the northern bog lemming in the southern portion of its range. Surveys for northern bog lemmings have not been conducted on a park-wide basis, but all sphagnum and fen/bog moss habitat patches are considered suitable habitat and should be preserved to maintain viable populations of northern bog lemmings (Reichel 1995). Breeding has been documented but population trend is unknown.

- Swift fox (*Vulpes velox*)
  The swift fox, a house cat-sized mammal that preys mostly on grasshoppers and ground squirrels, was historically common throughout the Great Plains and along the eastern border of Glacier National Park (Bailey and Bailey 1918). Records from fur trade along the Upper Missouri River show that 8,500 swift fox pelts were taken between 1835 and 1838 (Knowles et al. 1998). By 1969, the species was extinct in Montana. Since 1998, annual releases of captive-bred swift foxes from Canada have occurred on the Blackfeet Indian Reservation just east of Glacier National Park as part of a five-year reintroduction program. Survivorship has been high and successful denning

has been observed every year (Schmitt 2000). The population of swift foxes on the Blackfeet Indian Reservation is the only known reproducing population in the state of Montana. Threats to swift foxes are trapping/shooting, deteriorating range conditions, vehicle-caused mortality, rodent control programs, pesticides, and predation by coyotes, which have become unnaturally abundant in the absence of wolves. Swift foxes are rare visitors to the fescue grasslands along the east side of the park. Denning has not been observed in the park, but hunting foxes has been documented. Sightings have occurred in the St. Mary and Cut Bank Valleys (GNP files).

- Fisher (*Martes pennanti*)
  Fishers are residents of coniferous forests and riparian areas. Breeding in the park is probable, but the population status and trend are unknown. Fisher were probably eliminated from Montana, as there were no trapping records for the state from 1920-1960. In 1950-60, fisher were transplanted from British Columbia to Montana, but population numbers remain low (USFS 1994). Fisher inhabit moist coniferous forests and prefer mature stands with abundant small mammal prey. They generally frequent drainage bottoms, lower slopes, and riparian areas (USFS 1994). Fisher have been documented on both sides of the Continental Divide in the park, including the St. Mary, McDonald, Two Medicine and Many Glacier drainages (GNP files).

- Wolverine (*Gulo gulo*)
  The wolverine is a rare resident of coniferous forests and alpine meadows on both sides of the Continental Divide. Breeding has been documented, but population status and trend are unknown. Wolverine were apparently extirpated from Montana by 1920 due to over-harvest, but recovered through dispersal from Canada and Glacier National Park (Newby and Wright 1955). Wolverine appear to require large, isolated tracts of wilderness supporting a diverse prey base. They utilize a range of habitats including alpine areas, mature forest, ecotonal areas, and riparian areas. Wolverines exhibit a distinct seasonal elevational pattern moving to lower elevations during the winter where they search for carrion on ungulate winter ranges. A limiting factor to wolverine distribution may be the availability of suitable denning habitat. Wolverine appear to require remote alpine cirques for denning and are especially sensitive to human disturbance during courtship, denning and rearing of young (Copeland 1996). The park is considered to have very high quality wolverine habitat due to its extensive alpine areas, rugged topography, remoteness, and diverse ungulate populations. Removal of large predators such as wolves and mountain lions from an ecosystem can reduce the amount of carrion available to wolverine. Wolverine have been detected across elevational gradients in most park drainages with sightings concentrated in the Two Medicine, St. Mary, McDonald, and Many Glacier drainages (Yates et al. 1994, Hahr et al. 1999, Hahr et al. 2000).

- Rocky mountain bighorn sheep (*Ovis canadensis*)
  Historically common throughout the Rocky Mountains, bighorn sheep experienced population declines beginning in the early 1890s due to disease (transmitted through contact with domestic sheep) and over-harvest. Although current population levels are higher because of reintroductions and hunting regulations, much of historic bighorn sheep range is still unoccupied (Wisdom et al. 2000). While traveling through what is now the east side of Glacier National Park in the late 1880s, naturalist and big game hunter George B. Grinnell concluded that bighorn sheep “are so plenty that they are to be found on every peak.” The park’s bighorn sheep population has been affected by periodic disease and illegal

hunting (GNP files). The park's bighorn sheep population has recently been estimated at a minimum of 445 individuals (Dicus 2001). Assessing historic bighorn sheep population trends in Glacier National Park has proven difficult, due to unreliable population estimates prior to the 1970s (Keating 1985). Data suggest that bighorn sheep no longer utilize some areas in the park where they occurred in the 1930s (Keating 1985).

The park's bighorn sheep mainly range along the crest of the Continental Divide and along the peaks and ridges to the east. The east side of the park provides excellent winter range because the strong winds and sparse vegetation leave the south facing slopes relatively snow-free in winter. Source habitats for bighorn sheep are found mostly in the alpine and subalpine areas where open habitats and high-quality forage exist. Cliffs and steep, rocky terrain are two important habitat features that sheep require for predator avoidance and escape. Post-fire habitats also benefit sheep by increasing visibility and improving forage (Wisdom et al. 2000). Bighorn sheep show seasonal movement patterns between winter, summer, and transitional ranges used for lambing and rutting. If access to these areas is restricted due to habitat fragmentation or direct human disturbance, bighorn sheep may shift their distribution, or experience increased physiological stress (Wisdom et al. 2000). Bighorn sheep are especially sensitive to disturbance during lambing (late April to early June). Knowledge of seasonally important habitats and critical travel routes is passed down from generation to generation. Loss of this knowledge due to local extirpations could preclude the recolonization of suitable habitat for a considerable period of time (Geist 1971). Year-round sheep range occurs in the St. Mary, Two Medicine and Many Glacier drainages (GNP files).

- Townsends' big-eared bat (*Corynorhinus townsedii*)
  Townsends' big-eared bats depend on caves and cave-like structures for nursery colonies, day roosts, and hibernacula. This species is a forest generalist within the subalpine, montane woodland, shrubland and riparian community groups (Nagorsen and Brigham 1993). Because of their restrictive habitat requirements, Townsends' big-eared bats have a patchy distribution. Alteration and disturbance of roost structures, exposure to pesticides, changes in insect prey populations, and shooting are the main threats to Townsends' big-eared bat populations in western North America (Wisdom et al. 2000). Although no recent records exist for this species in the park, there are records from adjacent lands in Flathead, Glacier and Lincoln Counties and in British Columbia, Canada. There is also a record of the species collected in 1874 from Waterton Lake. Since the specimen was collected during an international boundary survey, it was quite likely collected in or very near what later became Glacier National Park. Occurrence of this species in the park has not been verified, in part, because extensive bat surveys have never been conducted.

- Silver-haired bat (*Lasionycteris noctivagans*)
  Silver-haired bats are known to occur in forested areas and woodlands on both the east and west sides of the Glacier National Park, including the McDonald Valley. This species shows a preference for late-successional stages of subalpine, montane, and riparian woodland community groups (Wisdom et al. 2000). Silver-haired bats use contrasting habitat—forested areas for roosting and open areas for foraging. Large diameter snags and live trees are used for roosting (Christy and West 1993), and shrubs, herbaceous wetlands, and riparian areas are special habitat features necessary for this species. A lack of information has made an assessment of this species' status in northwest Montana and Glacier National Park difficult. Extensive bat surveys have not been conducted in the park and population status and trend are unknown.

- Hoary bat (*Lasiurus cinereus*)
  Hoary bats are known to occur rarely in forested areas and woodlands on both the east and west sides of Glacier National Park. This species shows a preference for late-successional stages of

subalpine, montane and riparian woodland community groups. Hoary bats also use younger stands of all montane, and lower montane forest types and aspen and cottonwood-willow for foraging (Wisdom et al. 2000). The hoary bat is an edge-associated species often roosting in deciduous trees or conifers at the edge of clearings (Wisdom et al. 2000). A lack of information has made an assessment of this species' status in northwest Montana difficult. Extensive bat surveys have never been conducted in Glacier National Park and population status and trend is unknown.

- Westslope cutthroat trout (*Oncorhynchus clarki lewisi*)
  In 2000, the U.S. Fish and Wildlife Service considered the westslope cutthroat trout for possible listing under the Endangered Species Act, and the decision was made not to list the species. The fish 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 (Marnell 1988). Introductions of non-indigenous sport fish have compromised about 84% of the historical range of the native cutthroat trout in Glacier (Marnell 1988). Despite repeated invasions and introductions of non-native salmonids and the associated genetic contamination of some native populations, many lakes in Glacier still contain secure populations of westslope cutthroat trout (Marnell 1988).

  Seventeen lakes in the park contain pure genetic stocks of native westslope cutthroat trout. The remaining fish-bearing lakes contain non-indigenous fish or hybrids that are mostly the introduced Yellowstone cutthroat trout, brook trout, or rainbow trout (*Oncorhynchus mykiss*). 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.

- Shorthead sculpin (*Cottus confusus*)
  Shorthead sculpins live in a few streams in the Columbia River drainage. Their habitat ranges from small to large, cold, clear streams to large rivers and deep lakes. Very little is known about the distribution and status of this species in the park.

- Spoonhead sculpin (*Cottus ricei*)
  Spoonhead sculpins live in the Hudson Bay Drainage. Their habitat ranges from small, swift streams to large rivers and deep lakes. Very little is known about the distribution and status of this species in the park.

- Trout-perch *(Percopsis omiscomaycus)*
  Trout-perch live in the Hudson Bay drainage. Their habitat is typically in lakes, but this species also uses clear to moderately turbid streams, particularly when spawning. Very little is known about the distribution and status of this species in the park.

- Boreal toad *(Bufo boreas)*
  Boreal toads are mainly terrestrial and very mobile, and consequently sometimes difficult to detect during field surveys. Adults may also show a seasonal shift to nocturnal behavior or take refuge from hot, dry conditions by burrowing in the ground litter or inside rodent holes. Serious declines of this species throughout portions of its southern range are cause for concern for its status in other regions. Boreal toads were found in most of the major drainages in the park, except portions of the North and Middle Fork, Flathead River drainages. Breeding populations of boreal toads do not often live near predatory fish populations (Marnell 1997). There is a large breeding population of boreal toads in the vicinity of the Two Medicine developed area, and a large migration of young boreal toads was observed in the North Fork in the summer of 2002. Very little is known about the distribution and status of this species in the park.

- Rocky Mountain capshell (*Acroloxus coloradensis*)
  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 site is one of only a few in the United States where a viable population has survived. Most other documented capshell populations are in Canada, but they have also been found in several lakes in Colorado. In 1992, it was petitioned for emergency listing as a threatened species in the United States. The U.S. Fish and Wildlife Service rejected the petition. Although *Acroloxus coloradensi* is rare, the Service did not conclude that it is threatened or endangered. Very little is known about the distribution and status of this species in the park.

- Tailed frog *(Ascaphus truei)*
  The tailed frog is mostly nocturnal and highly aquatic dependent, living in cold turbulent headwaters streams with cobble substrates (Marnell 1997). Populations of this species in Glacier are disjunct. The removal of streamside vegetation and increases in fine sediments can have a negative effect on tailed frog recruitment and survival. Tailed frogs in Glacier can apparently co-exist with fish in streams that have abundant escape cover, a fishery that is mainly lacustrine, and fish that are not predatory (Marnell 1997). Tailed frogs have been observed in very few areas of the park. Most recorded observations are from the McDonald and Two Medicine Valleys and the Middle Fork, Flathead River drainage (U.S. Geological Survey files, Marnell 1997). This species is difficult to detect during surveys due to its nocturnal behavior, and may be more common than current data show. The frog's breeding activity has been documented in the park, but its population trend is currently unknown.

- Great gray owl (*Strix nebulosa*)
  The great gray owl is a rare resident in mature and old-growth coniferous forest with nearby meadows for foraging and nesting. Great gray owls are a contrast species, requiring the juxtaposition of habitats used for foraging and for nesting/roosting. Snags are a special habitat feature for great gray owls. Great gray owls do not build their own nests but rely instead on large abandoned stick nests and platforms such as the broken tops of large-diameter trees. Great gray owls are widely distributed, although at low population levels, in most forested areas in northwest Montana (Wisdom et al. 2000). The persistence of the great gray owl populations depends on maintaining snag structures, meadow systems, and prey populations (Hayward et al. 1994). Nesting has been documented in the park but status is unknown.

- Boreal owl (*Aegolius funereus*)
  The boreal owl is a rare resident in mature forests and unmanaged younger forests, especially subalpine and montane forests and riparian woodlands. Snags or large trees with either natural cavities or cavities excavated by other species are used by boreal owls for nesting (Hayward et al. 1994). Forests that include large amounts of decaying woody material near the ground and associated lichens and fungi, support populations of the boreal owl's principal prey, red-backed voles (*Clethrionomys gapperi*). Boreal owls may occur in a patchy geographic pattern making the proximity of neighboring populations crucial to the long-term persistence of the local population (Hayward et al. 1994). Very few areas of the park have been surveyed for owls. Boreal owls were detected in the McDonald, Two Medicine, Cutbank, and North Fork, Flathead River drainages (GNP files). Nesting has been documented but population trend is unknown.

- Peregrine falcon (*Falco peregrinus*)
  The U.S. Fish and Wildlife Service removed the peregrine falcon from the list of threatened and endangered species in 1999. Although no longer endangered, peregrine falcons, their eggs, parts,

and nests will continue to be protected from unauthorized killing, possession, transportation, and importation by the Migratory Bird Treaty Act (1918). Also, the species will continue to be monitored across the nation for the next 13 years to provide data on at least two generations of peregrines and to ensure that the bird is doing well after being delisted. 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 (Yates et al.1991).

- Northern goshawk (*Accipiter gentilis*)
  Northern goshawks are uncommon from spring to fall in forested areas, especially in mature to old-growth coniferous and mixed forests in the park. Adult goshawks generally remain on their territories throughout the year, although they may shift to lower elevations in the fall. Goshawks require large nest trees in dense stands to support their bulky nest structures, and prefer to forage in small openings or dense stands with relatively open understories (Hayward 1983). Goshawks have been observed throughout the park, but only a handful of nests have been documented. Goshawk surveys have been conducted in the St. Mary Valley only. Many sightings have occurred in the McDonald, St. Mary and Many Glacier drainages (GNP files).

- Golden eagle (*Aquila chrysaetos*)
  Golden eagles are fairly common in open areas of the park from spring to fall. They nest in cliffs (and possibly trees) throughout the park including the McDonald, North Fork, Middle Fork, St. Mary, Two Medicine, Waterton, and Many Glacier drainages (GNP files). Specific nests have been located and monitored in Glacier National Park, but population status and trend is currently unknown (Yates et al. 1991, Sumner and Schmidt 1998, Sumner and Gilbert 1999). The Many Glacier Valley has a high density of nesting golden eagles.

  Productivity for golden eagles in Montana has been low and may be declining (Joslin and Youmans 1999). Golden eagles may be disturbed during the nesting season by human intrusion, resulting in lowered productivity due to disruption of courtship activities, over-exposure of eggs or young birds to weather, and premature fledging of juveniles. Direct mortality of juveniles due to starvation or predation is also possible if adults are displaced from the area and regular nest attendance does not occur (Fyfe and Olendorff 1976).

  Golden eagle migration through Glacier National Park has been documented as thousands of eagles travel north to nesting areas in spring and south to wintering areas in autumn (Yates 1994, Yates et al. 2001). The Livingston and Lewis Mountain Ranges, and connecting spur ridges, are used by migrating eagles during these periods and the importance of the travel corridor is still under investigation

Upper McDonald Creek, with about 25 pairs, is considered the most critical harlequin breeding stream in Montana.

- Harlequin duck (*Histrionicus histrionicus*)
  Harlequin ducks are fairly common from spring to fall in fast-moving water (streams and rivers) and less frequently on lakes. Productivity is highly variable. Harlequin duck declines have been documented throughout the western populations, including in Montana, where there are approximately 110 pairs (Genter 1993). Upper McDonald Creek, with about 25 pairs, is considered the most critical harlequin breeding stream in Montana (Ashley 1998). Harlequins winter in coastal areas and migrate inland during summer to nest along clean, fast-flowing mountain streams and

rivers where they can breed and nest away from human disturbance (Clarkson 1994). Recreational boating, sport fishing and other human activities have been shown to displace harlequin ducks, especially during nesting and brood rearing periods (Clarkson 1994). A spring boating closure is in effect to protect harlequins from disturbance on several essential harlequin breeding streams on Upper McDonald Creek. In addition to the McDonald Valley, harlequin pairs and/or broods have also been documented in the Two Medicine, Many Glacier and St. Mary drainages (GNP files). Dr. Grinnell reported seeing a female and brood of six young in the Many Glacier drainage in the early 1900s (Bailey and Bailey 1918), however, no broods have been documented in this drainage since.

- Common loon (*Gavia immer*)
  Common loons occur from spring through fall, but rarely during winter, on large and small lakes throughout the park. A high proportion of Montanan's nesting pairs are found in the park, making it especially important to the viability of the state's loon population. The highest productivity occurs among breeding pairs in the North Fork of the Flathead River Valley. Since annual parkwide loon surveys were initiated during the 1980s, breeding has rarely been documented on the east side of the park outside of the Belly River drainage (GNP files). However, common loons have been observed on all the major lakes in the Many Glacier, Two Medicine, and St. Mary drainages. Parkwide productivity appears to have declined since the 1980s (GNP files). Historic information on common loon distribution and productivity is limited.

- Pileated woodpecker (*Dryocopus pileatus*)
  The pileated woodpecker is a fairly common resident of late-seral stages of montane, lower montane, and riparian woodland community groups. Pileated woodpeckers depend on large snags for nesting and roosting. Nesting has been documented in the park, but population status and trend are unknown (GNP files).

- Black-backed woodpecker (*Picoides arcticus*)
  Black-backed woodpeckers are rare residents of mature to old-growth subalpine, montane, and lower montane forests and riparian woodlands. This species is almost exclusively found in recently burned conifer forests in the park for as long as 10 to 12 years after a fire, with only a few sighting reports from mature forests. The black-backed woodpecker uses beetle-infested forests (Caton 1996). Black-backed woodpeckers excavate cavities for nesting in live trees with heart-rot or recently killed trees (Wisdom et al. 2000). The portion of this species' range, which includes the park, has experienced strong declines in black-backed woodpecker source habitats due to the decline of mature forests and the altered frequency of stand-replacing fires (Wisdom et al. 2000). This species has been documented in the North Fork and McDonald drainages (GNP files). Nesting has been documented, but population trend is unknown.

- Olive-sided flycatcher (*Nattallornis borealis*)
  Olive-sided flycatchers breed in forested areas of North America and winter in Central and South America. This species is found in recently burned conifer forest and seems to persist at least 15 years after a fire. It is less dependent on burned forest than the black-backed woodpecker, occurring in mature forest edge habitat throughout the park. They are a contrast species using mature coniferous forests for nesting and forest openings for foraging. They are uncommon from spring to fall in conifer forests, bogs, and recently burned forest. Nesting has been documented but population trend is unknown. Breeding bird survey data for the interior Columbia River Basin indicate populations have declined between 1966 and 1994 (Wisdom et al. 2000). They have been documented in the St. Mary, McDonald, Many Glacier and North Fork drainages (GNP files).

- Northern hawk owl (*Surnia ulula*)
  This species is a rare resident and migrant in recently burned forest. Nesting occurs in large-diameter snags and has been documented in the North Fork Valley (Gniadek et al., in prep.), but population trend is unknown (GNP files).

- Ferruginous hawk (*Buteo regalis*)
  Ferruginous hawks are rare in grassland habitats from spring to fall, and have been documented in the Many and East Glacier areas. Nesting has not been documented in the park (GNP files).

- Trumpeter swan (*Cygnus buccinator*)
  Trumpeter swans are rare on lakes, ponds, rivers and streams during spring and fall migration. Nesting may occur on the east side of the park; in 2002, this species was reported to have successfully raised young on Kootenai Lakes in the Waterton River drainage, near Goat Haunt. This is likely the first documented nesting in the park. Trumpeter swans are known to nest in Waterton Lakes National Park, Canada, and on adjacent ranch lands in Alberta. Trumpeter swans are often observed in spring and fall at the outlet and inlet of Lake McDonald and along Lake Sherburne at Many Glacier (GNP files).

- LeConte's sparrow (*Ammodramus leconteii*)
  This bird is rare from spring to fall in wet meadows, primarily in the North Fork; nesting is documented but population trend unknown (GNP files).

- American white pelican (*Pelecanus erythrorhynchos*)
  This species is rare during summer adjacent to lower elevation water bodies near the park boundary on both sides of Continental Divide. Most sightings have been on St. Mary Lake, Two Medicine Lake, and Lake Josephine. There is no evidence of breeding in the park (GNP files).

- Black swift (*Cypseloides niger*)
  This species is rare in spring and summer; documented in the McDonald, St. Mary, and North Fork drainages with nesting documented in the McDonald Valley (GNP files).

- Black tern (*Chlidonias niger*)
  This bird is rare in spring and summer in the North Fork and McDonald Creek drainages and on the eastern boundary of Glacier National Park near the town of Babb, MT (GNP files).

- Forster’s tern (*Sterna fosteri*)
  This bird is an accidental spring visitor to the park along the east side (GNP files).

- Common tern (*Sterna hirundo*)
  This bird is rare in spring and fall along the east side of the park (GNP files).

- Caspian tern (*Sterna caspia*)
  This bird is rare in fall along the east side of the park (GNP files).

- Franklin’s gull (*Larus pipixcan*)
  This bird is uncommon on the east and west sides of the park in spring and summer.

- Black-crowned night heron (*Nycticorax nycticorax*)
  This bird is an accidental visitor on the west side of the park.

- Loggerhead shrike *(Lanius ludovicianus)*
  This bird is rare in spring, summer and fall east and west of the Continental Divide.

- White-tailed ptarmigan *(Lagopus leucurus)*
  This bird is common year-round in alpine areas of the park.

- Brown creeper *(Certhia americana)*
  This bird is common year-round in mature forest east and west of the Continental Divide.

- Clark's nutcracker *(Nucifraga columbiana)*
  This bird is common year-round east and west of the Continental Divide across elevational gradients. The 50% decline in the whitebark pine population in the park has generated concern over the status of Clark's nutcrackers, a closely associated species.

- Horned grebe *(Podiceps auritus)*
  This bird is common in spring and summer on the east and west sides. It is uncommon and rare in fall and winter respectively.

- Barrow's goldeneye *(Bucephala islandica)*
  This bird is common in spring, summer and fall on the east and west sides. It is uncommon in winter.

- Hooded merganser *(Lophodytes cucullatus)*
  This bird is uncommon in spring, summer and fall on the east and west sides. It is rare in winter.

- Ruffed grouse *(Bonasa umbellus)*
  This bird is common year-round throughout the park.

- Long-billed curlew *(Numenius americanus)*
  This bird is rare in spring on both sides of the Continental Divide.

- Marbled godwit *(Limosa fedoa)*
  This bird is rare in spring on both sides of the Continental Divide.

- Vaux's swift *(Chaetura vauxi)*
  This bird is common in spring and summer on both sides of the Continental Divide.

- Calliope hummingbird *(Stellula calliope)*
  This bird is common in spring and summer on both sides of the Continental Divide.

- Lewis's woodpecker *(Melanerpes lewis)*
  This bird is uncommon in spring and summer on both sides of the Continental Divide.

- Williamson's sapsucker *(Sphyrapicus thyroideus)*
  This bird is rare in spring and summer on both sides of the Continental Divide.

- Three-toed woodpecker *(Picoides tridactylus)*
  This bird is common year-round throughout the park.

- Willow flycatcher *(Empidonax traillii)*
  This bird is uncommon in spring and summer on both sides of the Continental Divide.

- Hammond's flycatcher *(Empidonax hammondii)*
  This bird is common in spring and summer on both sides of the Continental Divide.

- Cordilleran flycatcher *(Empidonax difficilis)*
  Uncommon in spring and summer on both sides of the Continental Divide.

- Winter wren *(Troglodytes troglodytes)*
  This bird is common in spring and summer on the east and west sides. It is uncommon in fall and winter.

- Veery *(Catharus fuscescens)*
  This bird is uncommon in spring, summer, and fall on both sides of the Continental Divide.

- Red-eyed vireo *(Vireo olivaceus)*
  This bird is uncommon in spring and summer on both sides of the Continental Divide.

- Lazuli bunting *(Passerina amoena)*
  This bird is uncommon in spring and summer on both sides of the Continental Divide.

- Brewer's sparrow *(Spizella breweri)*
  This bird is uncommon in spring and summer on both sides of the Continental Divide.

- Lark bunting *(Calamospiza melanocorys)*
  This bird is an accidental visitor in summer on both sides of the Continental Divide.

- McCown's longspur *(Calcarius mccownii)*
  This bird is rare in spring on the east side of the Continental Divide.

- Chestnut-collared longspur *(Calcarius ornatus)*
  This bird is rare in spring on both sides of the Continental Divide.

Wildlife Threatened and Endangered Species and Species of Concern by Area

The following section lists wildlife threatened and endangered species and species of concern found in the Going-to-the-Sun Corridor and the developed areas.

- Going-to-the-Sun Road Corridor
  The endangered gray wolf and the threatened Canada lynx, grizzly bear, bald eagle, and bull trout are known to occur throughout the Going-to-the-Sun Road corridor. These 44 wildlife species of concern also use or inhabit the area: the northern bog lemming, swift fox, fisher, wolverine, Rocky Mountain bighorn sheep, silver-haired bat, great gray owl, peregrine falcon, northern goshawk, golden eagle, harlequin duck, common loon, pileated woodpecker, black-backed woodpecker, olive-sided flycatcher, ferruginous hawk, trumpeter swan, LeConte's sparrow, American white pelican, black swift, loggerhead shrike, white-tailed ptarmigan, brown creeper, Clark's nutcracker, horned grebe, Barrow's goldeneye, hooded merganser, ruffed grouse, long-billed curlew, Vaux's swift, calliope hummingbird, Lewis's woodpecker, three-toed woodpecker, willow flycatcher,

Hammond's flycatcher, winter wren, veery, red-eyed vireo, lazuli bunting, Brewer's sparrow, westslope cutthroat trout, shorthead sculpin, tailed frog, boreal toad and Rocky Mountain capshell.

Gray wolf, lynx, grizzly bear, bald eagle and bull trout are known to use areas in the Apgar Village developed area. There are bald eagle forage areas and a documented roost along Lower McDonald Creek near Apgar Village, and a grizzly bear travel corridor crosses McDonald Valley near Apgar and along Lake McDonald.

The endangered gray wolf and the threatened Canada lynx, grizzly bear, bald eagle, and bull trout are known to occur throughout the Going-to-the-Sun Road corridor.

The Lake McDonald developed area contains known bald eagle roosting and foraging areas, and there is a grizzly bear corridor along the Going-to-the-Sun Road adjacent to the Lake McDonald developed area. Bull trout also live in aquatic areas in the Lake McDonald developed area.

There is no comprehensive information on the exact composition of species of concern found in the Apgar Village, Lake McDonald and Rising Sun developed areas. However, the presence of 41 wildlife species of concern has been documented in the visitor service zone of the Going-to-the-Sun Road corridor. These species include the northern bog lemming, fisher, wolverine, Rocky Mountain bighorn sheep, silver-haired bat, peregrine falcon, northern goshawk, golden eagle, harlequin duck, common loon, pileated woodpecker, trumpeter swan, blackswift, loggerhead shrike, white-tailed ptarmigan, brown creeper, Clark's nutcracker, horned grebe, Barrow's goldeneye, hooded merganser, ruffed grouse, Vaux's swift, calliope hummingbird, Lewis's woodpecker, three-toed woodpecker, willow flycatcher, Hammond's flycatcher, winter wren, veery and lazuli bunting. Bull trout, westslope cutthroat trout, shorthead sculpin, tailed frogs, boreal toads, also live in aquatic areas in the Apgar Village and Lake McDonald developed areas. Columbia spotted frogs, boreal toads and long-toed salamanders occur in the Rising Sun developed area.

- Two Medicine

  The threatened Canada lynx, gray wolf and grizzly bear, as well as the endangered bald eagle, are known to live in the Two Medicine area. Thirty-two wildlife species of concern also live in the area, including the fisher, wolverine, Rocky Mountain bighorn sheep, great gray owl, boreal owl, northern goshawk, golden eagle, harlequin duck, common loon, pileated woodpecker, white-tailed ptarmigan, brown creeper, Clark's nutcracker, horned grebe, Barrow's goldeneye, hooded merganser, ruffed grouse, calliope hummingbird, three-toed woodpecker, willow flycatcher, Hammond's flycatcher, winter wren, veery, red-eyed vireo, lazuli bunting, Brewer's sparrow, Columbia spotted frog, tailed frog, boreal toad and westslope cutthroat trout.

  Lynx, gray wolf, grizzly bear and bald eagle are known to use areas in or near the Two Medicine developed area, as well as 17 wildlife species of concern. Species of concern include the fisher, wolverine, Rocky Mountain bighorn sheep, northern goshawk, golden eagle, harlequin duck, common loon, pileated woodpecker, brown creeper, Clark's nutcracker, Barrow's goldeneye, ruffed grouse and winter wren. Columbia spotted frogs, tailed frogs and boreal toads also occur in the Two Medicine drainage in areas of the Two Medicine developed area.

USNPS Photo

- Many Glacier
  The endangered gray wolf and the threatened bald eagle, grizzly bear and Canada lynx are known to live in the Many Glacier area. The federally listed threatened bull trout does not occur in the Many Glacier area; however, this species is found in Swiftcurrent Creek below Lake Sherburne outside the park boundary. There are 28 wildlife species of concern in the Many Glacier area, including the fisher, wolverine, Rocky Mountain bighorn sheep, peregrine falcon, northern goshawk, golden eagle, harlequin duck, pileated woodpecker, olive-sided flycatcher, trumpeter swan, white-tailed ptarmigan, brown creeper, Clark's nutcracker, Barrow's goldeneye, ruffed grouse, calliope hummingbird, three-toed woodpecker, Hammond's flycatcher, winter wren, veery, lazuli bunting, Brewer's sparrow, Columbia spotted frog, boreal toad and long-toed salamander.

  Gray wolf, bald eagle, grizzly bear and lynx are all known to use the Many Glacier and Swiftcurrent developed areas. Gray wolf pack activity and lynx have been documented in the Many Glacier Valley and move throughout the developed areas. Travel corridors for grizzly bears exist near the Many Glacier Hotel and the Swiftcurrent Motor Inn.

  There is no comprehensive information on the exact composition of species of concern found in the Many Glacier developed area. However, the visitor service zone provides habitat for fisher, wolverine, Rocky Mountain bighorn sheep, peregrine falcon, northern goshawk, golden eagle, harlequin duck, common loon, trumpeter swan, Barrow's goldeneye, ruffed grouse, Columbia spotted frog, boreal toad and long-toed salamander.

- Goat Haunt-Belly River
  The endangered gray wolf and the threatened bald eagle, grizzly bear, Canada lynx and bull trout are known to use the Goat Haunt-Belly River area. The St. Mary-Belly River drainage, which includes the area east of the Continental Divide in the Goat Haunt-Belly River area, contains a large amount of lake and stream habitat for bull trout. Thirty-two wildlife species of concern are also known to exist in this area. Species of concern in this area are the fisher, wolverine, Rocky Mountain bighorn sheep, silver-haired bat, great gray owl, boreal owl, peregrine falcon, northern goshawk, golden eagle, harlequin duck, common loon, pileated woodpecker, ferruginous hawk, trumpeter swan, black swift, white-tailed ptarmigan, brown creeper, Clark's nutcracker, horned grebe, Barrow's goldeneye, hooded merganser, ruffed grouse, calliope hummingbird, three-toed woodpecker, willow flycatcher, Hammond's flycatcher and winter wren. Aquatic species of concern found in the Goat Haunt-Belly River area include westslope cutthroat trout, spoonhead sculpin, trout-perch and boreal toad.

  The Montana arctic grayling and Yellowstone cutthroat trout, which are also listed by the Montana Natural Heritage Program as "species of special concern," are found in the Goat Haunt-Belly River area, but are not native to Glacier National Park.

- North Fork
  The threatened bald eagle, bull trout and the endangered Canada lynx, gray wolf and grizzly bear have been documented in the North Fork area. There are five known bald eagle breeding areas in the North Fork, and two gray wolf packs occupy the area. The North Fork of the Flathead drainage

contains a significant amount of lake and stream habitat for bull trout. Forty-four wildlife species of concern are also known to occur in the North Fork area. These species are the northern bog lemming, fisher, wolverine, Rocky Mountain bighorn sheep, great gray owl, boreal owl, northern goshawk, golden eagle, harlequin duck, common loon, pileated woodpecker, black-backed woodpecker, olive-sided flycatcher, northern hawk-owl, trumpeter swan, LeConte's sparrow, black swift, black tern, common tern, loggerhead shrike, white-tailed ptarmigan, brown creeper, Clark's nutcracker, horned grebe, Barrow's goldeneye, hooded merganser, ruffed grouse, long-billed curlew, Vaux's swift, calliope hummingbird, Lewis's woodpecker, three-toed woodpecker, willow flycatcher, Hammond's flycatcher, cordilleran flycatcher, winter wren, veery, red-eyed vireo, lazuli bunting and Brewer's sparrow. The aquatic species of concern in this area are westslope cutthroat trout, shorthead sculpin, tailed frog and boreal toad.

The Yellowstone cutthroat trout, which is also listed by the Montana Natural Heritage Program as a "species of special concern," is found in the North Fork area, but is not native to Glacier National Park.

- Middle Fork
  The threatened bald eagle and bull trout, and the endangered Canada lynx, gray wolf and grizzly bear live in the Middle Fork area. The Middle Fork of the Flathead drainage contains a large amount of lake and stream habitat for bull trout. Thirty-three species of concern live in the area, including the fisher, wolverine, Rocky Mountain bighorn sheep, great gray owl, boreal owl, peregrine falcon, northern goshawk, golden eagle, harlequin duck, common loon, pileated woodpecker, black-backed woodpecker, northern hawk-owl, black swift, white-tailed ptarmigan, brown creeper, Clark's nutcracker, Barrow's goldeneye, hooded merganser, ruffed grouse, Vaux's swift, calliope hummingbird, three-toed woodpecker, willow flycatcher, Hammond's flycatcher, winter wren, veery, red-eyed vireo and lazuli bunting. Aquatic species of concern found in the Middle Fork area include westslope cutthroat trout, shorthead sculpin, tailed frog and boreal toad.

  The Yellowstone cutthroat trout, which is also listed by the Montana Natural Heritage Program as a "species of special concern," is found in the Middle Fork area but is not native to Glacier National Park.

Federally and State Listed Plant Species

No federally listed threatened or endangered plants have been identified in Glacier National Park at this time. The park may have habitat for the federally threatened water howellia (*Howellia aquatilis*), which 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 park wetlands that have been surveyed. Spalding's catchfly *(Silene spalding)* has recently been listed by the Fish and Wildlife Service as a threatened species. This species occurs in Montana; however, no potential habitat for the species has been identified in Glacier National Park.

The Fish and Wildlife Service lists the slender moonwort (*Botrychium lineare*), a plant species found in Glacier National Park, as a candidate species. The Montana Natural Heritage Program ranks the slender moonwort as a G1/S1 species, meaning that both on a global and state level, the plant is "critically imperiled because of extreme rarity (five or fewer occurrences or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction." Slender moonwort grows in open meadows, under trees, roadside ditches, and on limestone cliffs at higher elevations. It has been found in early successional habitats in the Many Glacier and Chief Mountain Road areas.

The following are plant, moss, and lichen species of concern for Glacier National Park according to species listed as plant "species of special concern" by the Montana Natural Heritage Program. The rank for these species includes the state rank by the Natural Heritage Program, unless the plant is also globally rare, in which case its global rank is also listed.

There are 68 vascular plant species, 35 moss species and two lichen species of concern that are known to occur in Glacier National Park. For many of these species, there is also suitable habitat outside the park.

TABLE 3-3. VASCULAR PLANT SPECIES OF CONCERN

Code Definitions

GHBR=Goat Haunt-Belly River; GTSR=Going-To-The-Sun Road; MF=Middle Fork; MG=Many Glacier; NF=North Fork; TM=Two Medicine

G = global status; S = state-wide status; T = rank for subspecific taxon; Q = taxonomic questions involved; H = historically known only from records before 1925; may be rediscovered

1 = Critically imperiled (<5 occurrences) because of extreme rarity or because of some factor of its biology making it especially vulnerable to extinction.

2 = Has demonstrable factors making it vulnerable to extinction throughout its range (6 to 20 occurrences).

3 = Either very rare or local throughout its restricted range (21 to 100 occurrences) or vulnerable to extinction because of other factors.

4 = Apparently secure, though it may be quite rare in parts of its range, especially at the periphery.

5 = Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery.

? = Inexact or uncertain. For numeric ranks, denotes inexactness.

Common Name	Scientific Name	Habitat	Location	Rank
Round-leaved orchis	*Amerorchis rotundifolia*	along streams and in wet woods, usually with good drainage, often on limestone	GHBR	G5/S2 S3
lyre-leaf rockcress	*Arabis lyrata var. kamchatica***	open, rocky slopes in montane and subalpine zones	GTSR	G5T5/ S2
wavy moonwort	*Botrychium crenulatum*	wet mossy areas, meadows, stream bottoms, around seeps, on edges of marshes, and in wet roadwide swales	NF	G3/S2
western moonwort	*Botrychium hesperium*	grasslands or low vegetation in gravelly soils in the valleys and foothills	MG, MF, NF	G3/S2
mountain moonwort	*Botrychium montanum*	deep litter of springy, mature forests; also in riparian thickets, mesic meadows, and grassy trail edges where there is little vegetated cover	GTSR	G3/S3
pale moonwort	*Botrychium pallidum***	fescue grasslands in the valley zone	NF	G2G3/ S1
peculiar moonwort	*Botrychium paradoxum*	near lakeshores, open meadows, and in dense stands of tall herbs in foothill and subalpine zones, often on disturbed sites near the Continental Divide	MG, NF	G3/S2
few-seeded bittercress	*Cardamine oligosperma var. kamtschatica*	moist, sparsely vegetated cliffs at talus slopes above timberline	NF	G5/S1

Common Name	Scientific Name	Habitat	Location	Rank
creeping sedge	*Carex chordorhiza*	sphagnum bogs at low elevations	NF, GTSR	G5/S2
maritime sedge	*Carex incurviformis var. incurviformis*	wet rock ledges and small streams above treeline	GTSR	G4G5T4 T5/S1
lens-fruited sedge	*Carex lenticularis var. dolia***	wet meadows and boggy ground, along ponds and shallow streams	NF, GTSR	G5T3Q/ S2
pale sedge	*Carex livida****	cold, calcareous, poorly drained lowlands and wet peaty ground at low elevations in foothill and submontane zones, shade intolerant	GTSR	G5/S3
rock sedge	*Carex petricosa***	barren, stony, limestone soils	TM	G4/S1
beaked sedge	*Carex rostrata***	organic soils of fens and floating peat mats	NF, GTSR	G5/S1
thin-flowered sedge	*Carex tenuiflora***	in montane zone around 5,000-ft elevation	NF	G5/S1
bright sedge	*Carex tincta*	meadows, open woods, sloughs, and roadsides	GHBR	G4G5/ SU
pink corydalis	*Corydalis sempervirens**	rocky, dry soils of eroding or disturbed slopes, frequently after a burn	MG, GHBR, NF, GTSR	G4G5/ S1
spotted lady-slipper	*Cypripedium passerinum*	moist to wet forest at low elevations, sand dune complexes, and near streambanks and lakeshores; prefers open habitat to shade	NF. GHBR	G4G5/ S2
mountain bladder fern	*Cystopteris montana***	moist areas in the mountains at mid to high elevations	GTSR	G5/SH
Alaskan clubmoss	*Diphasiastrum sitchense*	meadows and open rocky places at mid to high elevations	GTSR	G5/S3
dense-leaf draba	*Draba densifolia*	gravelly and stony, open soil of rocky slopes and exposed ridges from the mid-montane to alpine zones	MG, GTSR	G5/S2
Macoun's draba	*Draba macounii***	moist to wet areas of cool, slopes, outcrops and streams above treeline	GHBR, GTSR	G3G4/ S1
English sundew	*Drosera anglica*	with moss in wet, organic soils of fens, swamps and bogs in the montane zone	MF, GTSR	G5/S2
Buckler fern	*Dryopteris cristata*	moist forest, thickets, marshes, swamps, and sphagnum bogs at low elevations	MF	G5/S2
northern wildrye	*Elymus innovatus*	sandy meadows, riparian areas, rocky hillsides, and in open lodgepole or spruce forests	GHBR	G5/S1
giant helleborine	*Epipactis gigantea*	open, wet sites, and in mossy shady areas along rivers, streams, meadows, seeps, and hanging gardens from warm desert shrub to spruce communities	GTSR	G4/S2
Lackschewitz' fleabane	*Erigeron lackschewitzii*	gravelly, calcareous soil/talus on ridgetops at mid to high elevations	GHBR	G3/S3
slender cottongrass	*Eriophorum gracile*	in wet, organic soil of fens at mid to high elevations	NF, MF, GTSR	G5/S2
northern eyebright	*Euphrasia arctica var. disjuncta*	in alpine bogs, moist peaty soil, streambanks, and other wet places	MG, GTSR	G5/S1

Common Name	Scientific Name	Habitat	Location	Rank
viviparous fescue	*Festuca vivipara***	moist to wet alpine turf often on slopes between 7,000-8,000 feet	NF, GTSR	G54G5 Q/S2
glaucous gentian	*Gentiana glauca***	wet to boggy soils of rock ledges at or above treeline	GTSR	G4G5/ S1
Macoun's gentian	*Gentianopsis macounii*	boggy soil of wet meadows and fens in the foothill zone	GHBR	G5/S1
northern rattlesnake-plantain	*Goodyera repens*	shade-loving species found in cool, coniferous forests, usually with a mossy understory	NF	G5/S3
bractless hedge-hyssop	*Gratiola ebracteata*	drying mud around ponds in the foothills and on the plains	MF, TM	G4/S1
three-flowered rush	*Juncus albescens*	peatlands and moist, well-developed turf and gravelly soils along streams and seeps in the alpine zone	GTSR, MG	G5/S2
pale laurel	*Kalmia polifolia*	in peat-lands, including spruce forest and outer lake margins in the montane zone	GTSR, NF	G5/S1
simple kobresia	*Kobresia simpliciuscula*	moist, organic soils in alpine turf on exposed slopes	GTSR, MG	G5/S2
pinewoods sweetpea	*Lathyrus bijugatus*	open ponderosa pine and western larch forests at low to mid elevations	NF	G4/S1
ground pine	*Lycopodium dendroideum*	low elevations in moist, montane forest	GHBR, GTSR	G5/S1
running pine	*Lycopodium lagopus***	turf along moist slopes at mid to high elevations	GTSR	G5/S1
short-flowered monkeyflower	*Mimulus breviflorus***	vernally moist soil among rock outcrops in coniferous forests or grasslands at mid elevations	MF	G4/S1
adder's tongue	*Ophioglossum pusillum*	wet meadows, margins of fens, and gravelly moist soil at low to mid elevations	GTSR	G5/S2
stalked-pod crazyweed	*Oxytropis podocarpa*	exposed rocky alpine ridges or turfy alpine hillsides, often on limestone substrates	MG	G4/S1
alpine glacier poppy	*Papaver pygmaeum*	rocky, open slopes at high elevations	GTSR, NF, TM, MG	G3/S3
palmate-leaved coltsfoot	*Petasites frigidus var. nivalis***	wet forested areas	GHBR, NF	G5/S1
Banff loose-flowered bluegrass	*Poa laxa ssp. banffiana***	mudstone slopes and alpine turf at high elevations	MG	G5?T1/ S1
Austin's knotweed	*Polygonum douglasii ssp. austinae*	open, graveled, often shale-derived soil of eroding slopes and banks in the montane zone	MF	G5T4/ S2/S3
blunt-leaved pondweed	*Potamogeton obtusifolius*	shallow waters from low to high elevation	MF	G5/S2

Common Name	Scientific Name	Habitat	Location	Rank
five-leaf cinquefoil	*Potentilla quinquefolia*	dry, gravelly soil of windswept ridges and slopes in the alpine zone	GTSR, TM	G5T4/ S2
one-flowered cinquefoil	*Potentilla uniflora*	open, gravelly slopes and ridgetops at high elevations	TM, MG	G5/S1
heart-leaved buttercup	*Ranunculus cardiophyllus*	moist meadows in the foothill zone	GHBR	G4G5/ S2
northern buttercup	*Ranunculus pedatifidus*	moist meadows, grasslands, alpine tundra, or open, rocky soil on windswept ridges; grows best in calcareous regions	GTSR, TM	G5/S1
timberline buttercup	*Ranunculus verecundus*	meadows, moraines, open slopes and ridges, often in gravelly areas at treeline	GHBR, GTSR, NF, MG	G5/S2
arctic pearlwort	*Sagina nivalis****	moist, open, gravelly soil in the alpine zone	GHBR	G5/S1
Barratt's willow	*Salix barrattiana*	boggy meadows, moist open hillsides in mountains and along lakeshores and streambanks	GTSR	G5/S1
autumn willow	*Salix serissma*	cold, often calcareous bogs at low to mid elevations	MG	G4/S2
pod grass	*Scheuchzeria palustris*	wet, organic soil of fens and bogs at low to mid elevations	GTSR	G5/S2
tufted club-rush	*Scirpus cespitosus*	wet meadows and bogs at low to high elevations	GTSR, MG	G5/S2
Hudson's Bay bulrush	*Scirpus hudsonianus**	wet meadows and springs at low to mid elevations	GTSR, MG	G5/S1
water bulrush	*Scirpus subterminalis*	submerged in rivers, ponds, lakes, streams, and standing water up to 3 or 4 feet deep at low elevations	GTSR	G4G5/ S2
small-flowered groundsel	*Senecio pauciflorus*	moist meadows and cliffs at mid elevations	NF	G4G5/ S1
northern beechfern	*Thelypteris phegopteris*	boreal, wet temperate, cool mesothermal climates on moist, calcareous cliff crevices or moist banks in rich, damp forest floors	GTSR	G5/S2
little false asphodel	*Tofieldia pusilla***	moist, often shallow soils in alpine areas	MG, GTSR	G5/S2
cushion townsendia	*Townsendia condensata*	open, rocky, soil of exposed slopes and ridgetops at mid to high elevations	MG, TM	G4/S2
Flat-leaved bladderwort	*Utricularia intermedia*	shallow, standing, or slow-moving water	GTSR	G5/S1
Velvetleaf blueberry	*Vaccinium myrtilloides*	moist to rather dry forests in the montane zone	GTSR	G5/S1

* only locations in the western US
** only location(s) in Montana
*** only location for the northern Rocky Mountains

TABLE 3-4. MOSS SPECIES OF CONCERN

Scientific Name	Habitat	Location	Rank
Brachythecium turgidum	partially submerged in pond on tundra	GTSR	G4/ S1
Bryum lonchocaulon	moist, peaty soils	NF, GTSR	G5?/ S1
Bryum pallens	on soil or rocks	MG, GTSR	G4G5/S1
Bryum schleicheri	wet rock surfaces	GTSR	G5?/ S1
Dichodontium olympicum	wet rock surfaces and soil	GTSR	GU/S1
Dicranella grevilleana	moist shaded banks	GTSR	G2G4/S1
Dicranella heteromalla	moist peaty slight slopes	GTSR	G5?/S1
Dicranum fragilifolium	moist shaded banks and slopes and on rotting wood	GTSR	G4G5/S1
Distichium inclinatum	rock surfaces	TM, GTSR	G4G5/S1
Grimmia mollis	rock and occasionally tundra	GTSR	G3G5/ S1
Kiaeria blyttii	rock at mid to high elevations	NF, GTSR	G5/S1
Kiaeria starkei	peaty soils, stream edges, ledges and banks	GTSR	G5/S1
Meesia longiseta	in swamps and sphagnum bogs	GTSR	G4?/S1
Meesia triquetra	moist to wet soils	GTSR	G5/S2
Meesia uliginosa	peaty or calcareous soils, fens, and in wet depressions at high elevations	GTSR	G4/S1
Myurella tenerrima	soil, cliffs, banks and overhangs; fens at mid elevations	GTSR	G3G4/S1
Neckera douglasii	lakeshore	GTSR	G4/S1
Paludella squarrosa	fens, springs, meadows and seeps in tundra at high elevations	GTSR	G3G5/S1
Paraleucobryum enerve	acidic tundra, often in depressions and at the top of rock outcrops at high elevations	GTSR	G5?/S1
Paraleucobryum longifolium	acidic tundra and on rock outcrops at high elevations	GTSR, MF	G5/S1
Plagiobryum demissum	wet rock	GHBR	G3G5/S1
Plagiobryum zierii	wet rock	GTSR, NF	G3G4/S1
Pohlia drummondii	wet to moist soils including clay at mid to high elevations	GTSR	G3G4/S1
Pohlia obtusifolia	cold, wet soil such as the edge of snowfields	GTSR	G2G4/S1
Pseudocalliergon turgescens	wet rock in alpine zone	GTSR	G3G5/S1
Schistostega pennata	moist to wet dark places such as caves and overturned bases of trees	GTSR	G4/S1
Sphagnum centrale	fens and bogs at low to high elevations	GTSR, NF	G5/S1
Sphagnum contortum	fens and bogs at low to high elevations	GTSR	G5/S1
Sphagnum girgensohnii	fens and bogs at low to high elevations	MG, GTSR	G5/S1
Sphagnum magellanicum	fens and bogs at low to high elevations	NF	G5/S1

Scientific Name	Habitat	Location	Rank
Stegonia latifolia	dry soil	GTSR	G3G5/S1
Tayloria lingulata	fens, preferably slightly acidic, at high elevations	GTSR	G3G5/S1
Tayloria serrata	dung, decomposing wood, and soil	GTSR, TM	G4/S1
Thamnobryum neckeroides	rock in the alpine zone	GTSR	G?/SH
Tortula norvegica	wet soils and rocks in the alpine zone	GTSR, MF	G5/S1

TABLE 3-5. LICHEN SPECIES OF CONCERN

Scientific Name	Habitat	Location	Rank
Bryoria subdivergens	alpine sod at high elevations	GTSR	G2/S2
Collema curtisporum	bark of Populus species	GTSR	G3/S2

Plant Species of Special Concern by Area

The following section lists plant species of special concern found in the Going-to-the-Sun Road Corridor and developed areas.

- Going-to-the-Sun Road Corridor
  There are 52 plant species of concern in the McDonald Valley, including 27 vascular plant species, 24 mosses and one lichen. Plant species include mountain moonwort, western moonwort, wavy moonwort, adder's tongue, slender cottongrass, pod grass, pale laurel, creeping sedge, pale sedge, lens-fruited sedge, tufted club-rush, English sundew, ground pine, Alaskan clubmoss, alpine glacier poppy, velvetleaf blueberry, Hudson's Bay bulrush, flat-leaved bladderwort, lyre-leaf rockcress, pink corydalis, giant helleborine, Macoun's draba, glaucous gentian, water bulrush and northern beechfern. It is possible that beaked sedge may also be located in this valley. Mosses include *Brachythecium turgidum*, *Bryum lonchocaulon*, *Bryum pallens*, *Dichodontium olympicum*, *Dicranella heteromalla*, *Dicranum fragilifolium*, *Distichium inclinatum*, *Kiaeria blyttii, Kiaeria starkei, Grimmia mollis, Meesia triquetra, Neckera douglasii*, *Paraleucobryum longifolium, Plagiobryum zierii, Pohlia drummondii, Pohlia obtusifolia, Pseudocalliergon turgescens, Schistostega pennata*, *Sphagnum centrale*, *Sphagnum contortum, Sphagnum girgensohnii, Tayloria serrata, Tortula norvegica and Thamnobryum neckeroides.* The lichen is *Collema curtisporum*.

  There are 21 vascular plant species of concern and 12 moss species of concern in the St. Mary Valley. Plants include dense-leaf draba, rock sedge, northern eyebright, little false asphodel, simple kobresia, three-flowered rush, timberline buttercup, five-leaf cinquefoil, northern buttercup, pink corydalis, viviparous fescue, lens-fruited sedge, Barratt's willow, Macoun's draba, mountain bladder fern, northern beachfern, maritime sedge, pale laurel, running pine, alpine glacier poppy and tufted club-rush. Moss species are *Bryum schleicheri*, *Dicranum fragilifolium, Dicranella grevilleana*, *Kiaeria starkei*, *Meesia longiseta, Meesia uliginosa*, *Myurella tenerrima, Paludella squarrosa, Paraleucobryum enerve, Stegonia latifolia*, *Tayloria lingulata* and *Tortula norvegica*.

One plant species of concern, mountain moonwort, has been observed in the Apgar Village area.

There is a historic record showing a moss species of concern, *Neckera douglasii*, in the Lake McDonald developed area below the lodge. However, there have been no observations of this species since 1901, and a survey in 2001 could not relocate it.

In the Rising Sun developed area, there is a record of a historic sighting of pink corydalis. However, no observations of this species have been made since 1928, and a survey in 2001 could not relocate this plant that typically grows in recently burned areas.

- Two Medicine
  There are eight plant species of concern in the Two Medicine area: cushion townsendia, bractless hedge hyssop, five-leaf cinquefoil, one-flowered cinquefoil, northern buttercup and mosses *Distichium inclinatum* and *Tayloria serrata*.

  There are no plant species of concern in the Two Medicine developed area.

- Many Glacier
  There are 18 vascular plants of concern in the Many Glacier area: western moonwort, slender moonwort, peculiar moonwort, pink corydalis, dense-leaf draba, northern eyebright, three-flowered rush, Hudson's Bay bulrush, little false asphodel, cushion townsendia, Banff loose-flowered bluegrass, one-flowered cinquefoil, stalked-pod crazyweed, alpine glacier poppy, autumn willow, tufted club-rush, simple kobresia and timberline buttercup. There are also two moss species of concern in this area: *Bryum pallens* and *Sphagnum girgensohnii.*

  There is one historical record of pink corydalis near the Many Glacier Hotel. However, no observations of this species have been made since 1948, and a survey in 2001 could not relocate this plant that typically grows in recently burned areas.

  There are no plants of special concern in the Swiftcurrent developed area.

- Goat Haunt-Belly River
  Species of concern in the Goat Haunt Valley include bright sedge, ground pine and pink corydalis. There are 12 plant species of concern in the Belly River Valley: palmate-leaved coltsfoot, Macoun's gentian, spotted lady-slipper, round-leaved orchid, northern wildrye, Macoun's draba, Lackschewitz' fleabane, arctic pearlwort, timberline buttercup, heart-leaved buttercup and moss *Plagiobryum demissum*.

- Middle Fork
  Ten plant species of concern grow in the Middle Fork Valley, including slender cottongrass, English sundew, buckler fern, bractless hedge-hyssop, western moonwort, short-flowered monkeyflower, blunt-leaved pondweed, Austin's knotweed and mosses *Paraleucobryum longifolium* and *Tortula norvegica*.

NATURAL SOUNDS

An important part of the mission of the National Park Service is to preserve the natural "soundscapes" associated with national parks. Natural soundscapes are the unspoiled sounds of nature. They are an important resource and have intrinsic value as a part of the unique environment of Glacier National Park. Natural sounds of wind, water, animals and other natural phenomena predominate throughout most of the park.

Natural soundscapes are the unimpaired sounds of nature.

Human activities in the park generate artificial noise that varies, depending on time and location. Sources of noise in the park include road traffic, motorboats, scenic air tours, railroad traffic, developed area activity and general maintenance and administrative activities (chainsaws, helicopter flights and emergency vehicle sirens). Elevated noise levels are generally concentrated near campgrounds, lodging, roads and developed areas. Noise from scenic air tours can be heard throughout the park. Future development outside the park, including mineral development, logging and new construction, may also lead to increased noise in the park.

The highest amount of noise is in the developed areas in the park, including the Apgar Village, Lake McDonald, Rising Sun, Two Medicine, Many Glacier and Swiftcurrent developed areas. Traffic, motorboats, people, music and facility management noises prevail in these areas. Road traffic and people generate most of the noise along Going-to-the-Sun Road. Noise in day use zones may include traffic, some motorized boating, horses and people, but natural sound is still prevalent. There is less noise in the rustic zones due to limited traffic, people and horses. The backcountry zones are dominated by natural quiet, except for periodic helicopter flights.

AIR QUALITY

Glacier National Park is classified as a mandatory Class I area under section 162(a) of the Clean Air Act. The act gives the federal land manager and the park manager the responsibility for protecting air quality and related values, including visibility, vegetation, wildlife, soils, water quality, cultural resources, recreational resources and public health, from adverse air pollution impacts. There are no major metropolitan areas within 125 miles of the park, and no regional smog typical of highly populated areas with a high amount of vehicle traffic. The Columbia Falls, Kalispell and Whitefish areas, all just west of Glacier National Park, currently do not attain national air quality standards for fine particulate matter (PM10). The International Air Quality Advisory Board (1998) 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.

Air quality is considered good in Glacier National Park. Airborne particulate matter, including smoke from both natural and manmade fires and dust from unpaved roads, occasionally impairs visibility. Sulfuric compounds, including sulfur dioxide and ammonium sulfate from industrial emissions, can also contribute to local haze. Visibility problems in the park can be more severe when there are inversions. Flathead County, which includes the part of the park west of the Continental Divide, is in nonattainment for particulate matter having an aerodynamic diameter of 10ug or less (PM-10). Flathead county implements measures contained in a PM-10 control plan to ensure ambient concentrations of PM-10 do not exceed the National Ambient Air Quality Standards.

The annual visibility levels at Glacier National Park are approximately 52 miles, which is lower than typical in the central Rocky Mountains but higher than many eastern sites. Concentrations of fine

particles suspended in the ambient air impair visibility. Fine aerosol and coarse aerosol concentrations averaged 5.5 $\mu g/m^3$ each. There were no strong seasonal variations except for nitrate, which showed a strong winter peak, and coarse mass, which peaked in the winter. Organics contribute by far the largest amount of fine particle mass (58.4%) followed by sulfate (17.9%), soil (10.4%), light-absorbing carbon (7.7%) and nitrate (5.6%). The organic and soot particles come from vegetative burning and urban sources; sulfates and nitrates come from sources of sulfur dioxide and nitrogen oxides, such as power plants; and coarse mass and soils come from wind blown dust.

Concentrations of sulfate and nitrate ion in precipitation that have been measured in Glacier National Park are comparable on average to other sites in the northwestern United States, but are very low compared to most sites in the eastern United States. In 1997, the park reported a sulfate ion concentration of 0.3 milligrams per liter (mg/L) and a nitrate ion concentration of 0.5 mg/L.

The annual maximum for one-year ozone levels at Glacier National Park is lower than those measured at most of the other monitoring sites on the National Park System. Between 1992 and 1997, the park's annual daily maximum one-hour concentrations were between 58 and 77 ppb. The park's peak ozone levels are comparable to those measured at other National Park System sites in the Pacific Northwest but are much lower than levels measured in National Park System sites in southern California and in the northeast and east-central United States. The park's ozone levels are also well below the U.S. Environmental Protection Agency's eight-hour average ozone standard designed to protect human health.

Winter inversions cause local increases in carbon monoxide at Kalispell, 33 miles southwest of the park's entrance at West Glacier. Most of Flathead County's 70,000 residents live within 15 miles of Kalispell, the largest city in northwestern Montana. Emissions from vehicles, wood-burning stoves and the Columbia Falls Aluminum Company, combined with winter meteorological conditions, cause seasonal increases in carbon monoxide (NPS 1998a).

The main sources of pollutants that surround Glacier National Park west of the Continental Divide are industrialized areas south and west of the park. East of the Continental Divide, pollutants in the air entering the park are often associated with northern air flows from the Canadian Rocky Mountain front. The United States and Canada are considering a variety of air quality tools for managing the issue of air quality across boundaries.

Glacier National Park participates in several air quality monitoring programs. The National Dry Deposition Network measures gaseous pollutants and meteorological information. 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 (IMPROVE) measures visual range, air temperature and relative humidity. Visibility conditions are measured by the IMPROVE sampler, 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.

Air quality issues remain the same throughout all of Glacier National Park.

CULTURAL RESOURCES

Recent archaeological evidence suggests that the Clovis people, believed to be the ancestors of American Indians, occupied and used the Glacier National Park area 10,000 to 12,000 years ago (Rockwell 1995). Archaeological and historical evidence of temporary camps and trails shows seasonal use of the area for hunting, fishing, plant gathering and religious practice (Cherry 2001a). Year-round occupation of the area seems to have occurred as early as 5000 B.C. in the Waterton Lakes area. There is evidence of base camps and winter kills in and around Waterton Lakes (Reeves 1970), and of smaller kills and occupation sites in higher meadows, used during the summer and early fall. By the time the first European explorers came, several different tribes inhabited the area. The Blackfeet Indians controlled the wide prairies east of the mountains, and the Salish and Kootenai Indians lived and hunted in the western valleys, and traveled east of the mountains to hunt buffalo.

The fur trade motivated much of the early exploration of the Glacier National Park area by Europeans. Between 1730 and 1850, French, British and American fur traders entered the area to search for beaver pelts. They openly traded with the Indians, introducing the tribes to horses, guns and alcohol. Forts were built, but subsequently, they were mostly abandoned and destroyed. During the period from around 1850 to 1900, settlers and miners came to the area looking for land and minerals, but mining was eventually considered unprofitable. The Great Northern Railway was extended to Kalispell in 1891, and the first permanent residents moved to Lake McDonald in 1892. These residents discovered that they could feed and house wealthy visitors who came to the area, and tourism quickly became a way for settlers to make a living.

In 1897, President Cleveland set aside most of the park's current areas as a "forest reserve," but this status did not preclude mining, hunting, or settling. One of the first park rangers, Frank Liebig, was assigned in 1902. He was in charge of maintaining order and enforcing regulations in the half million acres of forest reserve. Conservationists George Bird Grinnell and Dr. Lyman Sperry promoted turning the land into a national park and helped popularize and romanticize the beauty of the area. The Great Northern Railway, which had tracks that ran just along the south end of the present park, also expressed great interest in the development of a national park, and on May 11, 1910, President Taft signed the bill creating Glacier National Park.

The Great Northern Railway funded most of the construction of the first park structures. A Swiss-style hotel and chalet system was created to attract wealthy tourists to the west. With Glacier Park Hotel (now Glacier Park Lodge), Many Glacier Hotel, the Lewis Glacier Hotel (now Lake McDonald Lodge) and a string of Swiss-style chalets, tourists could ride horseback through several sections of the park. In the early years, only the very wealthy could afford to tour the park, but in the 1920s it became apparent that the park needed to accommodate the increasing number of motorists in America. Going-to-the-Sun Road was dedicated in 1933, allowing motorists to drive through the park. From the 1930s on, when the typical tourists were no longer wealthy rail-riders but traveling motorists, auto camp areas and motels were built at Rising Sun and Swiftcurrent to cater to tourists.

The "Mission 66" program, implemented in 1956 with expected completion by the 50th anniversary of the National Park Service in 1966, was a plan to improve and expand visitor services by increased

staffing, construction of modern buildings, and improvement of roads, campgrounds and other facilities. Mission 66 represents an important era in the history of the National Park Service. There is a growing recognition of the significance of buildings and structures from this period and within a few years, many of them will qualify for listing in the National Register of Historic Places.

HISTORIC RESOURCES

The National Historic Preservation Act of 1966, as amended, mandates that all properties more than 50 years old that may be affected by a federal action be evaluated for eligibility for listing in the National Register of Historic Places. National register listing has been completed for 357 park buildings and structures. Five buildings and one structure have been designated as national historic landmarks.

The following is a description of historic resources that are in the national register.

Going-to-the-Sun Road Corridor

The Going-to-the-Sun Road corridor has one national historic landmark, two historic districts containing 44 contributing buildings and structures, and two sections of historic trails.

The entire length of Going-to-the-Sun Road from the foot of Lake McDonald to Divide Creek is a national historic landmark, a national historic civil engineering landmark, and a national register historic district. Going-to-the-Sun Road and its associated culverts, tunnels and bridges are listed in the national register as the Going-to-the-Sun Road Historic District. The national historic landmark listing of Going-to-the-Sun Road includes the road and 14 associated principal structures, including bridges, tunnels and an underpass. Going-to-the-Sun Road was the first road in the country with historic landmark status. It was nominated, in part, because no other road had its historic associations, artistic and engineering significance, or exceptional state of preservation and integrity. The road was designated a national historic landmark in part for its distinctive “landscape engineering” that blended the practices of civil engineering and landscape architecture. The nomination stated that no other road combined the historic associations, the artistic and engineering significance, and the excellent state of preservation of Going-to-the-Sun Road. The nomination further recognized the road for its exceptional spatial organization, or the composition and sequence of outdoor spaces in the district; circulation, or the means and patterns of movement through the district; topography, or the ways in which the landscape planning considers the site’s topographic features and modifications to them; vegetation, or the consideration of existing vegetation as well as the management of vegetation by pruning, removal and addition of plant material; and structures, including bridges, tunnels, underpasses and trails.

The Sun Camp Fireguard Cabin, adjacent to Going-to-the-Sun Road near Sun Point, is in the national register.

Glacier National Park Headquarters, at the west entrance of the park, is also a historic district. It includes residential buildings, the mess hall, the community building, the carpenter shop, the auto repair shop, the plumbing and electric shop, the sign shop, the entrance station, the trails office and associated outbuildings.

The Fish Creek Bay Boat House on the west side of Lake McDonald and the Upper Lake McDonald Ranger Station Historic District on the northeast tip of Lake McDonald are in the national register as well. The Upper Lake McDonald Ranger Station Historic District includes the ranger station, the boat house, the barn and its associated outbuildings.

The Sperry Chalet Historic District and the Granite Park Chalet Historic District are in the national register, and both chalets are national historic landmarks because of their Swiss chalet style architecture and as remnants of the linked network of hotels and chalets built by the Great Northern Railway. The Sperry Chalet Historic District includes the Sperry Chalet Dormitory, as well as the kitchen/dining room. The Granite Park Chalet Historic District includes the Granite Park Chalet building and Granite Park Dormitory.

The St. Mary Utility Area Historic District is located adjacent to the park boundary near the entrance at St. Mary. The historic district includes one residence, the district office, the dormitory, the electrical shop, the gas and oil building, repair garage/shop, various equipment sheds and outbuildings and the barn, tack room and blacksmith shop.

The 1913 St. Mary Ranger Station, Packers Roost and the Apgar Lookout in the Going-to-the-Sun Road corridor rustic zone, as well as Gunsight Pass Shelter, Logan Creek Patrol Cabin and Mt. Brown, Swiftcurrent and Heaven's Peak Lookouts in the backcountry zone, are in the national register. Part of the Inside Trail from the Cutbank Ranger Station to the former site of St. Mary Chalet; part of the South Circle Trail from the former Sun Point Chalet site to Many Glacier Hotel; and full trail sections from Sun Point to Sperry Chalet and from Sperry Chalet to Lake McDonald Lodge are also in the national register.

The Apgar area is one of the earliest settled areas of Glacier National Park. The first settlers were Milo Apgar, Charlie Howe and Frank Geduhn, who homesteaded on the south shore in what is now Apgar Village. Because the land was not suitable for farming, the early settlers had a difficult time. They relied on hunting and trapping for food until Mrs. Apgar discovered that tourists would pay for home-cooked meals. The early settlers began to provide travelers with meals and guest cabins, and private homes appeared in the area around the foot of Lake McDonald. Apgar developed into a successful village and has served as a major service center ever since. No buildings or structures in the Apgar Village developed area are in the national register; however, the Apgar Village Schoolhouse, now a privately owned gift store, and the National Park Service Permit Office may be eligible for the national register. (See Map 2-3. Apgar Village Existing Features: Cultural, Visitor Use, Buildings.)

The Lake McDonald area is also one of the earliest established areas. George Snyder built the first hotel on the present Lake McDonald Lodge site in 1895. Between 1904 and 1906, Olive and John E. Lewis took ownership of this hotel and began to construct additional guest cabins. Lewis constructed a new hotel, the Lewis Glacier Hotel, on the site between 1913 and 1914. This is the oldest visitor accommodation remaining in the park. The front of the lodge was built to face the lake because it was originally accessible mainly by boat. The Lewis' sold the lodge to a subsidiary (Dakota and Great Northern Townsite Company) of the Great Northern Railway in 1930, which, two years later, sold it to the federal government at one-half of its purchase price. The hotel was renamed Lake McDonald Lodge. A general store was added to the area in 1927, and the coffee shop and a service station were added to the lodge as part of "Mission 66." In 1978, the Lake McDonald Lodge Historic District was listed in the national register.

Lake McDonald Lodge is the centerpiece of the historic district. The Secretary of the Interior designated the lodge as a national historic landmark in 1987 for its architectural significance. The building's design combines elements of the Swiss chalet style while incorporating elements of the rustic style. The historic district also includes the Lake McDonald Lodge cabins and outbuildings; the Garden Court, Cobb House and Snyder Hall Dormitories, and Nietzling Cabin, the General Store, the Recreation Hall and the Boatmen's Residence. The Lower Snyder Creek Bridge, which is close to the

hotel on the old section of Going-to-the-Sun Road, also contributes to the historic district. (See Map 2-6. Lake McDonald Existing Features: Cultural, Visitor Use, Buildings.)

Cabins were built at Rising Sun to accommodate the increase in motoring tourists and the growing need for more affordable visitor lodging. By 1941, the area contained 19 cabins, a general store and a registration building/dormitory located east of Rose Creek and north of St. Mary Lake and Going-to-the-Sun Road. The cabins are located in an irregular pattern along the natural topographical lines of the wooded area. The original design included two styles of two-unit cabins, one with a full bath and one with a watercloset and sink. This auto camp was the only facility in Glacier National Park that was kept open for tourists during World War II. As part of "Mission 66," a lobby/coffee shop, service station and two medium-priced motels were added. Today, Rising Sun includes 37 motel rooms and 35 cabin units, a restaurant, a camp store, public showers and employee housing.

The Rising Sun Auto Camp Historic District was listed in the national register in 1996 and includes the General Store/Motel, employee dormitories and the original rental cabins. The Rose Creek Campground Camptender's Cabin is also in the national register but is outside of the historic district. (See Map 2-9. Rising Sun Existing Features: Cultural, Visitor Use, Buildings.)

Two Medicine

In the Two Medicine area, there are no historic districts; there are two individually listed buildings, and two sections of historic trail.

On the north side of Cutbank Creek, the Cutbank Ranger Station/Residence, Woodshed and Barn comprise the Cutbank Ranger Station Historic District. Trails from Two Medicine to the former Cutbank Chalets site and from the Cutbank Chalets site to Triple Divide Pass are historic trails in the national register.

The Great Northern Railway built the Two Medicine Chalets in 1914 as part of its string of Swiss chalets. The chalet was located to provide a spectacular view of the surrounding mountains and there was a corral and barn, two boat houses and two piers. Use of the horseback and chalet system declined with the influx of motoring tourists after the opening of Going-to-the-Sun Road in 1933. Lack of public demand for chalet-type accommodations resulted in the burning of the Two Medicine Chalet buildings in 1956. Only the dining hall and a section called Chalet C were left; the dining hall, now the General Store, was designated a national historic landmark in 1987. It was recognized for its Swiss style architecture and association of the Great Northern Railway's chalet system. Swanson Boat House, the General Store and the Two Medicine Campground Camptender's Cabin are listed in the national register. (See Map 2-12. Two Medicine Existing Features: Cultural, Visitor Use, Buildings.)

Many Glacier

In the Many Glacier Area, which includes Swiftcurrent, there are three historic districts containing 64 contributing buildings. The area has one individually listed building and three sections of historic trail.

The Many Glacier entrance station on the north side of Lake Sherburne, as well as the ranger cabin, outbuildings, mess hall and barn are included in the Sherburne Ranger Station Historic District. Portions of the trails from Many Glacier Hotel to the former site of Going-to-the-Sun Chalet, Granite Park Chalet and Cosley Lake are in the national register. Ptarmigan Tunnel is in the national register as well.

The first buildings constructed at Many Glacier were chalets, as part of the Great Northern Railway's Swiss chalet system. Eight chalets were constructed in 1913 on the slope of Mt. Altyn above the future site of the hotel. All but two of the chalets were destroyed by the Heaven's Peak fire in 1936. The two remaining chalets are now the Caretaker's House and the Jammer Dormitory. Soon after the chalets were built, construction of the Many Glacier Hotel began in 1914. A sawmill, built on site east of the hotel, provided the lumber for the hotel's frame, siding and original furniture; and stone for the building's foundation was also quarried on location. The main four-story structure in Swiss Alpine style, as well as the Lower Dormitory, were completed in 1915. In 1917, the Many Glacier Hotel annex was added; and by 1918, additions, including a second annex, pool and support building were completed. The Many Glacier Hotel was the largest hotel in Montana for many years. The sawmill was destroyed in 1925. The Power House was built on the river by 1924, the Boat House was built in 1927, and the Upper Dormitory was built in 1928.

The Many Glacier Hotel District was listed in the national register in1976; the nomination was amended in 1995, and the Secretary of the Interior designated the hotel a national historic landmark in 1987. It is the largest and most significant structure from the Great Northern Railway period, and is the best example of Swiss Alpine architecture remaining in the park.

The Many Glacier Hotel is the center of the Many Glacier Hotel Historic District, which includes the pedestrian trails and footbridges, Caretaker's House, Lower and Upper Dormitories, Jammer Dormitory, Icehouse, Boat Concessioner Housing (historically the Boat House). The Many Glacier horse concessioner barn and bunkhouse, also in the national register, are located east of the Many Glacier Hotel developed area between Swiftcurrent Lake and Lake Sherburne. (See Map 2-15. Many Glacier Existing Features: Cultural, Visitor Use, Buildings.)

When the National Park Service decided to cater to the increasing number of motorists coming to visit Glacier National Park, the Great Northern Railway developed the first cabin camp, known as Swiftcurrent, on a forested site one mile west of Many Glacier Hotel. Twenty-seven cabins were built in 1933, arranged in three circles of nine cabins to imitate rings of Indian tepees. In 1935, a general store was added, and three additional cabins were added the next year. The cabins were moderately priced and became a successful economical alternative to staying in the Many Glacier Hotel. The Heaven's Peak fire of 1936 destroyed all of the original cabins except 12, but the National Park Service replaced most of the cabins and added a coffee shop in 1940. A motor inn was added in 1955. The Swiftcurrent Auto Camp Historic District was listed in the national register in 1996 (Cherry 2001d).

The Swiftcurrent Auto Camp Historic District includes the cabins, laundry and shower building and the Restaurant/Store. The Swiftcurrent Ranger Station Historic District is also located in the Swiftcurrent developed area and includes the ranger station, cabins and outbuildings. The Swiftcurrent Campground Camptender's Cabin is also in the national register. (See Map 2-19. Swiftcurrent Existing Features: Cultural, Visitor Use, Buildings.)

Goat Haunt-Belly River

The Goat Haunt-Belly River area has one historic district containing ten contributing buildings, one individually listed building and two sections of historic trail.

Middle Fork

The Middle Fork area has two historic districts containing six contributing buildings and ten individually listed buildings. The Walton Ranger Station Historic District is in the visitor service zone and includes the ranger station residence and its outbuildings, and eight backcountry cabins.

There are one historic district and several historic patrol cabins and fire lookouts in the Middle Fork backcountry zone.

ARCHAEOLOGICAL AND ETHNOGRAPHIC RESOURCES

The Glacier National Park region remains an area of profound importance to Native Americans ....

Archaeological studies suggest that the ancestors of the Blackfeet, and the Salish and Kootenai people have used and inhabited the area that is now Glacier National Park for over 10,000 years. The Blackfeet, and the Salish and Kootenai Tribes retain close cultural and spiritual ties to the land within the National Park. By the time the first European explorers came into the area, the tribes now collectively known as the Blackfeet lived in the vast prairies east of the Continental Divide. The Salish and Kootenai Indians lived and hunted in the valleys west of the Continental Divide, traveling east of the mountains to hunt buffalo.

With the westward expansion of the United States, European-Americans began settling the region, and the Blackfeet, and Salish and Kootenai were forced onto reservations. In 1855, the Blackfeet Reservation was created beginning at the Continental Divide and extending east, but in 1895 an agreement with the Blackfeet withdrew the land from their reservation that was later to become the eastern part of Glacier National Park. The Blackfeet Reservation today covers the 1.5-million acres of land bordering the east side of the park. The Flathead Indian Reservation is southwest of the park. (See Map 1-1. Vicinity of Glacier National Park.)

Field studies have located over 400 prehistoric and historic archaeological and ethnographic sites in Glacier National Park (NPS 1999c). The prehistoric sites include camps, sites for fishing and hunting, religious sites and a quarry. There are also historic archaeological sites associated with homesteads and other historic developments, such as roads, trails and chalets.

Many archaeological sites and various natural resource features in and associated with Glacier National Park are also important ethnographic resources. Ethnographic resources are elements of the landscape that are linked by members of a contemporary community to their traditional ways of life. The National Park Service more specifically defines ethnographic resources as any “site, structure, object, landscape, or natural resource with traditional cultural meaning and values to associated peoples and other resource users” (NPS Management Policies 2001).

The Glacier National Park region remains an area of profound importance to Native Americans, particularly the Kootenai and Blackfeet, whose traditional associations with these lands extend back well over 1,000 years. Natural features, such as high ridgetops and mountaintops are important vision quest sites; certain plants that grow in the park are used in ceremonies and for healing; and various

animals are believed to possess spiritual powers. Areas in the park that include these resources, and areas where ceremonies were once performed, are sacred to different tribes, including the Blackfeet, and the Salish and Kootenai, and are still used today. While all of the geographic areas in the park have some ethnographic value, there are distinctly important sites in some of the areas.

The archaeological and ethnographic resources of Glacier National Park make up one of the most diverse cultural-historical records of prehistoric resource harvesting, occupancy and vision questing in the Northern Rocky Mountains (Reeves 2000).

Going-to-the-Sun Road Corridor

There are both prehistoric and historic archaeological sites in the Going-to-the-Sun Road corridor. Prehistoric sites in the corridor include evidence of hunting camps, a stone circle, rock cairns, a pictograph site, lithic scatters and a site that demonstrates important cultural and environmental change (Reeves 2000). Historic sites in the area are mostly associated with homesteading and road construction.

Many sites for vision questing have also been identified in the Going-to-the-Sun Road corridor (Reeves 2000).

Two Medicine

Many prehistoric archaeological sites are in the Two Medicine area. Sites include campsites, hunting finds, a rock/cairn alignment related to religion, lithic scatters and isolated finds.

The Two Medicine area contains many ethnographically important areas. In addition to the archaeological evidence listed above, the area is rich in vision quest sites.

Many Glacier

There are several archaeological sites in the Many Glacier Valley. Prehistoric sites include campsites and hunting sites, cairns, isolated finds and lithic scatters (Reeves 2000). Many of the prehistoric archaeological sites in the Many Glacier area, as well as sites identified as vision quest sites, are important ethnographic resources.

Goat Haunt-Belly River

Many archaeological sites connected to prehistoric activities have been found in the Goat Haunt-Belly River area. There is also a prehistoric site that was occupied and used for harvesting resources, and hunting camps, hunting sites, campsites, a pictograph site and lithic scatters (Reeves 2000).

Many vision quest sites have also been identified in the Goat Haunt-Belly River area (Reeves 2000).

Middle Fork

Very few archaeological sites are in the Middle Fork area. Prehistoric lithic scatters and isolated finds have been identified in the Middle Fork Valley.

VISUAL RESOURCES

Glacier National Park is greatly valued for its breathtaking views of sculptured peaks and ridges, deep valleys and sparkling lakes.

GOING-TO-THE-SUN ROAD CORRIDOR

The Going-to-the-Sun Road corridor provides views of a cross-section of the park's environment from the forested lake and streamside areas on each side of the park to the rocky, exposed alpine areas near the Continental Divide.

Dense vegetation in the Apgar Village area limits views but enhances the village/main street scenery. Views to the north down the village main street focus on Lake McDonald as a terminus. The view is partially obstructed by the lakeside Village Inn; however, views from the lakeshore are spectacular. The panoramic view from the lakeshore includes Howe Ridge, Rogers Peak, Stanton Mountain, Mt. Vaught, McPartland Mountain, the Garden Wall, Mt. Cannon, Mt. Brown, Matterhorn, Little Matterhorn, Edwards Mountain, Gunsight Mountain and the Belton Hills.

The Lake McDonald area is densely forested with limited views from in the developed area. From the entrance into the developed area, the view focuses on Lake McDonald Lodge National Historic Landmark. The Lake McDonald lakeside offers unobstructed views of the lake and the surrounding mountains.

The Rising Sun developed area has views of open meadows down-valley to the east and spectacular mountain scenery to the south and west. Views to the south are across St. Mary Lake. The density of vegetation near the cabins filters views in this area and lends to the rustic cabin atmosphere and scenery of Rising Sun.

TWO MEDICINE

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 Two Medicine developed area offers relatively isolated, spectacular mountain scenery. The primary views are across Two Medicine Lake to the mountains, including Rising Wolf Mountain to the northwest. Views from the approach and in the developed area also emphasize the Two Medicine General Store historic landmark against the lake and mountain scenery.

MANY GLACIER

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 developed area were situated to take advantage of the outstanding views. The dominant visual features from the hotel are the views across Swiftcurrent Lake to the mountain peaks. The ridge to the east of the hotel offers 360-degree views up and down the three major valley

systems of the area. Views of the Many Glacier Hotel National Historic Landmark with the backdrop of the lake and mountains are also significant in this area.

The views from the Swiftcurrent developed area are limited due to the density of the surrounding vegetation. Dense vegetation in the area lends to the intentional rustic, cabin-camp scenery of Swiftcurrent. Views open up from the parking lot to the surrounding mountain peaks.

GOAT HAUNT-BELLY RIVER

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. A prominent landmark in this area is Chief Mountain, which strides the park boundary and the Blackfeet Indian Reservation and is visible from a great distance on the plains to the east.

MIDDLE FORK

The Middle Fork area is heavily forested with few viewpoints. Views of mountain peaks are most important along the valley floor of the Middle Fork. The Middle Fork of the Flathead Wild and Scenic River can be viewed at points along the west side of this area.

SOCIOECONOMIC ENVIRONMENT

REGIONAL AND LOCAL COMMUNITIES

The affected socioeconomic region is defined as the three-county area of Flathead, Glacier and Lake Counties. (See Map 1-1. Vicinity of Glacier National Park.) This section discusses economic, employment and demographic characteristics for the three-county area.

Economy

The foundation of the regional economy is mainly based on tourism, agriculture and regional trade. Tourism is a large part of the regional economy and has dramatically increased during the last several years as this region has become one of Montana's leading tourist destinations. The trend in tourism has been estimated by reviewing visitation data from Glacier National Park (NPS 1999c), traffic counts on U.S. Highway 2 (WIS 2001), and accommodations tax revenue (Institute for Tourism 1997). All three show steady growth from 1980 to the mid-1990s. About 20% of all non-resident visitor groups in the state travel through the Flathead-Glacier area and about 50% visit the park. These estimates translate to about 750,000 non-resident park visitors, assuming that 7.7 million non-residents visited Montana in 1993-1994 (NPS 1999c).

While diverse recreational opportunities exist in the region, Glacier National Park is the main cornerstone of the regional tourism economy. The park also offers amenities that attract business and industry, as well as individuals who relocate or

retire in the area. The park's seasonal character greatly influences the regional economy. In the last five years, 59% of the average annual park visitors visited in July and August, 29% visited in the shoulder months of June and September and the remaining eight months attracted only 12% of total annual visitors (MK Centennial 2001a). This seasonal fluctuation in visitation influences regional unemployment rates, average personal income and the success of related tourist businesses.

Production of agricultural goods, including hay, wheat, barley and some hardy fruits and livestock, has been a traditional base of the local economy. Federal crop reduction programs and increased development of agricultural land, however, have caused a decrease in agricultural land and employment in the three-county area (MK Centennial 2001a).

Kalispell is approximately 33 miles from the park's entrance at West Glacier. It has become the main trade center for northwest Montana and is important to regional economic activity.

Flathead and Lake Counties have fairly diverse economic structures, while Glacier County has more concentrated economic sectors. In addition to a wide range of recreational opportunities and tourism-related businesses, Flathead County has a variety of manufacturers, a concentration of professional services serving the region, growing numbers of second-home residents and a developing focus on visual and performing arts. Lake County is less dependent on tourism than Flathead and Glacier Counties. The economy of Lake County is concentrated on timber production, electric power generation, medical care and services related to the developing second-home community. Tourism and agriculture are the main drivers of the economy of Glacier County.

Employment

Employment by economic sector for Flathead, Glacier and Lake Counties is shown in Table 3-6. Most jobs related to the tourism and recreation industry are in the retail trade and services sectors of a county's economy. These two sectors account for an average of 52% of the total employment in the three-county area.

Average annual unemployment in the three-county area is 7.6%. This is much higher than the state average of 5.2%, mostly because of the seasonal character of the local economy. Due to the large tourism basis of the local economy, employment varies seasonally in the three-county area. Employment is at its highest in the summer months and at its lowest in the middle of winter (MK Centennial 2001a).

TABLE 3-6. PERCENT TOTAL EMPLOYMENT BY INDUSTRY

Industry	Flathead County	Glacier County	Lake County
Farm	2.2%	8.4%	9.4%
Agriculture[1]	1.8%	0.0%	2.0%
Mining	0.4%	2.9%	0.4%
Construction	7.9%	0.0%	6.9%
Manufacturing	11.0%	1.3%	9.6%
Transportation, Communications & Utilities	4.3%	3.8%	2.8%
Wholesale	2.8%	1.8%	1.1%
Retail	21.2%	14.6%	17.8%
Finance, Insurance & Real Estate	7.6%	3.7%	5.1%
Services	31.0%	37.6%	34.1%
Government	9.8%	21.1%	10.8%

[1]Includes Agriculture, Forestry and Fishing
Source: Regional Economic Information System, U.S. Bureau of Labor Statistics; U. of Va. Web site

In 2001, the average unemployment rate was 5.9% for Flathead County, 11.1% for Glacier County and 8.6% for Lake County (Montana Department of Labor & Industry). In addition to seasonal jobs that depend on tourism in Glacier County, high unemployment among the Blackfeet Tribe contributes to the increased unemployment rate for this county. The diversification of the economy in Lake County provides year-round employment and more stable levels of employment than in Flathead and Glacier Counties, which are more heavily dependent on tourism (MK Centennial 2001a).

Demographics

Table 3-7 shows selected socioeconomic characteristics for Flathead, Glacier and Lake Counties. American Indians are the leading minority group in the three-county region and therefore are included separately from percent minority population in the table.

There are approximately 114,261 people in the local three-county area, which is approximately 13% of the state's total population (U.S Census 2000). Flathead County is the second largest county in the state and has the fourth largest population. Kalispell, in Flathead County, is the only municipality in the three-county area with more than 10,000 people. In 2000 the population of Kalispell was 14,223. The Blackfeet Indian Reservation covers nearly half of the land in Glacier County and 76% of Glacier County's population is made up of members of the Blackfeet Tribe. The Flathead Indian Reservation, home of the Confederated Salish and Kootenai Tribes, is in Lake County. Over 26% of Lake County's population is American Indian. A higher population of people age 65 and older reflects a trend for Lake County as a popular retirement community.

Over the last several years, there has been sizeable population growth on the west side of the Continental Divide in Flathead and Lake Counties, but growth in Glacier County, on the east side of the mountains, has remained slow. A gradually slower rate of future population growth is expected for the entire three-county area, projected to increase from 114,225 in 2000 to 134,190 in 2010 and 154,260 in 2020 (NPA Data Services Inc.).

TABLE 3-7. SELECTED SOCIOECONOMIC CHARACTERISTICS FOR FLATHEAD, GLACIER AND LAKE COUNTIES, MONTANA

	Flathead County	Glacier County	Lake County	Montana
Population, 2000 Census count[1]	74,471	13,247	26,507	902,195
Population percent change, 1990-2000[1]	25.8%	9.3%	26.0%	12.9%
Percent population 65 years old and over, 1999 estimate[1]	12.8%	9.6%	13.9%	13.3%
Percent American Indian population, 1999 estimate[1]	1.8%	60.0%	24.1%	6.5%
Percent all other minority population, 1999 estimate[1]	1.9%	0.9%	2.4%	2.8%
Per capita personal income, 2000[2]	$23,142	$15,574	$17,809	$22,518
Percent of population below poverty, 1997 model-based estimate[1]	14.2%	33.6%	21.4%	15.5%
Percent unemployment, 2001[3]	5.9%	11.1%	8.6%	4.6%

Sources: [1]U.S. Bureau of the Census, State and County QuickFacts. Data derived from Population Counts1990 and 2000 Census of Population and Housing, Small Area Income and Poverty Estimates, County Business Patterns, and 1997 Economic Census.

[2]Regional Economic Information System, Bureau of Economic Analysis, 2002.

[3]Montana Department of Labor & Industry.

There are many relatively small identified communities within a short driving distance (approximately 45 miles lineal distance) of Glacier National Park, as shown in the following tables, respectively for the west side and east side of the park.

TABLE 3-8. CITIES, TOWNS AND CENSUS DESIGNATED PLACES (CDPS) WITHIN 45 MILES OF GLACIER NATIONAL PARK (WEST SIDE)

City/Town/CDP	County	2000 Census Population
Big Arm CDP	Lake	131
Bigfork CDP	Flathead	1,421
Columbia Falls city	Flathead	3,645
Dayton CDP	Lake	95
Elmo CDP	Lake	143
Evergreen CDP	Flathead	6,215
Hungry Horse CDP	Flathead	934
Kalispell city	Flathead	14,223
Lakeside CDP	Flathead	1,679
Martin City CDP	Flathead	331
Pablo CDP	Lake	1,814
Polson city	Lake	4,041
Rollins CDP	Lake	183
Somers CDP	Flathead	556
Whitefish city	Flathead	5,032
Woods Bay CDP	Lake	748

Source: U.S. Census Bureau, Released March 21, 2001, compiled by the Montana Department of Commerce

TABLE 3-9. CITIES, TOWNS AND CENSUS DESIGNATED PLACES (CDPS) WITHIN 45 MILES OF GLACIER NATIONAL PARK (EAST SIDE)

City/Town/CDP	County	2000 Census Population
Browning town	Glacier	1,065
Cut Bank city	Glacier	3,105
East Glacier Park Village CDP	Glacier	396
North Browning	Glacier	2,200
South Browning	Glacier	1,677

Source: U.S. Census Bureau, Released March 21, 2001, compiled by the Montana Department of Commerce.

In western Montana, incomes are relatively low. Average per capita income for the three-county region, $20,841, is 2% below the state average. Regionally, Flathead County has the highest per capita income and Glacier County has the lowest. Flathead County's per capita income is 10% above the state average. Although Flathead County's percentage of population in poverty is lower than the state average, Glacier and Lake Counties have percentages of population in poverty well above the state average (MK Centennial 2001a).

THE BLACKFEET AND THE CONFEDERATED SALISH AND KOOTENAI TRIBES

As discussed in the Cultural Resources section, archaeological studies suggest that the ancestors of the Blackfeet, and Salish and Kootenai people have used and inhabited the area that is now Glacier National Park for over 10,000 years. The Blackfeet and the Confederated Salish and Kootenai Tribes retain close cultural and spiritual ties to the land within the park.

When European-Americans began settling the region, the Blackfeet, and Salish and Kootenai were forced onto reservations. Today, the Blackfeet Reservation covers the 1.5-million acres of land

bordering the east side of the park. The Flathead Indian Reservation is southwest of the park. (See Map 1-1. Vicinity of Glacier National Park.)

The natural and cultural resources in Glacier National Park are very important to the Blackfeet, and the Confederated Salish and Kootenai Tribes. The mountain region is considered sacred and is an important place for tribal members to go to for spiritual purposes. Various plants and roots found throughout the park, which have traditional healing and curing abilities, as well as certain animals in the park are also considered sacred. Blackfeet, and Salish and Kootenai tribal members continue to use Glacier National Park for religious and traditional practices. Glacier National Park consults with both tribes to ensure the protection of traditional and spiritual resources.

Both reservations offer tourist attractions for visitors to Glacier National Park. The Blackfeet Reservation hosts the Museum of the Plains Indian, and Blackfeet Historic Sites and Tipi Village Tours. The Flathead Reservation contains the People's Center cultural center, Flathead Indian Museum, the National Bison Range/Pablo National Wildlife Refuge, and St. Ignatius Mission.

TABLE 3-10. RESIDENT POPULATION OF THE BLACKFEET AND FLATHEAD INDIAN RESERVATIONS

	2000 Census	1990 Census
Blackfeet Reservation	10,1001	8,549
Flathead Reservation	26,172[1]	21,259

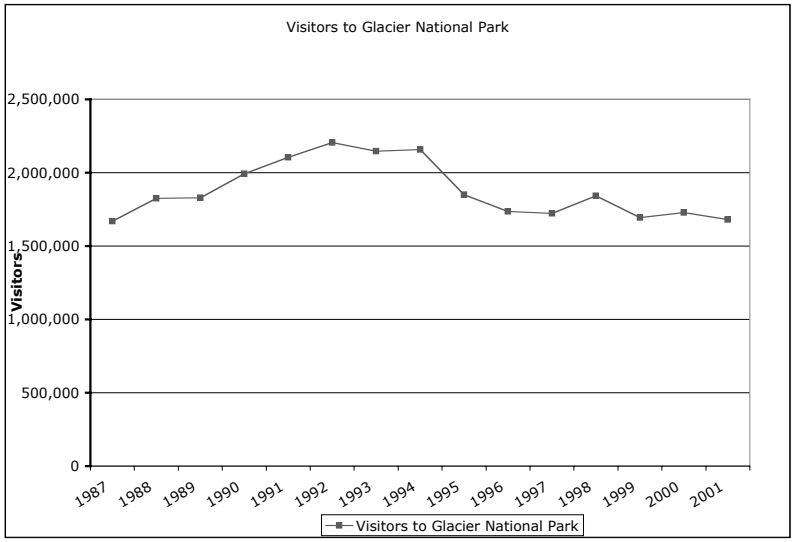
[1] The Census 2000 counted 6,999 residents of the Flathead Reservation identified as American Indians and Alaska Natives alone.

Source: U.S. Census Bureau, Released March 21, 2001, compiled by Montana Department of Commerce.

VISITOR USE AND EXPERIENCE

In recent years, Glacier National Park annual visitation has ranged between 1.7-1.8 million. The highest recorded visitation was 2,204,131, recorded in 1983. Since then, park visitation has exceeded two million only four times. Visitation has fluctuated throughout the years, but the number of visitors has been increasing overall since the park's opening in 1911 (NPS 1999c). Figure 3-1 illustrates the annual visitation levels over the past 15 years (NPS, 2002).

FIGURE 3-1. ANNUAL VISITATION LEVELS OVER 15 YEARS



Forecasts of visitor use for Glacier National Park were modeled and calculated in 2000. Table 3-8 illustrates forecasts, the margin of error, and the upper and lower bounds of forecasts for the years 2002 through 2012 (MK Centennial 2000b).

TABLE 3-11. FORECASTED ANNUAL NUMBER OF VISITORS TO GLACIER NATIONAL PARK

Year	Margin of Error	Lower Bound	Forecast	Upper Bound
2002	185,000	1,641,000	1,826,000	2,011,000
2003	198,000	1,647,000	1,845,000	2,042,000
2004	210,000	1,645,000	1,855,000	2,065,000
2005	223,000	1,638,000	1,861,000	2,084,000
2006	236,000	1,629,000	1,864,000	2,100,000
2007	249,000	1,617,000	1,866,000	2,115,000
2008	262,000	1,605,000	1,867,000	2,129,000
2009	275,000	1,593,000	1,868,000	2,142,000
2010	288,000	1,580,000	1,868,000	2,156,000
2011	301,000	1,567,000	1,868,000	2,169,000
2012	314,000	1,554,000	1,868,000	2,182,000

Glacier National Park is among the most prominent tourist destinations in Montana for both non-residents and Montanans. Based on responses to the "Nonresident Summer Travelers to Montana 2001 Survey" (Institute for Tourism and Recreation Research), 32% of all travelers and 43% of vacationers in Montana visited Glacier National Park, second highest to Yellowstone National Park. The Institute for Tourism and Recreation Research defines "Glacier Country" as the area which includes Missoula, and communities in Flathead, Glacier and Lake Counties. This area constitutes the three-county local and regional area that is evaluated. In the Glacier Country, 33% had overnight stays, the highest of any region in Montana (ibid, p. 4). Missoula, located 141 miles from the west entrance of Glacier National Park, hosted 20% of all overnights within the Glacier Country region, followed by East and West Glacier and St. Mary at 17%, Glacier National Park at 15%, Whitefish at 10%, and Kalispell at 8%. As one reason for their trip, 27% of nonresident travelers cited Glacier National Park, second highest of specified sites to Yellowstone National Park (ibid., p. 11).

Montanans comprise 20% of all U.S. visitors to Glacier National Park (NPS 2000d). For Montana visitors, the average number of trips planned to Glacier within the next 3 years was 21, compared to an average of 3 trips for non-residents (MK Centennial, 2001b, p 118). The National Park Service visitor survey conducted in 2000 also showed that 90% of visitors to Glacier National Park were from the United States and 10% were from a foreign country. Of survey respondents, the average visitor age was 50, while 55% were female and 45% were male. The average travel group size was 2.83 (MK Centennial 2001b).

The survey showed that the average number of days that a group spent in the park was four. The average number of nights spent in the park was also four. The survey asked about visitor travel to different areas of the park and amounts of time spent at each area. The results are shown in Table 3-12.

TABLE 3-12. PERCENTAGE OF VISITORS TO DEVELOPED AREAS AND TIME SPENT AT EACH AREA

Area	Percent of respondents who stopped	Highest % of respondents and length of time stopped
Apgar	48%	28% 15-30 minutes
Lake McDonald	63%	25% 15-30 minutes
Rising Sun	32%	41% < 15 minutes
Two Medicine	18%	36% 1-4 hours
Many Glacier / Swiftcurrent	39%	59% 4 hours - 1 day

The survey found that visitors come to Glacier National Park for a variety of reasons. Sixty-three percent of those contacted said their primary reason for visiting the park on that particular trip was to view the scenery; 16% wanted recreational opportunities such as hiking, biking, boating and camping; 5% wanted to experience a change from their "normal routine;" 4% wanted to enjoy socializing with family and/or friends; 3% came primarily to view wildlife; 2% visited the park primarily to take photographs and 7% visited for other reasons. Eleven percent of visitors camped at night in one of the park's 13 campgrounds, and more than 29,800 person nights were spent in the backcountry. Six percent participated in guided walks, talks and campfire programs, and 40% visited at park visitor education centers (MK Centennial 2001b).

Visitation and occupancy of concessioner lodging varies greatly by season. Typically, the peak visitation season is July and August. The shoulder seasons are May, June, September and October, and the off-season normally includes the months of November to April. Concessioner lodging has been generally available during the months of May through September. Appendix 7 shows detailed monthly visitation records from 1979 through 2001. Weather and factors of state and national economic and political conditions can affect visitation levels.

Commercial Operations in Glacier National Park

There are currently eight concession contracts, roughly 20 incidental business permits, permits with the United States Forest Service for river rafting services, and rotating call out lists related to emergency road services for the provision of commercial services in Glacier National Park. These include:

TABLE 3-13. *Existing Commercial Services in Glacier National Park*

Concessioners	Services Provided	Authorization Type
Glacier Park, Inc.	Lodging Food/Beverage/Catered meals Retail/Vending/ATMs Guided Interpretive Vehicle Tours Public Transportation Public Laundry Public Showers	Concession Contract
Glacier Park Boat Co	Boat Tours Small Boat Rentals	Concession Contract
Waterton International Shoreline Cruise Co	Boat Tour – Waterton Lake	Concession Contract
Glacier Wilderness Guides	Guided Day Hiking Guided Backpacking	Concession Contract
Belton Chalet	Sperry Chalet lodging and food service	Concession Contract
Glacier Wilderness Guides	Granite Park Chalet lodging	Concession Contract
Mule Shoe Outfitters	Guided Horseback Riding Horse Packing Services Horse Boarding at Many Glacier Stables	Concession Contract

Concessioners	Services Provided	Authorization Type
Sun Tours	Guided Interpretive Vehicle Tours	Concession Contract
Various Operators	Guided Art Seminars	Incidental Business Permits
Various Operators	Guided Bicycle Tours	Incidental Business Permits
Various Operators	Guided Photography Workshops	Incidental Business Permits
Various Operators	Guided Ski Tours/Snowshoe Tours	Incidental Business Permits
Various Operators	Emergency road services/towing	Rotating call out list
Various Operators	Guided Rafting	USFS Permits

Other commercial services are provided by private landowners in the Apgar area including:

Eddies Grocery and Restaurant
School House Gifts
Montana House Gifts
Apgar Village Lodge
Cedar Tree Gifts

Some of these services are provided from buildings and facilities within the park and some have their base of operation outside the park boundaries.

ENERGY CONSUMPTION

In April 1999, a memorandum of understanding between the U.S. Department of Energy and the U.S. Department of the Interior was signed to promote the use of energy-efficient and renewable energy technologies and practices in national parks. This initiative will help to fulfill stipulations of both the Energy Policy Act of 1992, which directs the use of energy-efficient building designs and equipment, and Executive Order 12902, Energy Efficiency and Water Conservation at Federal Facilities. Existing historic lodging facilities and the variety of employee accommodations are in most cases inadequately weatherized causing inefficient heating.

The commercial services plan alternatives could potentially produce minor changes in energy consumption. Electricity is the major energy source used for lodging and visitor service facilities. However, some propane is used at the Many Glacier developed area by the boat and horse concessioners, and diesel is used to power all large commercial boats in the park.

LANDOWNERS IN AND ADJACENT TO PARK BOUNDARIES

As discussed above in the section Regional Location and Setting, Glacier National Park is surrounded mostly by publicly owned and Indian reservation land. Most of the land west and south of the park, west of the Continental Divide, is Flathead National Forestland, and to the south and east of the divide is Lewis and Clark National Forestland (known as the Badger-Two Medicine area). The 1.5 million-acre Blackfeet Indian Reservation is on the park's eastern boundary. Canada's Waterton Lakes National Park, province of Alberta is north and east of the Continental Divide, and the province of British Columbia manages land north and west of the Continental Divide. The Akamina-Kishinena Provincial Park, British Columbia, is at the junction of Montana, Alberta and British Columbia.

There is privately owned land surrounding the park. (See Map 3-2. Adjacent Land Use at Glacier National Park.)

Privately owned land in Glacier National Park boundaries includes land that is undeveloped or used for residential, recreational, or commercial purposes.

Going-to-the-Sun Road Corridor

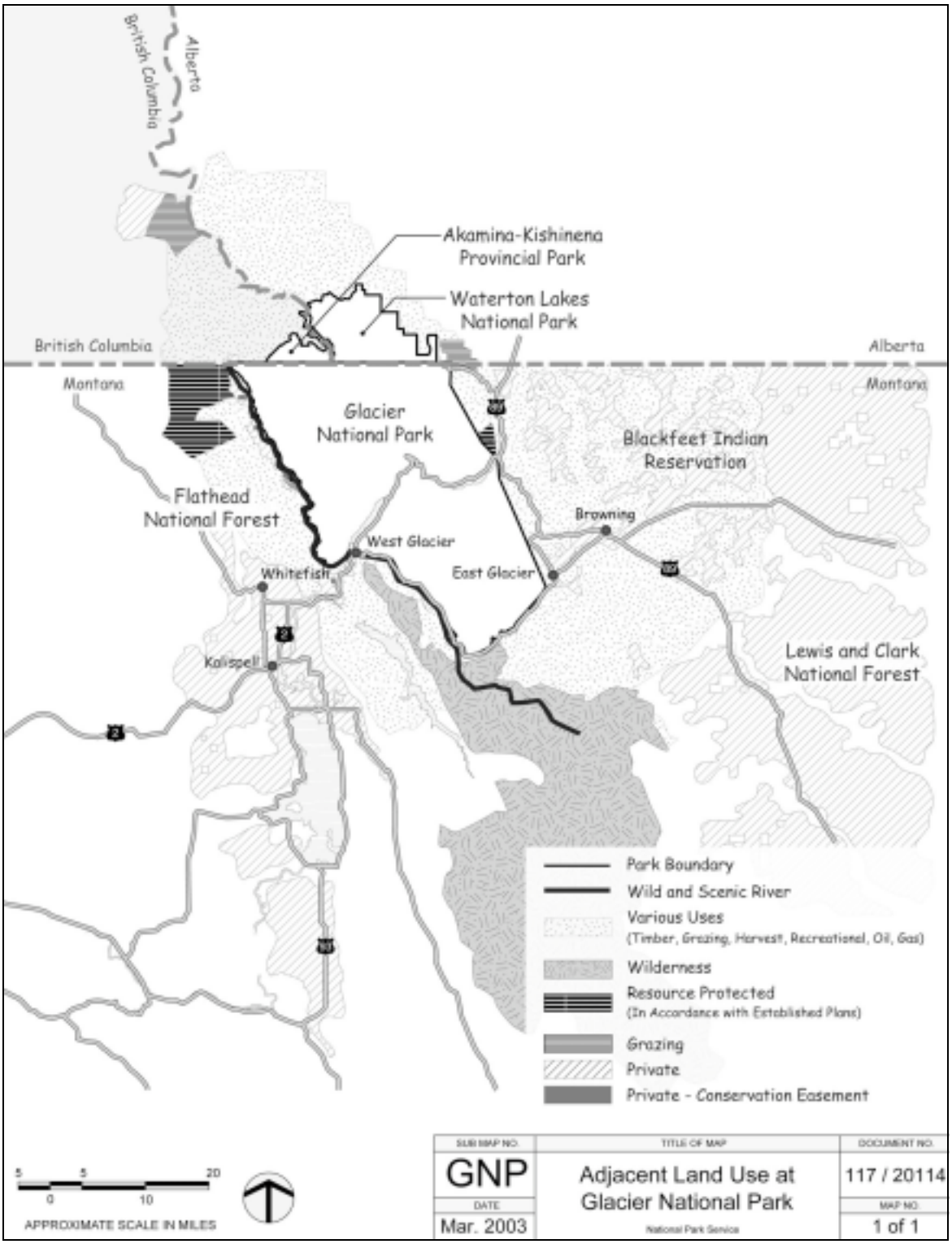
Much of the private land in the park is in the Going-to-the-Sun Road corridor in the Apgar Village area or around Lake McDonald. A large group of private inholdings is located on the south shore of Lake McDonald. The area includes approximately 15 acres, most of which are developed and used as seasonal residences. Five tracts of privately owned land, just over 1 acre in total, are located along the south shore of Lake McDonald between the Apgar Village developed area and the Apgar Campground. All of these tracts are used for residential purposes. There is also a group of privately owned tracts on the north shore of Lake McDonald. The group is composed of over 4 acres total, and contains structures that are used for seasonal residences and utility purposes. Over 16 acres of private land are located at the upper end of Lake McDonald near Upper McDonald Creek. All of this land is used for seasonal residences. A few additional tracts of private land are scattered along the east shore of Lake McDonald between the upper end of the lake and the Lake McDonald developed area. There are also a few small tracts of private land east of the Lake McDonald developed area across Going-to-the-Sun Road.

There are numerous private inholdings in the Apgar Village developed area. (See Map 2-3. Apgar Village Existing Features: Cultural, Visitor Use, Buildings.) The properties are used for a variety of seasonal, commercial and residential uses. A few of the tracts are undeveloped.

Various tracts of private land occur in the Lake McDonald Lodge area. (See Map 2-6. Lake McDonald Existing Features: Cultural, Visitor Use, Buildings.) One of the tracts is used as a private commercial motel during the summer (the Stewart Motel), and the remaining tracts are used as seasonal residences.

Middle Fork

One privately owned tract occurs in the Middle Fork area. A 120-acre privately owned tract is located along the Middle Fork of the Flathead River. The land is currently undeveloped.



MAP 3-2. ADJACENT LAND USE AT GLACIER NATIONAL PARK