SUMMARY

FINAL ENVIRONMENTAL IMPACT STATEMENT

This *Final Environmental Impact Statement* (FEIS) evaluates a range of alternatives for managing mining activity, analyzing cumulative impacts, and mitigating environmental impacts in Wrangell-St. Elias National Park and Preserve (see Location of Wrangell-St. Elias National Park and Preserve, Alaska map). Four alternatives, including a proposed action, have been evaluated:

Alternative A (post-1985 status quo/no action) – review and analyze mining proposals using a qualitative evaluation of cumulative impacts

Alternative B – review and analyze mining proposals using a quantitative evaluation of cumulative impacts and resource protection goals

Alternative C – review and analyze mining proposals using a quantitative evaluation of cumulative impacts and resource protection goals with the addition of restrictions for mining claims patented in the future and a strengthened mining claim acquisition program

Alternative D (proposed action) – acquisition of all patented and valid unpatented mining claims

On July 22, 1985, the U.S. District Court for the District of Alaska enjoined the National Park Service (NPS) from approving plans of operations for mining in three national park system units. The court order resulted from litigation filed by the Northern Alaska Environmental Center, the Alaska Chapter of the Sierra Club, and the Denali Citizens Council (Civil Case J85-009). The court order directed the NPS to ensure full compliance with the National Environmental Policy Act (PL 91-190; NEPA) and the NPS regulations for mining and mining claims (36 CFR Subpart 9A) before taking actions to approve new mining operations in park units. The court also required the National Park Service to prepare adequate environmental impact statements covering the cumulative impacts of multiple mining operations in Wrangell-St. Elias National Park and Preserve and Yukon-Charley Rivers National Preserve. On December 4, 1985, this order was amended to require the preparation of an additional environmental impact statement for mining in Denali National Park and Preserve. A final judgment and injunction was issued on March 3, 1988.

This FEIS was prepared in response to the court order. It addresses the cumulative impacts of mining associated with managing mining activity, analyzing cumulative impacts, and mitigating environmental impacts in the Nabesna, Chisana, Nizina, Kennicott, and Granite Peak study areas of Wrangell-St. Elias National Park and Preserve. This action coincides with the need to evaluate the minerals management programs in the Yukon-Charley Rivers, Wrangell-St. Elias, and Denali NPS units to provide for adequate resource management and protection, and is one element of a minerals management plan.

In developing this FEIS, numerous issues were identified through scoping for analysis. Some of these issues include hydrologic changes, fisheries, fish habitat, water quality, impacts on wetlands, aquatic ecosystem integrity, long-term and short-term impacts, nonmining uses of patented claims, reclamation, wildlife habitat (Dall sheep, grizzly bear, moose, caribou, wolves), threatened and endangered species, criteria for cumulative effects analysis, impact thresholds, significance of impacts, economic impacts, access, impacts of access, impacts on subsistence, heavy metals

contamination, abandoned mine lands, impacts on scenic values, acquisition costs of mining properties, and wilderness.

For purposes of analysis, a probable mineral development scenario was developed and applied for each alternative to project environmental impacts. The scenario predicts where and to what extent future mining activity might reasonably occur in the park over the next 10 years. The scenario does not represent an NPS proposal, nor does it suggest levels of mining activity acceptable to the National Park Service.

Under alternative A (post-1985 status quo/no action), the National Park Service would review and analyze mining plans of operations submitted for proposed activity on patented and valid unpatented mining claims according to applicable regulations including 36 CFR Subpart 9A and the access provisions of 43 CFR Part 36. The National Park Service would review individual plans of operations on a case-by-case basis and prepare environmental documents as required by the National Environmental Policy Act (PL 91-190). Determinations of site-specific and cumulative mining impacts would be made qualitatively.

Under alternative B, the National Park Service would review and analyze proposed mining plans of operations according to applicable regulations. The National Park Service would review plans of operations on a comprehensive basis and prepare environmental documents as required by the National Environmental Policy Act. "Target" resources would be identified and used as the focal point for evaluating the effects of proposed mining activity. Resource protection goals would be established where adequate resource information is available and used to evaluate cumulative impacts. Resource protection goals would be established for the following target resources: aquatic resources, grizzly bear habitat, moose habitat, Dall sheep habitat, and caribou habitat. Resource protection goals would be only part of the information used by the National Park Service in determining the appropriate action on a proposed mining plan of operations. If the resource protection goal for any target resource cannot be met because of the potential effects of a proposed mining operation, the operator would have the option to perform mitigation to reduce the magnitude of the effect within the resource protection goal or otherwise protect resource values. In areas where resource protection goals have not been met because of past mining activity, the operator would have the option to perform mitigation that would avoid further effects on specific resources or reduce resource impacts. Resource protection goals would not be established at this time for wetlands, wolves, visual quality, subsistence, recreation, wilderness values, local economy, and cultural resources. In cases where it is not possible to approve a mining plan of operations or other circumstances would not justify approval, the National Park Service would pursue acquisition of the mining claims.

Alternative C is identical to alternative B with two exceptions. As for alternative B, the National Park Service would review and analyze proposed mining plans of operations according to applicable regulations. The National Park Service would review plans of operations on a comprehensive basis and prepare environmental documents as required by the National Environmental Policy Act. "Target" resources would be identified and used as the focal point for evaluating the effects of proposed mining activity. Resource protection goals would be established where adequate resource information is available and used to evaluate cumulative impacts. Resource protection goals would be established for the following target resources: aquatic resources, grizzly bear habitat, moose habitat, Dall sheep habitat, and caribou habitat. Resource protection goals would be only part of the information used by the National Park Service in determining the appropriate action on a proposed mining plan of operations. If the resource protection goal for any target resource cannot be met because of the potential effects of a proposed mining operation, the operator would have the option to perform mitigation to reduce the magnitude of the effect within the resource protection goal or otherwise protect resource values. In areas where resource protection goals have not been met

because of past mining activity, the operator would have the option to perform mitigation that would avoid further effects on specific resources or reduce resource impacts. Resource protection goals would not be established at this time for wetlands, wolves, visual quality, subsistence, recreation, wilderness values, local economy, and cultural resources. In cases where it is not possible to approve a mining plan of operations or other circumstances would not justify approval, the National Park Service would pursue acquisition of the mining claims. Alternative C differs from alternative B in that patent restrictions would be applied to all valid unpatented mining claims taken to patent in the future; this would require a change in the law. Once patented, the claim surface would remain in federal ownership to limit the extent of additional conversions of patented claims to nonmining uses. The restricted patent would convey the minerals only, and the claims would be subject to a stricter standard for reclamation. In addition, a strengthened mining claim acquisition program would be initiated under alternative C to acquire valid unpatented and patented claims whose development by mining or otherwise would be detrimental to park values.

Under the proposed action (alternative D), the National Park Service would develop a mining claim acquisition plan to acquire all patented and valid unpatented mining claims in the park/preserve. Existing nonmining developments or improvements on patented claims would be reviewed for compatibility with park purposes and possible acquisition. Compatible nonmining developments and improvements could be excluded from acquisition. During the acquisition phase, the National Park Service would process mining plans of operations according to the procedures specified in alternative C. Existing operations with approved plans would be allowed to complete activities, including reclamatioin, as approved. The National Park Service would also process plan amendments or operational modifications according to the procedures specified in alternative C. Validity determinations for all unpatented mining claims not examined would occur and Congressional appropriations would be required for claim acquisition.

Under each of the four alternatives, mining claim acquisition methods would include purchase, exchange, or donation. A negotiated transaction would be sought based on fair market value. Eminent domain could be exercised in appropriate cases. Mining claims would be acquired under existing authorities of the secretary of the interior. Under each alternative, the National Park Service would pursue a program for reclamation of unreclaimed, abandoned, and acquired mined lands owned in fee by the United States within the unit's boundaries.

Alternative A could have the most adverse impacts on park resources because it involves the greatest potential for additional mining and nonmining uses of mining claims. Alternative B, C, or D would reduce adverse impacts from mining different amounts. Alternative B provides for a quantitative analysis of the cumulative effects of mining activities but does not prevent nonmining uses on claims taken to patent. In addition, alternative B does not include a strengthened program of mining claim acquisition. Alternative C would reduce the impacts from nonmining activities; provide for an quantitative analysis of cumulative impacts; strengthen claim acquisition; and reduce nonmining uses of claims taken to patent in the future. Alternative D would reduce surface impacts associated with mining and nonmining uses of mining claims more than alternative A, B, or C.

DRAFT ENVIRONMENTAL IMPACT STATEMENT

The Draft Environmental Impact Statement (DEIS) assessed the cumulative impacts of multiple mining operations in Wrangell-St. Elias National Park and Preserve as required by the U.S. District Court's final judgement and injunction. The alternatives evaluated in the DEIS are identical to those evaluated in this FEIS with exception to alternative B which was identified as the proposed action in the DEIS.

The DEIS was released to the public on April 13, 1989, with a comment period of 60 days. In response to requests for a longer comment period and the availability of background information used for developing the DEIS, the comment period was extended by 60 days to August 14, 1989. Public hearings on the DEIS were conducted in Fairbanks on May 16, 1989, and in Anchorage on May 18, 1989.

Public Responses to the DEIS. General public responses to the DEIS included the following:

- Site restoration and reclamation.
- Monitoring and compliance of mining operations and related activity.
- Non-mining uses, developments, and improvements of patented mining claims.
- Methodology for assessing cumulative impacts.
- Establishment and use of resource protection goals in the mining plan of operations evaluation process.
- Mineral development scenario and opportunities for new mining activity.

Copies of the public hearing transcripts on the DEIS are in Volume 2 of this document, as are the written comments and responses from federal, state, and local agencies, a Native corporation, organizations, and individuals.

INTRODUCTION TO THE PARK ENVIRONMENT

Wrangell-St. Elias National Park and Preserve extends over a region of vast proportions and diverse environments, representing some of the most outstanding examples of Alaska's natural, scenic, and cultural resources. Extensive high mountain terrain, enormous glaciers and icefields, active thermal features, large canyons, extensive wildlife populations, and major historic mining complexes represent a few of the more significant resources.

GEOGRAPHY

Wrangell-St. Elias National Park and Preserve contains areas of extremely rugged high mountain terrain including some of the highest peaks in the United States. Physiographically distinct major ranges include the Wrangell, St. Elias, Chugach, Mentasta, and Nutzotin mountains. The Mentasta and Nutzotin mountains, extensions of the Alaska Range, eventually grade into the Kluane Mountains in Canada. The Wrangell and St. Elias mountains form one continuous range which runs into Canada, and the Chugach Mountains merge with the St. Elias Mountains in the southeastern area of the park (see Wrangell-St. Elias National Park and Preserve overview map).

GEOLOGY AND MINERAL RESOURCES

There are three different geological terrains within the park and each is bounded by faults. The Yukon Complex of Precambrian to Devonian age phyllite, quartz-mica schist, marble, and other metasedimentary and metavolcanic rocks cut through the northeast corner of the park (USGS 1972). These rocks contain very little mineralization within the area of the park.

Southwest of the Denali fault and northeast of the Border Ranges fault are rocks underlain by the Taku-Skolai terrain. These rocks are as old as Pennsylvanian in age and are made up of volcanic rocks and basalt flows, limestones, sandstones, shales, graywacke, conglomerate, dolomite, and metamorphosed sedimentary rocks. Relatively undeformed continental sedimentary rocks of Cretaceous age or younger and late Cenozoic terrestrial volcanic flows overlie the older rocks (USGS 1973). Most of the significant mineralization in the park occurs within this area.

South of the Border Ranges fault consists of the Upper Mesozoic and Tertiary age rocks of the Chugach terrain. These rocks consist of weakly metamorphosed but highly deformed interbedded graywacke and argillite with minor amounts of slate which were formed in a deep marine environment (USGS 1974). These rocks host several clusters of lode and placer gold deposits.

Most of the mineral deposits are concentrated in a northwest-trending belt along the southern flank of the Wrangell Mountains, and, to a lesser extent, in a similar belt along the northeast flank of the range (USGS 1976). Production of copper and by-product silver from the Kennecott mines dwarfs all other mineral production from the area. Copper occurs in Kennecott-type deposits, veins, stockworks, and contact metamorphic deposits, porphyry deposits, volcanogenic deposits, and as native copper.

Both lode and placer gold deposits occur in the park, but placer deposits have provided most of the gold production. The majority of the placer gold mining occurred in the Dan, Young, and Chititu Creek drainages and in the Chisana area. Lesser amounts of production came from Golconda Creek. Many of the placer deposits also contain significant amounts of copper. Veins containing enough

gold to be mined occur in only a few deposits; most of the production of lode gold was from the Nabesna mine with minor production from the Yellowband mine.

Although silver occurs throughout the area, it is rarely the dominant mineral in a deposit. Most of the silver-bearing deposits are associated with numerous lodes that are notable mainly for copper (USGS 1976).

CLIMATE

The southern side of the Wrangell Mountains (McCarthy area) is within the transitional climatic zone between the more temperate coastal zone and the climatic extremes of the Alaskan interior. Precipitation ranges from 10 to 12 inches (including 50 inches of snow) annually in the western end of the Chitina Valley, to 24 inches annually and much heavier snowfall in the McCarthy area. Winter low temperatures around McCarthy are in the -20° to -40° F range, and summer temperatures in the +70° to +80° degree F range.

North of the Wrangell Mountains the climate is continental. Since maritime moist air flow is blocked by the mountains, the annual precipitation is much less (8 inches), with much less snow. Winter temperatures are considerably lower than on the southern (McCarthy) side of the mountains, with temperatures as low as -50° to -70° F.

The winter climate generally restricts active mining to the summer months of June, July, August, and early September. Winter activities, such as hauling in of heavier equipment and supplies, generally occur after the ground has frozen in November or even later if rivers must be crossed after they have frozen. Spring breakup of the larger rivers occurs in late April or early May, with the ground generally thawing enough by early May to make travel difficult.

Air quality within the park has a class II status. Wind blown silt is the greatest cause of air quality degradation. Localized and brief occurrences of dust occur when vehicles pass along the Nabesna and McCarthy roads, and of smoke from cooking or heating fires in residences. Because of the nearby coastal influence, visibility is not consistently excellent.

TRANSPORTATION AND ACCESS

The outer boundaries of Wrangell-St. Elias National Park and Preserve can be reached by paved, all-weather, winter-maintained roads. Anchorage is about 200 road miles from the park's western border, Fairbanks is about 250 road miles to the northwest, and Valdez about 100 road miles south. In their present condition, both the Glenn highway (to Anchorage) and the Richardson highway (south to Valdez or north to Delta Junction) are capable of carrying heavy equipment frequently used for mining activities.

Vehicular access into the park is by the McCarthy and Nabesna roads, two unpaved but improved roads. Both roads are located on federal lands within state rights-of-way and are maintained by the Alaska Division of Transportation and Public Facilities.

The Nabesna road is 46 miles long and runs from Slana on the Tok cutoff to Nabesna on the northern side of the park. Although a number of cross drains were installed or improved recently, the Nabesna road is very rough and occasionally muddy, though usually passable for two-wheel-

drive vehicles in summer. In winter the Nabesna road is plowed only intermittently, and winter residents, travelers, or visitors use four-wheel-drive or snowmachines for access to the Nabesna area.

The McCarthy road is 63 miles long and links Chitina to the McCarthy area, though presently the road terminates just west of McCarthy at the Kennicott River. Access into the town of McCarthy in summer is by hand-operated cable car across two branches of the Kennicott River. Normally passable for two-wheel-drive vehicles, the McCarthy road is also very rough, muddy, and may be closed during periods of high water and heavy rain. This road is not plowed in winter, and requires four-wheel-drive or snowmachine for winter access.

The other roads providing access to areas within the park/preserve are the Kotsina road up the Kotsina River from Strelna and several roads leading out of McCarthy. The distance from McCarthy to the Kennecott mine is approximately 5 miles on a seasonally maintained unimproved road following the old railway grade which formerly serviced the Kennecott mines and mill; from McCarthy, it is 10 miles via unimproved road to May Creek across the Nizina River (a bridge across the river was washed out in 1968). It is another 7 miles to Dan Creek camp, and this route is not driveable. May Creek is also connected by a narrow trail passable with all terrain vehicles (ATVs) to Chititu camp (7 miles).

Access to inholdings is provided under Title XI Section 1110(b) of ANILCA.

In addition to these roads, approximately 87 trails of varying capabilities to support mechanized travel link the ends of roads within the park/preserve to mining claim sites, patented lands, or small tracts (see table 7). Further discussion on trails to mining claims is included in the description of the appropriate study area.

Foot travel, horses, boats, and all-terrain vehicles (ATVs) are used in some areas of the park during the summer. Winter travel is often easier than in summer because when most creeks freeze, travelers can use snowmachines, dog teams, snowshoes, cross-country skis, and ski-equipped aircraft.

Table 7. Length of Roads and Trails in Wrangell-St. Elias National Park and Preserve

Roads	Length in Miles
Nabesna Road	46
McCarthy Road	63
Total	109

Trails	Number of Miles
Current	264.8
Inactive	337.5
Total	602.3
Grand Total	711.3

Air travel is common within Wrangell-St. Elias National Park and Preserve. The length, the condition, and the terrain surrounding backcountry airstrips vary considerably. Unmaintained airstrips exist in many backcountry areas. Air taxi operators offer flight-seeing tours over the park/preserve from bases outside the Wrangell-St. Elias National Park and Preserve boundary. Fixed-wing aircraft may be operated anywhere within the park/preserve.

Access to many of the patented and unpatented mining claims is by light aircraft. The quality and length of the airstrips vary, from 4- to 5-thousand foot strips at McCarthy, May Creek, and Chisana, to several hundred-foot bush strips suitable only to Supercub aircraft. Landings may be made with small-wheeled planes on gravel bars in summer or by ski-equipped aircraft in winter.

Mining activities in the past have typically depended on transporting the heaviest equipment by truck or tractor-pulled sled during the winter months when large streams are frozen over. Summer access, during the actual mining season, is usually by air and/or using lightweight vehicles brought in during a previous winter.

LAND STATUS AND USE

Land Status Within Wrangell-St-Elias National Park and Preserve

Within Wrangell-St. Elias National Park and Preserve, legal provisions have provided for land conveyances to native village and regional corporations, the state, and individuals. These land selections have created one of the most complex landownership patterns of any national park system unit.

Approximately 709,000 acres (see table 8) of land within the Wrangell-St. Elias National Park and Preserve boundary are in nonfederal ownership. An additional 925,000 acres is under application, some of which may be conveyed to native corporations and the state of Alaska. Of this area, about 600,000 acres have been transferred by patent or interim conveyance. The remaining lands are managed by the National Park Service, pending final determination of ownership. Currently, land status is clouded by overselection, dual selection, and the incomplete adjudication of many small tract entries and native allotments. Some overselections will remain federally owned as entitlements are met, while other selections will be conveyed to private landownership. The subdivision of larger tracts and the potential transfer of state land to private individuals through the state land disposal program complicates the landownership pattern within the park/preserve.

Table 8. Land Status in Wrangell-St. Elias National Park and Preserve

Lands	Acres
Park	8,331,604
Preserve	4,856,420
Total	13,188,024
Federal	11,554,149
Nonfederal	709,140
Applications	924,735
Nonfederal Breakdown	
State patented	42,620
State application	19,078
Navigable waters (state)	9,569
University of Alaska patented	8,240
Native corporations patent	627,774
Native corporations application	811,068
Cemetery/historic sites app.	32,608
Native allotments	2,753
Small tracts	7,555
Mineral patents	10,629
Overlapping applications	60,848
Small tracts applications	1,133

The AHTNA Regional Corporation is the major native landholder in the park/preserve. Two other native corporations that have selected lands in the park/preserve are Chitina Village, Inc. and Chugach Alaska Corporation.

Recorded Placer, Lode and Millsite Mining Claims. Currently, 923 unpatented and patented placer, lode and millsite mining claims, covering approximately 19,952 acres, are recorded within the park/preserve (see appendix 7). This includes 466 patented claims encompassing 10,629 acres which can be broken down as follows.

	Number	Acres
Patented lode	356	6,621
Patented placer	99	3,954
Patented mill	11	54
Total	466	10,629

Patented mining claims are lands patented under the Mining Law of 1872 (30 U.S.C. 21 et seq.), as amended. Mineral patents extend the limited possessory rights of unpatented claims by conveying exclusive title to the land. In most cases, patents convey to the owner a title, in fee simple, to the locatable minerals, including the use of all surface resources covered by the claim.

A total of 457 unpatented mining claims currently exist in the park/preserve. An unpatented mining claim provides a possessory right to extract and remove minerals from the land, but does not convey full title to the land. The federal government maintains the right to manage the surface and surface resources, including use of the land for recreational purposes. ANILCA (PL96-487) ensures adequate and feasible access to claims which will neither cause significant adverse impacts on natural or other values, nor jeopardize public health or safety.

Most of the isolated small tracts of private land within the park/preserve contain cabins, lodges, or other small structures to support subsistence activities or visitor services.

Land Status Adjacent to Wrangell-St. Elias National Park and Preserve

Land ownership surrounding the park/preserve is mixed with a variety of uses, both compatible and potentially incompatible. The east side of Yakutat Bay is designated wilderness on the Tongass National Forest. To the north is the Tetlin National Wildlife Refuge. Also to the north is a major block of native-owned land comprised of the former Tetlin Indian Reservation. Current uses of these lands are compatible, and there are no known proposals which will be incompatible with the purposes of the park/preserve. To the west and south are a mixture of federal, state, native, and other private lands. These lands are used for fish and wildlife habitat and for residential, recreational, subsistence, and commercial activities. To the east, in Canada, are Kluane National Park and Kluane Game Sanctuary. The management of these areas is compatible with the purposes of the park/preserve.

VEGETATION AND WETLANDS

The wide range of elevations and climatic zones in the 13-million-acre Wrangell-St. Elias National Park and Preserve results in an equally wide range of growing conditions and resultant vegetation types. The park contains nearly all of the major vegetation types found in southcentral, southeastern, and interior Alaska (USFS 1972).

Only about two-thirds of the park/preserve north of the Chitina River is vegetated, while the remainder is a high altitude area with bare rock, snow, and ice.

Alpine tundra is found at elevations between 3,000 and 6,300 feet. Dry tundra, consisting mostly of low, matted alpine plants dominated by mountain avens, is found on the steeper mountain slopes and exposed ridges. Wet (or moist) tundra, consisting of sedges and grasses interspersed with low shrubs, occurs on the lower more gradual slopes. This meadow-like tundra is an extremely productive arctic/alpine vegetation type, providing summer grazing for caribou, and summer and winter food for Dall sheep, and nesting habitat for migrating tundra birds (see appendix 4 for all land cover class descriptions).

White spruce, up to 100 feet in height, grow commonly along river bottoms. White spruce is also mixed with birch, balsam poplar, and aspen on upland sites, especially on south-facing slopes with coarse, well-drained unfrozen soils. Forests along the coast consist of large Sitka spruce and western hemlock.

In the extensive flat and gently rolling terrain around the Wrangell Mountains, large areas of open forest consist primarily of black spruce. These slow-growth ("stunted") forests usually have a continuous shrub layer in depressions and a thick moss layer on the open forest floor. This forest type occurs on permafrost soils.

The park contains extensive areas of shrub thickets. Dense stands of tall willows are usually found along streambanks while dense alder thickets cover large areas on steep hillsides. Open thickets of resin birch are in the zone between the forest and alpine environments.

Wetlands, an important component of the ecosystem, are defined by the U.S. Army Corps of Engineers (USACE) as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas" (33 CFR 328).

According to the U.S. Fish and Wildlife Service (1987), wetlands perform "important physical and ecological functions that deserve special consideration. Wetlands play a major role in maintaining hydrologic systems and the quality and quantity of surface and groundwaters. Some wetlands can absorb large quantities of water and act as natural flood control systems for rivers by gradually releasing floodwaters and reducing the magnitude of high flows. Wetlands may slow the rate of runoff during periods of normal rainfall and help recharge aquifers. In some places, sediments and pollutants may be filtered out of water draining through wetlands, and water quality may thus be improved. Wetlands are extremely important to resident and migratory birds for resting, feeding, and nesting and can be important foraging grounds for large mammals such as caribou, moose, and bear."

Wetlands are found throughout Wrangell-St. Elias National Park and Preserve and include areas adjacent to streams and lakes, wet tundra, shallow tundra ponds, wet shrub scrub and forested wetlands. Many of the shallow tundra ponds and adjoining wetlands in the park support aquatic invertebrates, fish populations and waterfowl. The northern wood frog, the only amphibian in interior Alaska, is also found in wetland habitats throughout the park. Park/preserve wetlands have not been mapped.

Although the park has not burned as extensively as other areas of Alaska, much of the forest cover has a history of fire. The occurrence of fire greatly accelerated with the arrival of prospectors in the late 1890s (NPS 1973a). Miners started forest fires to stimulate the growth of grass for horses (USGS 1909, 1923), to create standing dead timber for fuelwood (Lutz 1959), and to "rid the country of mosquitoes and flies" (USGS 1914b). The response of an interior Alaskan coniferous forest to fire is complex and long-lasting (Lutz 1960).

The following fires have been documented (Lutz 1956).

In 1915 the Sourdough Hill fire burned 384,000 acres from the town of Chitina to the Kennicott River and from the Chitina River to the mountains on the north. It was probably started by sparks from the Copper River and Northwestern Railroad.

In 1915 the Kennicott fire burned 64,000 acres between the Kennicott and Nizina rivers. It was reportedly set to provide fuelwood for sale at the Kennecott mine.

In 1981 a fire near the mud volcanoes on the west slope of Mt. Drum burned 16,000 acres.

Miners removed a great deal of timber for local use. At the old Bonanza townsite on Chathenda Creek near Chisana, "demands for fuel in 1913 and 1914 caused the cutting of nearly all the trees for several miles below timber line" (USGS 1916). Sawmills operated in Chisana, on Chititu Creek, in Calamity Gulch, and probably numerous other locations (USGS 1916). Although not currently at levels of the past, harvest of live and dead trees for houselogs and fuelwood continues at present and is expected to increase (NPS 1983b).

AQUATIC RESOURCES

The varied topography and the climate of Wrangell-St. Elias National Park and Preserve consist of glacial streams, clear water streams, lakes, ponds, groundwater, and wetlands throughout the park. Sixteen species of fish inhabit the park/preserve waters.

Glacial Streams

Streams that have their origins in glacial areas of the park are fed primarily by glacial melt, with relatively smaller contributions from rain water, snowmelt, and groundwater. The flow in these glacial streams is greatest from May through September, with the peak flow generally occurring in July, when the highest seasonal temperatures cause the maximum melting of glacier ice and snow. High flows also occur with the rainstorms of late summer and fall. Outburst floods associated with glacier dammed lakes or water stored in glaciers also cause large stream flows in glacial streams (USGS 1985). Glacial streams that overtop their banks have a potential to disturb human settlements and other cultural and natural features wherever their waters flow.

Fine rock particulate is generated as a glacier moves over bedrock. Eventually this fine particulate ends up mixed with the meltwater and is transported into the stream. The result is suspended sediments and associated turbidity, which increases with increasing discharge. Glacial streams, therefore, run turbid during summer months when glacial melt is the greatest, and run relatively clear the remainder of the year.

The deposition of part of the sediment load causes many glacial streams to develop braided streambeds and wide active channels and floodplains. The major drainages in Wrangell-St. Elias National Park carry some of the highest suspended sediment loads measured in the state of Alaska (in excess of 2,000 mg/l at high flow). Glacial streams transport material from the streambed which also contributes to the development and change of a stream's braided pattern. Bars that develop between channels are usually low, with gravel surfaces, easily erodible, and sparsely, if at all, vegetated (USFWS 1980b).

Most of the glacial streams in the park have a pH near neutral. Hardness, alkalinity, and heavy metal concentrations vary among the streams due to the different geologic formations with which the water comes in contact. Most glacial streams, however, fall in the moderately hard category (75 - 150 mg/l calcium carbonate) and all stream waters show a degree of natural mineralization. Water temperatures in glacial streams remain near freezing throughout the summer due to the daily input of glacial meltwater.

Glacial streams, in general, have a higher gradient, higher sediment load, higher turbidity, greater scouring effect, and lower biotic productivity than nonglacial streams. Fish regularly travel through glacial streams in the park to spawning and rearing grounds and in some cases use glacial streams as wintering habitat, however, glacial streams generally do not support year-round resident fish

populations. Glacial streams in the park have recreation value in that each year visitors raft or canoe these waters (ADNR 1986).

Nonglacial Streams

Streams in nonglacial areas are fed by rain, snowmelt, and groundwater and for this reason, they are relatively clear compared to glacial fed streams. The suspended sediment load in these nonglacial streams is usually less than 50 mg/l, except at high flow. Nonglacial streams are not braided like typical glacial streams, but instead tend to flow in a single channel with riparian vegetation growing on banks near the channel.

Flow reaches a peak in nonglacial streams in April and May when solar radiation and warmer temperatures cause melting of snow and channel ice. Flow declines in June, July, and August and streamflow is lowest from September through March. Summer rainstorms can also cause flooding in these streams. A flow that reaches the bankfull depth can be expected every 1.5 to 2 years (Dunne and Leopold 1978).

Some nonglacial streams are intermittent. These streams contain water periodically, usually during the runoff in April and May, and also after major summer rainstorms. During high flow, the stream velocities are often torrential because of large volume of water and steep gradients. Because of this flow pattern, intermittent streams cannot support long lived aquatic biota.

The majority of nonglacial streams in the park have a pH near neutral, except for a few streams which drain iron sulfide areas and have pH values less than 6. Hardness concentrations vary among the streams due to the different geologic formations with which the water comes in contact; however, most nonglacial streams in the study area fall in the moderately hard category (75 - 150 mg/l calcium carbonate). Because the Wrangell and St. Elias mountains are highly mineralized (USGS 1975, 1976), instream metal concentrations are relatively high.

Nonglacial streams generally have a lower gradient, smaller sediment load, lower turbidity, lower scouring effect, cleaner gravels and higher primary productivity than glacial streams. Because of these conditions, nonglacial streams can support aquatic invertebrates and resident fish or migrant spawning fish. Sportfishing is a popular recreational activity and shorebirds are commonly found feeding in these clearwater streams.

Lakes and Ponds

Lakes are abundant throughout the park. Most of the lakes were formed by past glacial gouging or are currently fed by glacial meltwater at the foot of a glacier. Lakes that are glacial fed have turbid waters, but due to reduced velocity and settling time, these waters are not as turbid as glacial streams. Biologic productivity and the presence of fish varies among these glacial fed lakes dependent upon the contribution of glacial meltwater and the associated light transmission.

Shallow closed-basin tundra ponds feed the headwaters of several of the streams in the park. Water in these systems is usually clear and slow moving, and vegetation in the ponds is abundant. Many of the tundra ponds in the park/preserve support aquatic invertebrates and waterfowl, and several support fish populations.

Groundwater and Permafrost

Groundwater in the park/preserve is found primarily in areas of unconsolidated sand, gravel, silt, and clay which were deposited through glacier and river action. Finer deposits that are less pervious retard water movement and make poor aquifers.

Water may flow from the aquifer into a surface water source, or the surface water may recharge the aquifer, depending on relative water levels. This type of groundwater-surface water exchange occurs throughout the area.

Groundwater is more abundant along the major streams in a basin. Wells drilled in lowland areas produce water from unfrozen flood plains and alluvium at depths generally less than 40 feet. For example, the approximate well depths in lowland areas at Slana and Glennallen are 20 feet (USGS 1970).

Permafrost is intermittent and occurs as numerous isolated masses. Unfrozen zones exist beneath streams, snowbanks, lakes, glaciers, and south facing slopes (USGS 1970). The presence of permafrost can restrict groundwater circulation and exchange.

The groundwater in the park has high concentrations of metals, particularly iron, due to its long contact with highly mineralized surfaces. Dissolved solids may be higher where groundwater circulation is restricted by permafrost. Some groundwater in the park is saline due to underlying marine sedimentary deposits which contribute chloride and sodium (USGS 1985).

Fish Resources

Fish in Wrangell-St. Elias National Park and Preserve are not abundant, with the exception of some lake populations and the Copper River salmon runs. The number of populations and the population density are limited due to naturally harsh stream conditions including high gradient, torrential seasonal flows, high velocities, cold temperatures, high sediment loads in glacial streams, low biomass of prey organisms, and winter freeze conditions. Under harsh conditions such as these, natural mortality and slow growth limit the number of fish occurring in park waters.

Although the fish biomass in the study area streams is low, the clear running streams that originate in the park serves an important function in perpetuating local fish populations in a region of numerous glacial streams and in supporting considerable fish populations outside of the park.

Sixteen species of fish occur in the park: king salmon (*Oncorhynchus tshawytscha*), red salmon (*Oncorhynchus nerka*), coho salmon (*Oncorhynchus kisutch*), chum salmon (*Oncorhychus keta*), arctic grayling (*Thymallus arcticus*), rainbow trout (*Salmo gairdneri*), steelhead trout (*Salmo gairdneri*), Dolly Varden (*Salvelinus malma*), lake trout (*Salvelinus namaycush*), burbot (*Lota lota*), round whitefish (*Prosopium cylindraceum*), humpback whitefish (*Coregonus pidschian*), least cisco (*Coregonus sardinella*), slimy sculpin (*Cottus cognatus*), longnose sucker (*Catostomus catostomus*), and northern pike (*Esox lucius*) (ADFG, Williams, Roberson, Pearse, Anderson, Ott, Yanagawa, Peckham, pers. comm, 1987); ADFG 1979; ADFG 1975). For a detailed description of the occurrence and life history of these species in Wrangell-St. Elias National Park and Preserve, see appendix 18.

WILDLIFE RESOURCES

Wrangell-St. Elias is one of the largest protected ecosystems in North America and supports populations of at least 32 species of mammals, 127 species of birds, 16 species of fish, and 1 amphibian (USDI 1973).

Wildlife management within Wrangell St-Elias is a cooperative effort among the National Park Service and the Alaska Department of Fish and Game (ADFG) and USFWS (NPS 1986d). Portions of ADFG State Game Management Units (GMU) 11 and 12 are within Wrangell-St. Elias. The Nabesna and Chisana study areas are in GMU 12, which covers much of the area north of the Wrangell Mountains, but only half of which is in the park/preserve. The Nizina, Kennicott, and Granite Peak study areas are in GMU 11, which covers the area south and east of GMU 12, within the park/preserve boundary. ADFG uses these GMUs as the basis for wildlife population estimates, and for the setting of GMU-specific bag limits and regulations. Some population estimates reported in this document are based on these units.

The following discussions are taken from ADFG 1973a, 1985b and c, and 1986f unless otherwise noted.

Grizzly Bear

Population Estimates. Grizzly bear numbers and densities in the Wrangells are unknown; however, densities are thought to be average for interior Alaska. A population of 430 to 570 grizzly bears was estimated for GMU 12. In the nearby Nelchina basin, an average grizzly bear home range was 221 square miles (Ballard et al., 1982).

Few historical references to the grizzly bear population exist. In 1900 in the Chitina and Nizina River areas, explorers reported that both grizzly and black bears "are very numerous" (USGS 1900). In 1918 both grizzly and black bear were plentiful in the upper Chitina Valley, and "numerous tracks along clearwater streams, as soon as the salmon began running, showed that the bears had come down for a feast of fish" (USGS 1918). By 1923 in the Kuskulana area, bears were "less plentiful than when white men first entered the district" (USGS 1923).

Habitat Needs. Grizzly bears range throughout the vegetated areas of the park, but generally prefer high elevation tall shrub and low shrub and alpine tundra communities. Grizzly bears are omnivorous, opportunistic feeders and move to areas as foods become seasonally available. After the bears emerge from the den in late April, grasses, roots, sedges, and early herbaceous plants constitute the bulk of the diet, which is supplemented by an occasional moose or caribou calf. Peavine roots (*Hedysarum* spp.), which grow in low valleys, are a preferred early summer food. Early season foods are supplemented in summer and fall by large quantities of berries on glacial moraines, and occasional rodents and carrion.

Moose

Population Estimates. A reliable population estimate for the park is unavailable, but in the GMU 11 area it probably exceeds 5,000. A rough estimate for all of GMU 12 is 2,500. Moose densities for GMU 12 are low and not consistent over the unit. Moose numbers probably peaked in the 1960s due to habitat improvement caused by fires up to the 1940s and by predator control in the 1950s. The population declined in the 1970s.

Moose were probably heavily hunted by miners in the early 1900s. Moose were reported as "formerly present, but [are now] rare" in the upper Chitina Valley in 1918 (USGS 1918). In 1923 in the Kuskulana area they were considered very rare (USGS 1923).

Habitat Needs. Moose can generally be found throughout the park in all areas below about 5,000 feet elevation. Moose habitat requirements vary with the season. In winter they prefer the cover of alpine shrub or riparian shrub communities, and feltleaf willow (*Salix alaxensis*) browse. Other willows, birch, grass and lichen are used to a lesser extent. Willows remain an important food source through the spring, but animals also seek aquatic vegetation, sedges, and mineral licks (Tankersley 1981). Calving areas are typically thick lowland stands of trees and shrubs. Moose generally move to open upland shrub thickets in the summer, and use of these areas peaks during the fall rut. Moose are relatively adaptable to habitat perturbations compared to other large mammal species, and they can exist on plant communities that develop after fires, floods, or human disturbance.

Moose seasonally move between winter, calving, and summer/rutting range. Researchers found that the seasonal movements of moose in the upper Susitna River basin ranged from 10 to 58 miles, but in the park/preserve this is probably high. Winter concentration areas are primarily found along major water courses and bog margins. Areas of rutting and winter concentration normally do not overlap.

Crucial habitat needs include protected winter browse areas and traditional travel corridors between lowlands and high mountain slopes.

Dall Sheep

Population Estimates. The Dall sheep population of Wrangell represents one of the greatest concentrations of wild sheep in North America (NPS 1986d). This population is the largest of any large mammal in the area.

Sheep are found throughout the park in suitable high mountain terrain, although most are north of the Chitina River. The population is believed to be increasing. Total sheep numbers north of the Chitina were estimated in 1982 to be 15,700. This estimate was based on aerial counts in 1981 and 1982, following two years with minimal hunting. Compared to a 1984 statewide population estimate, this figure represents 22 percent of the sheep in the state.

An earlier survey was completed in the early 1970s. When 12 similar counting units are compared between the two surveys, an average 50 percent increase in sheep numbers is apparent. The increase appears to be highest in the northern Wrangells, although part of it was probably due to greater counting efficiency in the 1981-1982 survey. A population decline may have occurred over the winter of 1982-1983 (NPS 1982a). During an aerial census in 1983-1984, 350 sheep were counted south of the Chitina River (NPS 1984a).

Areas of highest sheep densities are the Nutzotin Mountains and slopes above Nabesna and Chisana, the southern flanks of Mt. Wrangell (including the Kuskulana and Kotsina drainages), and MacColl Ridge and the Crystalline Hills in the Chitina Valley (NPS 1986d). These areas contain some of the best Dall sheep habitat in Alaska (ADFG 1973a).

Historical reports indicate that a large Dall sheep population likely existed previously to mining. In 1900 explorers reported that in the Chitina and Nizina River areas, "the animals . . . chiefly

depended upon by the natives for food are mountain sheep and mountain goats." And that "hundreds of [sheep] were seen" in the area (USGS 1900).

During the early mining days, market hunting reduced many of the area's sheep populations (Scott et al. 1950). In the winter of 1916 alone, an estimated 2,000 Dall sheep were killed within 20 miles of placer camps in the Chisana area (USGS 1916). Reports from the Kuskulana drainage stated that "sheep are not found on some of the feeding grounds that they formerly frequented" (USGS 1923).

Some sheep herds on isolated mountain ranges may have been exterminated during this period. In the Kennicott area about 1917, a "game warden was appointed and a stop has been put to market hunting out of season" (USGS 1918).

Evidence indicates that statewide most Dall sheep populations declined between the years 1915 and 1940. Severe winters in the 1930s and 1940s contributed to this general decline.

Habitat Needs. Dall sheep generally prefer alpine and subalpine habitats which are near rugged rock outcrops that provide escape cover from predators. Although sheep crossings of lowland areas have been reported in the region (USDI 1973b), seasonal, altitudinal movements of relatively compact herds are normally the rule.

In spring, sheep generally move to lower elevations to seek the earliest new growth. Spring and summer plant food species include grasses, sedges, mountain dryad, willows, and forbs. As summer progresses sheep continually move higher, following new plant growth. Grasses and sedges constitute the bulk of the winter diet in the Alaska Range, and in a Kluane National Park study in Yukon, Canada, sage was also important (Hoefs 1981).

Herds usually winter on high, exposed slopes or ridges where southern exposure or wind normally ensures snow-free vegetation. Use of subalpine shrub types during the late winter or early spring has also been reported for the area (NPS Mullen, pers. comm. 1987). As the season progresses, the winter range may constrict to extremely small portions of the total range due to deep or crusted snow. These remaining areas therefore become crucial to the herd's survival. Winter ranges have not been identified in Wrangell-St. Elias.

Caribou

Population Estimates. Three caribou herds are recognized that use portions of the park/preserve. These are the Chisana, Mentasta, and Nelchina herds. The Chisana and Mentasta are small herds on the north side of the Wrangell Mountains, and the Nelchina is a large, wide-ranging herd which periodically uses lands in the northwest part of the park/preserve. Except for sporadic caribou use around Nabesna, Chisana is the only study area where caribou occur. It is part of the Chisana herd's range. The Chisana herd occupies the area from Cooper Pass, between Nabesna and Chisana, southeast across the Chisana to the White River, and into the Yukon, Canada. All of this range, except in Canada, is within the park/preserve. Its movements are limited compared to other herds in Alaska. The herd numbers about 1,100 animals, and the population is considered stable.

The Chisana herd may have originated in the 1920s and 1930s from movements into the area by the huge Fortymile herd to the north. When these movements ceased, remnant groups remained in the area. However, caribou probably lived in the Chisana/White River area prior to this. In 1916 it was reported that in this area "constant hunting has much reduced their numbers" (USGS 1916). Known historic population levels are limited to an estimate that the herd numbered from 2,000 to 3,000 in the 1960s.

Habitat Needs. Caribou are highly mobile, social animals that range over a large portion of the park/preserve. Wintering areas with abundant and easily accessible lichens are in climax spruce forest with less than 20 inches of snow or on high, windswept plateaus. Caribou also use the Chisana River bar and some low shrub, subalpine areas which may or may not be windswept. Ground and tree lichens, sedges, and horsetail are the preferred winter diet.

As soon as spring green-up begins, caribou move to areas where early-growing plant species occur. Chisana herd caribou do not partake in any specific migrations along known use corridors; their seasonal movements are normally dispersed, however, movements may occur down the White River to Canada. Spring brings calving in mid-May to early June. Preferred calving areas are typified by open, rolling terrain which provides a wide field of view and cover in secluded, brushy spots.

The use of plant food species continually shifts in spring and summer as new species begin to grow or reach maximum nutritional value. Spring and summer foods include grasses, sedges, willow catkins and leaves, shrub birches, and important forb types such as legumes. To escape midsummer insect harassment, caribou seek windswept ridges and other treeless uplands such as alpine low shrub and tundra. High altitude sedge meadows may be shared with Dall sheep.

Fall is another time of movement with caribou remaining on summer range until the decline of food availability forces them to wintering areas. The use of summer food species gradually gives way to the lichen dominated diet of winter. Breeding usually occurs in the first half of October.

Wolves

Population Estimates. Wolves are the main natural predator in the large mammal ecosystem of the park/preserve. Knowledge of wolf populations and pack home ranges is, however, extremely limited. Scientific studies have not been undertaken in the area.

Habitat Needs. Wolves are social animals, and their activities center around packs consisting of extended family members. In winter, packs may travel 50 miles a day in search of their primary prey: moose, caribou, and Dall sheep. Throughout the year wolves supplement their diet with snowshoe hares, ground squirrels, voles, and occasionally birds and fish (ADFG 1978).

THREATENED AND ENDANGERED SPECIES

The park/preserve contains no state or federally listed threatened or endangered plant species. The U.S. Fish and Wildlife Service recognizes the incidental occurrence of arctic or American peregrine falcons, which migrate through the park/preserve during their twice annual migration (see appendix 5). Although nesting sites have not been documented, it is highly probable that suitable peregrine falcon habitat is present in the area (NPS 1983b). The North American lynx is currently designated as a category 2 candidate species for possible future listing under the Endangered Species Act (PL 93-205). This designation is based primarily on concern for the status of its population in the lower-48 states.

VISUAL QUALITY

Wrangell-St. Elias National Park and Preserve contains perhaps the most extensive area of spectacular high mountain scenery in the country. An uncounted number of glaciated peaks rise from

all parts of the park/preserve. Nine of the 16 highest mountains in the United States are found here. Mount Wrangell, an enormous active volcano, rises 13,000 feet above the Copper River – its flanks covered by over 250 square miles of ice. Mt. St. Elias rises 18,000 feet from the sea which is only 15 miles away. Among hundreds of glaciers, the Nabesna is one of the world's longest, and the Malaspina, one the world's biggest piedmont glaciers (Brown 1982). Nearly the entire park/preserve is an excellent example of mountain scenery.

On the south side of the Wrangell Mountain range, the wide, spruce-lined valley of the Chitina River drains the center of the park – its barren and braided channel up to three miles wide. It joins the broad Copper River which then flows through the Chugach Mountains to the sea. On the north side, the Nabesna and Chisana rivers flow north through basin and canyon towards the Tanana. Overall, approximately two dozen river systems drain the park/preserve, the names themselves adding to the scenery – Kuskulana, Kotsina, Chetaslina, Chokosna, Lakina, Gilihina, Hanagita, Nizina, and Kiagna.

Pristine scenic quality is defined as unaltered, undisturbed, and relatively undeveloped landscapes. The Wrangell-St. Elias Land Protection Plan (NPS 1986d) lists scenic beauty and quality as one of the significant resources of the park/preserve. Maintaining the overall scenic quality of the park/preserve is a principal NPS goal.

CULTURAL RESOURCES

Prehistory and Ethnography

Few archaeological surveys have been conducted within Wrangell-St. Elias National Park and Preserve. Investigations in areas adjacent to the park/preserve suggest that the potential for archaeological remains, particularly the little understood late-prehistoric period, is very good. From these investigations, statements pertinent to the study region concerning culture chronology may be made.

A stratified site at Healy Lake, situated less than 100 miles northwest of the park/preserve, dates to 11,000 B.P. (before present) and represents one of the earliest firmly dated sites in Alaska. Termed the Chindadn (meaning "ancestor" in Athapaskan) complex, the lowest component at this site consists of bifacially flaked triangular projectile points and "teardrop-shaped" bifaces. From this and other early sites in Alaska, evidence for adaptation to a Pleistocene environment, that of a treeless grassland, emerges. The subsistence patterns of early peoples appears to be that of small nomadic groups occupying temporary hunting camps while exploiting seasonal resources.

Sites representing the Northern Archaic Tradition, dated c. 5,000 B.P. to 3,000 B.P., have been documented in the Tangle Lakes region, northwest of the park/preserve. Believed to represent boreal forest adapted cultures, Northern Archaic sites contain side notched projectile points, end scrapers, large unifaces, and may contain microblades or burins.

The archaeological record between 3,000 to 1,000 B.P for interior Alaska is extremely complex and has led to conflicting interpretations. This perplexity is due, in part, to the lack of good natural stratigraphy at many sites excavated from this period, and the often difficult placement of recovered lithic scatter within a time frame. Research within Kluane, a Canadian national park, which shares a common border with Wrangell-St. Elias, has shown the occurrence of sites from this period. Other sites near the park that have been documented include those at Lake Mansfield and along Healy and Butte Lakes to the north.

Numerous sites representing the Athapaskan Tradition, dating approximately from 1,000 B.P. to the historic period, have been documented along the park's/preserve's western boundary. One of the earliest sites, dated around 700 B.P., is GUL-077, which consists of cache pits and an associated late winter camp situated along the lower Gulkana River. Excavations at the site yielded artifacts made from native copper, bone and antler items, and lithic items. Major excavations have been conducted at Dakah De'nin's Village, a site situated along the Copper River near Chitina, dated from the Protohistoric Period. Directly across the river, at Taral, excavations at a historic period site have yielded numerous trade items.

The Athapaskans of historic times living in Wrangell-St Elias National Park and Preserve were the Ahtna and Upper Tananas. Their subsistence round traditionally consisted of the exploitation of large mammals, migratory fishes, birds and small mammals at the times and places they were most available. Athapaskan adaptation can best be characterized as "flexible", adjusting subsistence rounds and supporting social networks to best exploit an environment which was sometimes capricious in its yield.

The Ahtna have been described as occupying winter camps near the mouths of salmon rivers and streams or lake outlets. They fished in early summer, then moved to hunting camps at higher elevations in mid-August to find caribou, moose, goats, sheep and berries. In the winter, they returned to their semi-subterranean, sod-covered houses, and occasionally supplemented their stored fish and meat supplies with ptarmigan or other small game. Spring was often a lean time, in which hares, whitefish, grayling and muskrats staved off starvation.

The Ahtna were endowed with a resource of value to other people throughout the region: copper. It was traded throughout central and southern Alaska. It was generally procured during the summer while hunting at the upper reaches of the Chitina, Nizina, Nabesna, and Chisana Rivers. Hunting and copper procurement camps would be expected to occur within the mining areas.

The appearance of Russians and Americans on the Copper River in the 19th century may have wrought cultural changes among the Ahtna which are not yet clearly understood. It is possible that the introduction of fur trading affected economic systems and the social networks that sustained them. Some anthropologists have speculated that the presence of social ranking among the Ahtna may have been intensified after Western contact. This may have resulted in a difference in the size, location, and material remains on archaeological sites dating before and after contact.

Historic and Archaeological Resources

To date (June 1988) archaeological surveys have been conducted on 726 claims within Wrangell-St. Elias National Park and Preserve. The results of these investigations have been the documentation of 88 historic properties and 2 prehistoric sites.

The archaeological investigations consist of a prefield literature review, intensive pedestrian survey, and evaluation of findings. The survey crew consists of several field archaeologists, a historian, and a historical architect. The survey universe consists of all drainages containing valid mining claims. Typical survey coverage is "Intensive" as defined by the secretary of the interior's *Standards and Guidelines*. This includes a pedestrian survey of the claim areas sufficient to insure that all surface cultural resources within the area of examination will be located. Examination of all vertical exposures, such as road cuts, stream banks and earlier mining exposures are made. Standardized forms are utilized for tracking survey areas and documenting all finds. The evaluation of the sites for *National Register* eligibility is currently ongoing.

Prehistoric Sites

Approximately 115 Athapaskan sites have been ethnographically documented within the park/preserve boundaries. While none are purported to occur within any specific claim within the park/preserve, their occurrence, often adjacent to claim locations, suggests the high probability of their sites occurring within mining locations. These sites include winter villages, hunting and fishing camps, trails, house sites, food caches, a fence used to herd caribou, a trading area, and several historic cemeteries.

Sites verified by fieldwork within the park/preserve include a stratified site found along a small lake near the White River. This site contained close to 400 lithic debitage fragments, as well as microblades and a side notched projectile point. Typologically the artifacts may date to 5,000 B.P. Another site, found along the upper Nizina River, consists of a surface lithic scatter situated on a prominent overlook above the river and a small tributary.

The results of other small archaeological surveys in the park/preserve, as well as investigations adjacent to the area, suggest that there is a high potential for sites representing nearly all the prehistoric traditions described to date for central Alaska.

SUBSISTENCE USE OF RESOURCES/SECTION 810 EVALUATION

Subsistence uses by local rural residents are to be allowed in national preserves and where specifically permitted by ANILCA in national parks and monuments (sections 201, 202, 203, and 816). Subsistence uses within Wrangell-St. Elias National Preserve and, where traditional, within Wrangell-St. Elias National Park are to be permitted in accordance with titles II and VIII of ANILCA (PL96-487).

The resident-zone communities designated by the *Code of Federal Regulations* (36 CFR 13.73) for Wrangell-St. Elias National Park are as follows: Chisana (population 10), Chistochina (population 64), Chitina (population 40), Copper Center (population 229), Gakona (population 82), Gakona Junction (population 10), Glennallen (population 499), Gulkana (population 98), Kenny Lake (population 342), Lower Tonsina (population 38), McCarthy (population 29), Mentasta Lake (population 66), Nabesna (population 37, including Nabesna Road), Slana (population 57), Tazlina (population 38), Tok (population 692), Tonsina (population 130), and Yakutat (population 456). Residence in a resident-zoned community confers subsistence-use privileges within Wrangell-St. Elias National Park in lieu of a subsistence permit (36 *Code of Federal Regulations* 13.73). Any local rural resident whose primary, permanent home is outside a resident zone may apply to the superintendent for a subsistence permit if he or she can show an individual or a family history of customary and traditional subsistence use of park resources (36 CFR 13.44 [a][1]).

About 135 individuals out of a regional population of at least 2,917 eligible subsistence users regularly use the resources of the park/preserve for various types of subsistence uses (NPS 1986f; 1987a). The number of eligible local rural residents is calculated as the sum of the populations of the resident-zone communities. The demographic figures for all of the villages named above are estimates either from the 1985 population overview of the Alaska Department of Labor, listed in the bibliography, or from the park/preserve staff.

Since the park/preserve's establishment in 1980, the best estimate of subsistence by park personnel was that approximately ten miners have regularly engaged in subsistence activities within the entire park/preserve. However, in recent years, coincidental with the stoppage of mining in 1985, that

number has dropped to four who are local rural residents who happen to practice subsistence use within the preserve only (NPS 1987a).

The National Park Service recognizes that Wrangell-St. Elias National Park and Preserve may be especially important to certain communities and households in the area for subsistence purposes. Nevertheless, the Wrangell-St. Elias subsistence region that is used for analysis does not include the entire harvesting area and amount of harvests of the communities involved.

Thus, the Wrangell-St. Elias subsistence region for the table of estimated subsistence harvests below is not the entire region used by the people of the resident-zone communities of or by other eligible local rural residents. The region extends along the southern, western, and northern boundaries of the park/preserve as well as within the park/preserve itself. The estimates of subsistence harvests, in table 8, have been modified to cover a lesser region than that of the combined community harvests, but larger than the park/preserve. In general, the National Park Service estimates that subsistence harvests within the park/preserve constitute of approximately 55 percent of the Wrangell-St. Elias regional subsistence pattern selected for analysis for certain species.

The subsistence region was reduced for purposes of analysis to focus upon those lands more in proximity to Wrangell-St. Elias National Park and Preserve. Harvest figures available for a larger or smaller area than the subsistence region, defined by the use area identified, were adjusted downwards or upwards as deemed appropriate according to an estimated percentage of the differences involved. The estimates of subsistence harvests are intended to show only that a regional subsistence pattern exists for purposes of analysis of which the park/preserve is a part. No other purpose should be attributed to or construed from these figures. They should be understood to represent only general trends that are subject to revision based on future more accurate data.

The estimated harvest figures in table 9 represent a pattern of subsistence-resources use in the Wrangell-St. Elias subsistence region as defined above. The pattern of subsistence use reflects the pattern of harvest and consumption of local rural residents as a part of their lifestyles. The figures are rough estimates extrapolated from a variety of sources, listed in the bibliography, for a so-called typical year. The sources include technical reports of the Alaska Department of Fish and Game, the University of Alaska-Fairbanks, and the park/preserve staff. The methodology consists of averaging any total annual harvest figures per species that may be reasonably attributed to the local rural residents of the villages named previously and to the local subsistence-permit holders who are active users. Harvest figures available for a larger or smaller area than the subsistence region, defined by these resident-zone communities, were adjusted by appropriate percentages according to the differences involved and these reflect estimates for a broad region around the park/preserve including those of all state game management units of which the park/preserve is a part.

To identify the main subsistence species taken by approximate edible weight, an estimated percentage column has been provided in table 9. The conversion factors used are listed in technical paper number 107 of the Alaska Department of Fish and Game, Division of Subsistence, referenced in the bibliography. According to these percentages, the main subsistence species are moose (31%), fish (25%), furbearers (11%), and caribou (6%).

Table 9. Estimated Subsistence Harvests

Subsistence Resource	Regional Harvest	Estimated Percentage	Park/Preserve Portion of Regional Harvest
bears			
black	36 animals	2	20 animals
brown	34 animals	4	20 animals
caribou	59 animals	6	20 animals
Dall sheep	73 animals	4	40 animals
deer	63 animals	3	0 animals
marine mammals	35 animals	3	0 animals
moose	67 animals	31	37 animals
mountain goat	60 animals	4	0 animals
fish	41,930 fish	25	23,062 fish*
furbearers	1,336 animals	11	735 animals
small game/waterfowl	1,190 animals/birds	3	655 animals/birds
berries/other			
plants	5,000 pounds	4	2,500 pounds
firewood	578 cords		318 cords
house logs	1,056 logs		581 logs

*The majority of this take is from the Copper River just outside and adjacent to the park/preserve.

In addition to black and brown/grizzly bears, the list of subsistence species above includes several varieties of berries ranging from blueberries to salmonberries. "Fish" includes burbot; coho, chum, sockeye, and king salmon; grayling; trout; northern pike; sheefish; sucker; and whitefish. "Firewood" refers to the cutting of trees -- birch and spruce mostly for home heating. The category of "furbearers" comprises beaver, coyote, fox, lynx, marmot, marten, mink, muskrat, otter, weasel, wolf, and wolverine. "Marine mammals" includes seals and sea lions. "Other plants" consists of many varieties of greens and roots, rose hip, and wild onion and rhubarb. "Small game" includes gallinaceous birds such as rock and willow ptarmigan and ruffed and spruce grouse, as well as porcupine and snowshoe hare. "Waterfowl" includes several varieties of ducks and geese.

Common patterns of local use involve accessing the park/preserve by traditional means such as by foot, dog sled, horse, and snowmachine, and occasionally by airplane in the preserve. Subsistence activities occur in the park and in the preserve; the latter is known for its sport hunting.

Subsistence harvests in any given year may vary considerably from those of previous years because of such factors as weather, migration patterns, and natural population cycles. Patterns of subsistence use may vary from time to time and from place to place depending on the availability of wildlife and other renewable natural resources. However, the pattern assumed to be generally applicable to harvests in recent years for the Wrangell-St. Elias subsistence region has been defined for this analysis.

RECREATION AND VISITOR USE

Since the establishment of Wrangell-St. Elias as a park and preserve, recreational use has increased dramatically. Annual visitation has increased from 14,182 people in 1982 to 30,121 in 1987. The Wrangell-St. Elias National Park and Preserve General Management Plan projects 48,000 to 67,000 visitors in 1995.

Most visitors arrive by automobile by way of the McCarthy road from Chitina or the Nabesna road via Slana; the percentage of visitors who use these roads is estimated at 80 percent with approximately 2,000 visitors using the Nabesna Road. Approximately 10 percent of the visitor use involves backcountry recreation and about 1,300 people fly into, or over, the area each year for recreational or other park-related reasons.

Wrangell-St. Elias National Park and Preserve visitors participate in a variety of nonconsumptive activities, such as sight-seeing and photography. Other recreational activities include sport hunting, sportfishing, hiking, backpacking, camping, cross-country skiing, snowmobiling, glacier hiking, mountaineering, white-water river rafting, and kayaking. A large percentage of recreational activity in the park is undertaken by people who live in the Wrangell-St. Elias National Park and Preserve region.

Sport hunting is one of the more popular recreational activities. Park personnel estimate that hunting accounts for several thousand visits to the park and preserve each year. Dall sheep is the major species hunted, although moose and caribou are also popular. In areas close to the highways such as along the Nabesna road and in much of the Nelchina basin, hunter activity is the greatest. Guides, based both inside and outside of the park and preserve, offer hunting trips to visitors. These guides take clients to their guide areas (federal land), several of which are located within preserve boundaries. Lodges, cabins, and private airstrips used mainly for hunting purposes account for most existing recreational developments within the preserve.

Sportfishing is also a significant recreational pursuit in Wrangell-St. Elias, although stream fishing is very limited because most streams are fast-flowing in the summer months and frozen or greatly reduced in flow in the winter months. Although limited, both stream and lake fishing are found throughout the region with the greatest use occurring in those areas most accessible by vehicle, aircraft, or snowmachine. Dip-netting in the Copper River is the most popular form of fishing and attracts several thousand people each year during the season when salmon are moving upstream to spawn.

Hiking and backpacking activities are increasing in popularity among recreational participants in the region. Although there are relatively few existing hiking and backpacking trails in Wrangell-St. Elias National Park and Preserve, numerous old mining roads and hundreds of square miles of terrain traversable by foot lend themselves to virtually unlimited opportunities. Past estimates indicate that there are at least 175 access points from the primary highways into the park and preserve where foot trails are known to originate (NPS 1973a), but, in fact, the backcountry is accessible at almost any point that is not limited by rivers, vegetation, or private property. While mountaineering opportunities are unlimited, most of this activity is currently found on Mt. Sanford and Mt. Drum.

Water-based recreational use other than for fishing is somewhat limited by access. Rafting and kayaking on portions of the Copper and Chitina rivers have increased steadily in popularity over the last decade. Jacksina Creek, near Nabesna, has also recently become popular for white-water sports.

Winter recreation in the Wrangell-St. Elias National Park and Preserve region is primarily in the form of cross-country skiing and snowmobiling which are increasing rapidly in popularity. There are many areas available for winter activities, primarily in the open and relatively flat and traversable terrain. Presently the heaviest use is concentrated in the areas that are most accessible.

Many outdoor activities in the park/preserve require overnight stays, most often accomplished by camping. Along the road system adjacent to the park/preserve, several permanent, designated campgrounds can be found, but camping in the park/preserve is usually opportunistic. In addition, a number of primitive lodges exist in the region where guests may stay overnight. Many of the service and trade facilities surrounding the park and preserve depend heavily on seasonal recreational visitors.

WILDERNESS VALUES

One of the purposes of this document is to present the impacts of implementing the EIS alternatives on wilderness values (see below). With respect to wilderness, it is not the intent of this document to evaluate the suitability of any lands in the study areas for wilderness designation.

The Wilderness Act of 1964 (PL88-577) established a method of designating eligible federal lands as additions to the National Wilderness Preservation System. Section 2(c) of the act defines wilderness and generally characterizes the types of wilderness values which existed in the area prior to intensive human activity, and the values which this document addresses:

> A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this act an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

As required by section 1317 of ANILCA, the National Park Service began a wilderness review in 1984 by evaluating NPS-administered, nonwilderness lands to determine which lands would qualify for wilderness designation. This suitability review was incorporated into the 1986 General Management Plan for Wrangell-St. Elias National Park and Preserve.

There are currently 9.7 million acres of existing designated wilderness in the Wrangell-St. Elias National Park and Preserve. The wilderness suitability review found approximately 3,174,000 additional acres suitable for wilderness designation in the park/preserve (all ownerships included), of which about 2,696,000 are federally-owned acres. This additional acreage is about 24 percent of the entire park/preserve.

Approximately 366,500 acres were found to be unsuitable for wilderness designation. Areas not eligible for wilderness designation according to the wilderness suitability review are listed below.

These areas were found unsuitable for wilderness designation because the areas contained roads, designated ORV/ATV routes, residence and cabin areas, locales used heavily for subsistence and/or sport hunting, or areas used now and in the past for mining and associated activities.

A final environmental impact statement addressing possible wilderness designation alternatives has been made available for public review. The proposed action in the final statement wilderness recommendation recommends an addition of about 273,000 gross acres and the deletion (from existing wilderness) of approximately 109,000 acres.

Area	Acreage
Chisana	43,520
Nabesna Road	2,090
Copper/Tanada Lakes	62,080
Nabesna Road Terminus	7,680
Suslota (corridor)	3,840
McCarthy/Kennecott/Dan Creek/May Creek Area	145,930
Kuskulana drainage	98,290
McCarthy Road	2,980
Malaspina forelands	1,090
Total	367,500

SOCIOECONOMIC ENVIRONMENT

Population

The human population in the Wrangell-St. Elias National Park and Preserve region is very sparse and concentrated in communities that have developed along the transportation corridors of the area. The principal communities are Tok, Glennallen, Gulkana, Mentasta Lake, Tazlina, Tanacross, Tetlin, Northway, Kenny Lake, Gakona, Copper Center, Chistochina, McCarthy, Chitina, and Slana. These communities comprise both native (approximately 20 percent in 1980) and nonnative residents. The population of these communities is displayed in table 10.

The estimated total population in the Wrangell-St. Elias National Park and Preserve region, including the communities near the interior transportation corridors, was approximately 4,379 people in 1985. A relatively large increase in population occurred in the region from 1970 to 1980 which was associated with the construction of the Trans-Alaska pipeline, but since then the population has decreased slightly and stabilized.

About 100 year-round residents are scattered along the Nabesna and McCarthy roads. In the summer, this population grows with the influx of miners and people who own seasonal homes in the area.

Community Descriptions and Economic Base

The location of each community on the highway and elsewhere has determined the role it plays in the region. Except for Tok and Glennallen, most of the communities are marked by a roadhouse,

roadside services, and a few clustered houses. Many more houses and trailers are often found on side roads or trails.

Tok is characterized by support facilities for traffic along the Alaska and the Glenn highways. This community also offers support services to the nearby native communities in Tanacross, Tetlin, and Northway.

Table 10. Population of Selected Communities In and Near Wrangell-St. Elias National Park and Preserve

Primary Communities	1970	1980	1984	1985
Chisana	–	7	7	7
Chistochina	33	55	55	64
Chitina	38	42	41	40
Copper Center	206	213	229	229
Gakona	88	87	82	82
Glennallen	363	511	518	499
Gulkana	53	104	98	98
Kenny Lake[a]	NA	NA	NA	357
Lower Tonsina	NA	40	39	38
McCarthy	NA	22	72	NA
Mentasta Lake	68	59	68	66
Nabesna	4	–	–	–
New Slana[b]	NA	NA	NA	200
Northway	40	73	86	93
Slana	NA	49	49	57
Tazlina	NA	31	39	38
Tetlin	114	107	92	89
Tok		589	665	692
Tonsina	NA	135	130	130
Yakutat		449	470	456
RESIDUAL (est.)[c]	1,144	1,144	1,144	1,144
1985 TOTAL (approx.)				4,379
Large Service-Oriented Communities:				
Anchorage	–	174,431	227,848	235,269
Fairbanks	–	22,645	27,103	27,099
Valdez	1,106	3,079	3,388	3,271

Sources: 1970, 1980 U.S. Census; Alaska Department of Labor, 1986; Alaska Department of Fish and Game, Division of Subsistence, 1984.

[a] the Kenny Lake population includes two cooperatives.

[b] population estimate for New Slana is very rough. In 1983 BLM started a homesteading program on land northeast of the community of Slana bordering the preserve. Obtaining estimates of population in this new community proved very difficult.

[c] estimated number of "residual" population, i.e. population not part of census designated areas in rural areas (perhaps mostly subsistence population). Estimate was given for the 1970 census and not for the subsequent years so the number was assumed to be the same for purposes of estimating the population of the region.

Glennallen is located along the regional highway system and provides regional services such as government, education, banking, food, clothing, and medical care. This community is the site of a Bureau of Land Management (BLM) office and a post office. Glennallen also serves as a key truck and tourist stop for traffic from the Alaska highway to Anchorage and Valdez. Glennallen extends several miles along the Glenn highway and offers a wide range of services.

The villages of Gulkana, Mentasta Lake, and Tazlina are primarily native, with small Caucasian communities located nearby. Gulkana is the site of the most used airport in the region and Tazlina is the site of a Alaska Department of Natural Resources Forestry Office. Copper Center is the focal point of native regional activities and also has a few small businesses and a post office. Kenny Lake, Gakona, Chistochina, McCarthy, Chitina, and Slana are primarily nonnative settlements characterized by agriculture, homesteading, mining, and a few small businesses.

Those residents within the park and preserve are generally scattered along the Nabesna and McCarthy roads. Their economic activities may include prospecting, hunting, trapping, fishing, and guiding and many leave the region for at least some part of the year to earn cash or take breaks from their isolated lifestyles. Obviously, then, the economy of the region is generally quite undeveloped, and relies on seasonal-type employment and significant subsistence activity.

The 1980 U.S. Census shows that five categories contribute the most jobs to the region's nonagricultural economy: (1) construction; (2) federal, state, and local governments; (3) manufacturing; (4) services; and (5) transportation, communications, and utilities. Labor force statistics for 1980 show that construction and government employment accounted for approximately 40 percent of the total average annual employment in the region, although this has probably dropped since the completion of the Trans-Alaska pipeline.

Local Economy

In Wrangell-St. Elias National Park and Preserve, there have been three approved operations since the court order restriction on mining took effect. In 1985, 10 mines operated at least part-time in the park and preserve. All of these mines were considered small by state of Alaska standards, which means that fewer than five people worked on a particular mining operation. In total, these 10 mines employed between 19 and 25 people. These numbers are for known mining activities in the park and preserve, but there may have been other single-person, recreational-type miners that were operating without the park's permission or knowledge.

The role of mining in the local economy includes two parts: mining employment and the expenditures made by the mining industry for the purchase of goods and services. Because there are no accurate records of mining operation expenditures, a publication of the Alaska Department of Commerce and Economic Development (ADCED 1986), titled *The Role of Placer Mining In the Alaska Economy-1985*, and a Bureau of Mines publication, titled *Cost Estimation Handbook for Small Placer Mines* (BOM 1987), were used to estimate the level of economic activity generated by placer mining in the local communities.

Total expenditures made by Alaska placer miners for labor, goods and services were approximately $75 million in 1985 of which $63.4 million was spent in Alaska. Of the total expenditures, about 36 percent was made in Fairbanks, and 23 percent in Anchorage. Placer mining is a major contributor to the economy of rural Alaska as well with about 18 percent of the total expenditures being made in small communities around the state. The remainder of these expenditures go out-of-state.

In 1985, placer mining activities accounted for approximately 1,678 full-time equivalent jobs statewide. About 31 percent of the placer mining work force resides in Fairbanks, 16 percent resides in Anchorage, and about 34 percent of the work force comes from rural Alaska. Approximately 19 percent of the placer mining work force comes from outside of Alaska.

In addition, the placer mining industry has a large, indirect impact on the economy of the state. The total impact on sales in the Alaska economy is $127.4 million. The income multiplier results in total wages and salaries resulting from placer mining of $33 million and an estimated 841 people employed by support industries serving placer mining.

Statewide gold production has increased in the 1980s. For a period between 1982 and 1985, this increase was due to the increased production by large- and medium-sized mines. In 1985, there were 36 fewer recreational/assessment mines, 63 fewer small mines, and two fewer medium sized mines than in 1982. In 1985, however, there were 14 more large placer mines statewide than in 1982 (ADCED 1986).

Mining activities in the Wrangell-St. Elias region, because of the relative remoteness of the mining operations and the existence of regional distribution type communities, would rely more heavily on rural businesses than the ADCED study indicates. Therefore, for the purposes of this analysis, it is assumed that 20 percent (instead of 18 percent statewide average) of all mining expenditures from mining activities in the park/preserve could be expected to remain in the local communities.

The ADCED 1986 publication does not present lode mining expenditures to local communities. Other than such expenditures being proportionally similar in nature to placer mining for the types of goods and services procured from local and surrounding communities, there is no fixed relationship between expenditure amounts from lode mining compared to placer mining.

Even though certain levels of lode mining are presented in the mineral development scenario in this document, the intermittent and extremely variable development and production costs and revenue generated by relatively small lode mines, make expenditures to the local economy difficult to accurately estimate. In addition, if a deposit capable of supporting a large lode mine is found, the time required for development from exploration through production would be greater than for a small lode mine and expenditures to the local economy would be greater. Therefore, expenditure amounts to the local communities from lode mine operations is not presented in this statement.

Value Estimates of Mining Claims

In Wrangell-St. Elias National Park and Preserve, the gross value estimate of the patented mining claims is $11,000,000 to $14,000,000. The gross value estimate of the unpatented mining claims is $2,500,000 to $5,000,000. The total gross value estimate for mining claims is $13,500,000 to $19,000,000. For more detailed information on the gross value estimates refer to appendix 9.

NPS Minerals Management Program Administration

The National Park Service's Alaska minerals program activities include plan of operation review and analysis, environmental compliance, validity examinations, surveying, data collection, and field monitoring and enforcement. Approximately 20 to 25 people are employed at the regional office and the various park units to carry out these tasks (appendix 11).

HISTORY OF MINING IN WRANGELL-ST. ELIAS NATIONAL PARK AND PRESERVE

History

The American period, following the purchase of Alaska by the United States in 1867, was initially characterized by a level of inactivity in the Alaskan interior. During the 1880s and 1890s, the U. S. Army, Geological Survey, and Coastal Geodetic Survey mounted major expeditions which resulted in the first detailed mapping of the Wrangell-St. Elias region. Lieutenant Henry T. Allen explored the Chitina, Tanana, Koyukuk, and Copper River valleys as far as the Yukon Basin and brought back news of the geography and resources of the area in 1884 and 1885. Geologist Charles Willard Hayes surveyed the White River to Chitina route across the Wrangell Mountains in 1891, while geologist, Israel Cook Russell, explored the Mount St. Elias vicinity. By 1896 exploring parties reached the summit of the mountain.

In 1897-1898, the Klondike Gold Rush drew thousands of persons northward, many of whom searched for mineral deposits in the Wrangell-St. Elias area. Although the Klondike was in Canadian territory, some 6,000 prospectors attempted to reach the Klondike gold fields by way of an all-American route going from Valdez up the Copper River Valley and beyond. The route turned out to be impractical, and some of these men ended up searching for minerals in the Chugach and Wrangell mountains. Rich copper deposits were found on the south side of the Wrangell Mountains in 1900, and placer gold was discovered in the Nizina Valley in 1902.

Placer gold production along Chititu and Dan creeks in the Nizina District averaged about $65,000 per year between 1903 and 1909. A later placer gold discovery in the Chisana district set off a stampede in 1913-1914. Boom towns were founded at Chisana and Bonanza as several thousand people rushed to the Chisana-White River area. Placer mining declined in the Nizina and Chisana districts before World War I, but has continued at a relatively low level. Production has fluctuated over the decades depending on various factors such as transportation costs and the price of gold.

The most important mineral development in the region occurred as a result of the discovery of a copper deposit on Bonanza Ridge in 1900. Samples from this deposit assayed as high as 70 percent copper. In 1906, the Morgan-Guggenheim interests acquired these claims which constituted one of the world's richest copper deposits. The Kennecott Copper Corporation was formed, and development of the mineral deposit began in 1908. To transport the ore to an ocean port, the Kennecott Corporation constructed a 130 mile-long railroad from Cordova to the Kennecott Mill site.

Construction of the Copper River and Northwestern Railway was a major engineering feat. The rail line was completed in 1911 and shipments of copper ore began from the Kennecott Mine to smelters in Washington State that same year. The town of McCarthy and a number of other communities were built along the railroad as a result of the development of the Kennecott Mine. Prospecting for additional copper deposits occurred in surrounding areas, but other deposits did not prove rich enough to overcome the high costs of transportation. More than 1.2 billion pounds of copper, valued at $220 million, were produced by the Kennecott Mines before the rich ore deposit was exhausted. The mine was closed in 1938. Kennecott's copper output amounted to one quarter of the entire mineral wealth produced by the territory through 1938.

Prospecting for gold and other minerals also occurred in the Nabesna area on the north side of the Wrangell Mountains as early as 1899. A rich gold-lode vein was found in 1925, and, in 1929-1930, the Nabesna Mining Corporation was formed to develop this deposit. A 60-ton flotation mill was constructed in 1931, and the Nabesna Mine became one of the leading gold-lode producers in the territory during the 1930s. The mine was closed after the War Production Board issued Gold Mining Limitation Order L-208 in October of 1942, closing down all "nonessential" gold mines to

provide more manpower and equipment for the war effort. The Nabesna Mine reopened for several years after the war, but closed again in 1947. It produced approximately 2.5 tons of gold ore and approximately five tons of silver ore, along with lesser amounts of copper concentrates.

Historic mail and transportation routes, and the development of aviation in the region are significant themes during these years. Passengers, mail, and supplies were carried along early trails during the height of the gold and copper mining years. The Nicolai (Hanagita River) Trail traversed the Chugach Mountains from Taral on the Copper River to the Nizina mining district. Three different trails connected McCarthy with Chisana, and were used by the stampeders in 1913 and subsequent years. Other historic trails included the Dawson-Chisana and Kuskulana Pass trails. Steam boats plied the Copper River for a few years before the opening of the railroad. A road was constructed from Gulkana to Nabesna in the 1930s. In the 1920s and 1930s, bush pilots performed daring feats to fly passengers and supplies to the mining camps. Early airstrips built in the Wrangell-St. Elias region included Reeve Field at Nabesna, and airstrips at McCarthy, May Creek, and Chisana.

The population of the Wrangell-St. Elias region dwindled after World War II because mining in the area declined. Hunters and mountaineers used the communities along the Copper River Valley Highway, in steadily increasing numbers, as outfitting and departure points for their activities. Exploration and mineral production activities began increasing again as the price of precious metals increased in the 1970s.

Historic Sites

NPS cultural resource, field reconnaissance teams have inventoried approximately 70 historic sites within the boundaries of Wrangell-St. Elias National Park and Preserve. Most of these sites are associated with historic placer and lode mining operations. The sites include log and woodframe cabins, sheds, and tent frames that vary in condition from standing structures to ruins; open cut (ground surface) workings such as tailing piles and prospect pits; underground workings such as adits, shafts and tunnels; remnants of hydraulic mining systems such as dams, ditches, flumes and pipelines; mining related equipment such as pipe, hydraulic nozzles, wagons and gravel scoops; milling equipment and structures for processing ore; and trash scatters that are associated with mining related activities. These historic sites represent examples of changing mining technology over the last 85 years. Many of these sites are located on, or adjacent to, existing mining claims where they may be impacted by further mining activity, depending upon the specifics of each mining plan.

An evaluation of the condition and significance of each site under the criteria for the *National Register of Historic Places* is currently underway. Several important historic sites, including the Kennecott Mine, which is a national historic landmark, and the Nabesna Mine, which is on the *National Register*, are located adjacent to or on existing mining claims. Until the evaluation process has been completed, all of the sites not evaluated yet will be treated as potentially eligible for the National Register. Sites along streambeds or near creek banks frequently have been impacted by subsequent mining operations and/or erosion. The passage of time, weathering effects, periodic reutilization, or lengthy periods of abandonment have impacted the integrity and interpretative value of the sites.

MINERAL DEVELOPMENT SCENARIO

A mineral development scenario was prepared as a basis for predicting where and to what extent future mining activity might reasonably occur in the next 10 years. The scenario represents the most probable level of mineral development. Environmental impacts were projected for potential future mining to meet the requirements of the National Environmental Policy Act (NEPA) (PL91-190). The scenario does not represent an NPS proposal, nor does it suggest levels of mining activity which are acceptable to the National Park Service or approvable under existing regulations. The National Park Service has prepared the scenario in consultation with geologists and mineral experts from other federal and state agencies and representatives from statewide mining organizations.

Assumption

The amount, type, and age of past activity were considered of primary importance in anticipating future activity. Where futuremineral development activity is projected, it is assumed that the activity is reasonably possible considering the previous factors and operation size, tonnage or yardage of recoverable mineral, claim configuration and amount of land under claim, thoroughness of past exploration, and access.

The scenario is summarized herein, but for a detailed description see appendix 1.

In Wrangell-St. Elias National Park and Preserve, five areas would be directly affected by future mining. These are the Nabesna area (Nabesna study area); the Gold Hill area near Chisana (Chisana study area); the Dan and Chititu creek drainages on the Nizina River (Nizina study area); the Bonanza Ridge/McCarthy Creek area (Kennicott study area); and the Granite Peak area on the Kotsina River (Granite Peak study area).

Placer mining for gold would occur in the Chisana and Nizina study areas, and lode mining or exploration for gold, silver, or copper would occur in the Nabesna, Kennicott, Granite Peak, and Chisana study areas. Placer operations would range in size from small suction dredge/sluicing activity, which disturbs less than an acre per year, to large mechanized operations capable of processing several hundred thousand cubic yards of gravel per year. Lode activity would range from exploratory operations using a small hand-held drill rig to development of a mine capable of producing 150 tons per day.

It is assumed that new access roads to claims would not be necessary. Additional roads on-claim, however, would probably be constructed and are included in total disturbance presented.

Table 11 shows the type of activity expected to occur in each study area and the total acreages likely to be disturbed by future mining. Thirteen future operations are likely, and 10 would be active for the entire 10-year period. A total of 123 acres of future mining disturbance would be expected if all operations were approved.

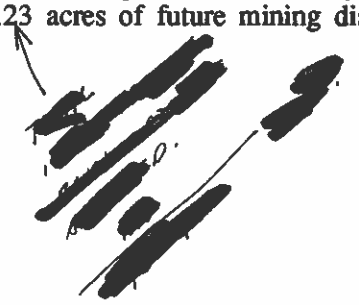

Table 11. Summary of the Mineral Development Scenario for Wrangell-St. Elias National Park and Preserve

Study Area	Type of Claims	Type of Activity	Amount of Disturbance
Nabesna	Lode	(1) Underground gold mine	35 acres
		(2) Heap leach operation	2 acres
Chisana	Placer	Small sluice/suction dredge operations	10 acres
	Lode	Small-scale exploration with hand-held drill	1 acre
Nizina	Placer	Large mechanized operations	55 acres
Kennicott	Lode	Exploration by large drill rig for copper/ silver, or reopen mine	15 acres
Granite Peak	Lode	Small silver mine and additional exploration	5 acres
Total Future Mining Disturbance			123 acres

TARGET RESOURCES

The first step in the analysis of cumulative impact in Wrangell-St. Elias National Park and Preserve is the selection of target resources. Target resources are natural, cultural, or socioeconomic resources identified as impact topics in this statement. All target resources originate from major issues identified in the EIS scoping process. For a discussion of all scoping issues and their relationships to this statement, see the consultation and coordination chapter. The impacts on target resources are analyzed either quantitatively, by using a predictive impact model, or qualitatively, by using a descriptive approach.

Target resources in this report are wetlands, aquatic ecosystem integrity, grizzly bear habitat, moose habitat, Dall sheep habitat, caribou habitat, wolves, visual quality, cultural resources, subsistence use, recreation and visitor use, wilderness values, and local economy. See appendix 3 for a detailed discussion of the cumulative impact methodology and target resources.

Once the extent and location of future mining activity was defined from the mineral development scenario, and the target resources selected, study areas were delineated in which to quantitatively analyze the cumulative impact of mining.

Study areas were delineated using the following three steps (see appendix 3 for a complete discussion).

- Claim groups identified in the mineral development scenario were mapped.
- Watersheds were selected as the spatial building blocks of the study areas. Contiguous watersheds containing scenario claim groups or major past mining disturbance were combined.
- The combined watershed boundaries were adjusted, if necessary, by resource specialists familiar with the areas. Boundary modifications were made when a watershed extended beyond the probable influence of mining on the resource. Thus, study area boundaries were different for the aquatic, and the wildlife habitat target resources.

Table 12 presents study areas and acreages for Wrangell-St. Elias.

Table 12. Study Area Acreages, Wrangell-St. Elias National Park and Preserve

Study Area	Resources	Acres
Nabesna	Aquatic ecosystem	4,051
	Wildlife habitat	6,630
Chisana	Aquatic ecosystem	12,756
	Wildlife habitat	16,496
Nizina	Aquatic ecosystem	47,764
	Wildlife habitat	66,851
Kennicott	Aquatic ecosystem	55,514
	Wildlife habitat	54,378
Granite Peak	Aquatic ecosystem	6,568
	Wildlife habitat	7,898