

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

This chapter analyzes the probable impacts, by resource topic, for the modified preferred alternative described in chapter 2. Impact summaries from the other alternatives are found in Table 2-15 at the end of chapter 2. Complete impact analyses for other alternatives are found in the *Revised Draft EIS*. Because the modified preferred alternative is very similar to the preferred alternative in the *Revised Draft EIS*, the impacts of the proposed actions are also very similar. This chapter repeats the analysis for Alternative 4, the NPS preferred alternative from the *Revised Draft EIS*, and shows changes in that analysis for the modified preferred alternative with insertions indicated by underlined text and deletions indicated with strikethrough text.

The impact assessment evaluates the magnitude of impacts and how these impacts compare to current conditions. The cumulative impact assessment outlines overall impacts resulting from past, current, proposed, and reasonably foreseeable management actions. The impact assessment is intended to guide the decision-maker in choosing a management action that protects the environment based on an objective understanding of environmental consequences.

METHODOLOGY

Various methods were used for the impact analyses in this chapter. The principal method involved a review of published and unpublished literature regarding the effects of human activities on the resources discussed in the individual sections in this chapter. Literature sources presenting data collected from Alaska and other northern environments were given priority, and unpublished data collected in the park were reviewed and assessed for applicability. It is assumed that the results of impact studies in similar tundra and taiga environments in Alaska and Canada can be extrapolated reasonably to the Denali backcountry when specific data are lacking for Denali National Park and Preserve. In addition to literature review, the impact analyses were based on observations by park employees; discussions with residents, interest groups, and businesses at scoping meetings and in telephone conversations; site reconnaissance; and best professional judgment based on previous experience with similar projects and activities. Mitigation measures were assumed to be in place when analyzing the impacts of visitor activities and plan elements under the action alternatives.

In addition to identifying the impacts of actions proposed in the plan, this analysis examines the cumulative effect of plan actions when combined with the effects of past, present, and future actions that are outside the scope of the plan. The general methods used in the cumulative effects analysis are based on impact assessment principles outlined in the handbook produced by the Council on Environmental Quality (CEQ 1997: vii):

- address additive, countervailing, and synergistic effects;
- look beyond the life of the action;
- address the sustainability of resources, ecosystems, and human communities.

Impacts are described in as specific a manner as possible, bearing in mind the programmatic, general nature of the management plan.

NPS Management Policies affirm and clarify that the National Park Service may allow certain impacts in national park system units as long as “park resources and values” are left unimpaired. The Management Policies define park resources and values as:

- The park’s scenery, natural and historic objects, and wildlife, and the processes and conditions that sustain them, including, to the extent present in the park: the ecological, biological, and physical processes that created the park and continue to act upon it; scenic features; natural visibility, both in daytime and at night; natural landscapes; natural soundscapes and smells; water and air resources; soils; geological resources; paleontological resources; archeological resources; cultural landscapes; ethnographic resources; historic and prehistoric sites, structures, and objects; museum collections; and native plants and animals;
- Opportunities to experience enjoyment of the above resources, to the extent that can be done without impairing any of them;
- The park’s role in contributing to the national dignity, the high public value and integrity, and the superlative environmental quality of the national park system, and the benefit and inspiration provided to the American people by the national park system; and
- Any additional attributes encompassed by the specific values and purposes for which it was established (NPS Management Policies 2001 1.4.6).

At Denali, the National Park Service is particularly concerned with the set of these resources and values that are specifically identified in Sections 101 and 102 of ANILCA, the preservation of which is the reason for the designation of new conservation system units. In other sections, ANILCA refers to these as “resource values” and “natural and other values.” For the purposes of evaluating impacts and determining impairment for Denali, this plan equates these two ANILCA terms with the NPS Management Policy term “resources and values.”

The geographic scope of this assessment is the entire 6-million-acre area of Denali National Park and Preserve, plus adjacent lands used for subsistence, recreation, and tourism, including the associated communities along the Parks Highway, as well as those off the road system. The temporal scope extends at least 20 years into the future, the duration of the plan.

For each resource, the analysis includes a conclusion about the level of impact and about impairment. For natural and cultural resources, the conclusions are based on the following criteria. The impacts are discussed in terms of intensity, duration, and context.

Intensity

- Low: A change in a resource condition is perceptible, but it does not noticeably alter the resource's function in the park's ecosystem, cultural context, or visitor experience.
- Medium: A change in a resource condition is measurable/observable and an alteration to the resource's function in the park's ecosystem, cultural context, or visitor experience is detectable.
- High: A change in a resource condition is measurable/observable and an alteration to the resource's function in the park's ecosystem, cultural context, or visitor experience is clearly and consistently observable.

Duration

- Temporary: Impacts would last only a single visitor season or for the duration of discreet activity, such as construction of a trail (generally less than two years).
- Long term: Impacts would extend from several years up to the life of the plan.
- Permanent: Impacts are a permanent change in the resource that would last beyond the life of the plan even if the actions that caused the impacts were to cease.

Context

- Common: The affected resource is not identified in enabling legislation and is not rare either within or outside the park. The portion of the resource affected does not fill a unique role within the park or its region of the park.
- Important: The affected resource is identified by enabling legislation or is rare either within or outside the park. The portion of the resource affected does not fill a unique role within the park or its region of the park.
- Unique: The affected resource is identified by enabling legislation and the portion of the resource affected uniquely fills a role within the park or its region of the park.

Overall Conclusion

Conclusions about the overall impacts on the resource synthesize information about intensity, duration, and context, which are weighed against each other to produce a final assessment. While each conclusion reflects a judgment call about the relative importance of the various factors involved, the following descriptors provide a general guide for how those conclusions are reached.

- Negligible: Impacts are generally low intensity, temporary, and do not affect unique resources.
- Minor: Impacts tend to be low intensity or of short duration, although common resources may have more intense, longer-term impacts.

- Moderate:** Impacts can be of any intensity or duration, although common resources are affected by higher intensity, longer impacts while unique resources are affected by medium or low intensity, shorter-duration impacts.
- Major:** Impacts are generally medium or high intensity, long term, or permanent, and affect important or unique resources.
- Impairment:** A resource would no longer fulfill the specific purposes identified in the park's establishing legislation or its role in maintaining the natural integrity of the park.

For some topics, such as Socioeconomics, separate criteria are included in the Methodology section of the topic.

ASSUMPTIONS

Assessing the consequences of the modified preferred alternative requires making some assumptions about changes in human use patterns over time. Listed below are some of the assumptions that are referenced in the impact analysis for individual resources. Additional assumptions useful for the particular impact topic may appear in the Methodology section of the impact topic. For the impact analysis, the following time period references refer to specific "visitor seasons:"

SummerBeginning of May to the end of September
 Early Winter...October and November
 Mid Winter.....December through mid-February
 Late WinterMid-February to the end of April

- 1) Summer visitation at Denali will resume its growth, although not at the 5% annual growth rate of the 1990s. The rate may be closer to the 2% growth seen in visitor arrivals to Alaska over the past several years (ADCED 2001). Much if not all of the growth will be among package tour travelers associated with cruise ships or other tour companies. Cruise ship arrivals in Alaska climbed 27% from 1999-2003 although this period showed a lull in visitation growth at Denali. The tourism industry clearly expects growth to return to Denali, since the number of rooms available for overnight accommodation in the Denali Borough grew 19% from 1999-2004, demonstrating continued industry interest in investment (statistic courtesy of Denali Borough).
- 2) Those package tour visitors interested in experiencing the Denali backcountry will generally rely on a guided service for access. This means that the demand for a variety of guided activities and commercial services will continue to grow, including the demand for activities and services that have not been offered at Denali in the past.

- 3) New visitor facilities will be constructed in South Denali consistent with the 1997 *South Side Denali Development Concept Plan*. As a result, some of the growth in visitation to the park backcountry will originate from the south side. Without management intervention, new south-side Denali destinations will develop on their own in locations relatively accessible by road, water, and air such as Windy Creek, Dunkle Hills, Tokositna River, the Chelatna Lake area, and glacier landing areas near Talkeetna.
- 4) Scenic air tour and air taxi services will be among the most popular of the activities sought by visitors. Although the number of passenger landings on glaciers was flat from 2001–2004, overall passenger growth from 1999–2004 was 38% and growth in landings 11% (2.1% growth in flights with landings, 6.6% annual growth in passenger volume), associated with the opening of new hotel rooms serving package tour travelers in the South Denali area (see Table 3-16).

While much of the scenic tour traffic will continue to originate from Talkeetna and the park entrance, scenic air tours from more distant locations such as Anchorage and Fairbanks will continue to increase, serving Alaska visitors who do not travel closer to Denali than these two cities. The growth in scenic air tour traffic will be mitigated somewhat by the increasing efficiency of the air tour operators, who will fill a higher percentage of seats on every flight and fly larger planes. For example, among concession flights that landed on glaciers between 1999 and 2004, the average passengers per flight increased from 3.6 to 4.5 (Table 3-16). However, even with an average 3.5% annual growth rate the amount of air traffic over the park could double by 2025.

- 5) The number of general aviation landings and overflights in the Denali area will remain small relative to the number of commercial scenic tours and air taxi traffic.
- 6) Overnight independent use of the Old Park backcountry will fluctuate within the same range as it has for the past 15 years (30,000–40,000 user nights), perhaps with some slight increase. Overnight use of accessible parts of the park additions, including mountaineering use on the glaciers and glaciated peaks, will continue to increase gradually. Day hiking will increase in areas where guided hiking opportunities are available (see Table 3-9).
- 7) Over the life of the plan, only minor growth will occur in overnight stays at accommodations in the Kantishna Hills, resulting both from minor expansions of existing businesses and from the construction of a hostel as described by the 1997 *Entrance Area and Road Corridor Development Concept Plan*.
- 8) Access to and use of public lands near or adjacent to Denali will continue to improve and grow. Limited numbers of new or improved transportation facilities will be responsible for some of the growth – such as planned improvements to the Petersville Road and the gradual expansion of the road system to serve newly developed settlement areas near the Parks Highway. However, much of the

- increased access will occur because of continued technological improvements and increases in ownership of off-road vehicle transportation, including both snowmachines and wheeled or tracked all-terrain vehicles. New trail systems serving both motorized and non-motorized users may be constructed or improved on lands near the park boundary.
- 9) Winter visitation will increase. In part, this increase will occur as more Alaskans discover that Denali is open in the winter through such promotional activities as the annual Winterfest. Winter visitation also will increase along with the growth of snowmachine technology and ownership (see below). In part, the growth will occur as a larger number of out-of-state winter visitors seek winter recreational opportunities in Alaska – the number of off-season (October–April) visitors in state for reasons other than business grew from 114,000 to 142,400 between the winters of 1996–1997 and 2002–2003, an increase of 25% (ADCED 2003).
 - 10) The power, speed, and range of the average snowmachine in Alaska and at Denali will continue to increase. The number of people using these snowmachines recreationally in Alaska will continue to increase. Most of the use in the Denali area will continue to be on the south side of the Alaska Range from late February through the end of April. The majority of use within park boundaries does not have characteristics that would meet the definition of “traditional activities” presently applied in the Old Park.
 - 11) Adoption of low-impact technology for motorized forms of access – airplane, snowmachine, motorboat – will generally not occur without incentives or regulations.
 - 12) Modes of access to the backcountry such as mountain bike, pack animal (horse, llama), or motorboat that have been only rarely used at Denali may become more popular over the lifetime of the plan.

BACKGROUND FOR ANALYSIS OF CUMULATIVE EFFECTS

Cumulative effects are defined as incremental impacts on the environment that result from adding the proposed action to other past, present, and reasonably foreseeable future actions, including those taken by both federal and nonfederal agencies, as well as actions undertaken by individuals. The next section outlines the actions considered in this analysis for the Denali Backcountry Plan. Cumulative impacts may result from singularly minor but collectively significant actions taking place over a period of time (CEQ Sec 1508.7).

This analysis evaluates the incremental contribution of impacts from the modified preferred alternative to the impacts of unrelated past and reasonably foreseeable future developments and activities in the Denali region. The analysis builds on and extends the information and analyses in the *General Management Plan EIS* (NPS 1986), the *South Side Final Development Concept Plan/EIS* (NPS 1997), the *Entrance Area and Road*

Corridor Development Concept Plan/EIS (“frontcountry” plan; NPS 1997a), the *Spruce Creek Access EA* (NPS 2002a) and the *Environmental Assessment for the Proposed Permanent Closure of the former Mount McKinley National Park to Snowmobile Use* (NPS 2000).

The period considered under cumulative effects stretches from 1972 – the first summer season when the George Parks Highway was open – to 2025, at the end of the life of the plan.

Management Areas

- The 1976 Backcountry Management Plan established backcountry units for the Old Park and quotas for overnight use in many of the units. In 1984, additional units were added to the system and quotas modified.

Access

- The 1986 General Management Plan for Denali established a cap of 10,512 round-trip vehicle trips on the Denali park road per summer season. A regulation implementing this cap went into effect in 2000.
- In 1995, the National Park Service began requiring registration 60 days in advance of the expedition start date for climbing either Mount McKinley or Mount Foraker.
- Technological improvements in snowmachines enabled a large but unquantified expansion of snowmachine use in Denali during the 1990s. Regulations implementing ANILCA section 1110(a) permit the use of snowmachines for traditional activities (where such activities are permitted by ANILCA or other law) but did not define traditional activities. Consequently, the expansion in use has been generally unmanaged. The growth in popularity of snowmachines is demonstrated by an increase in the number of registrations. Since registration in Alaska became a requirement in 2000, the number of registered machines has increased from 33,576 to 41,710, an increase of 7.5% per year. Statewide, 70% of machines are registered in the area between Anchorage and Fairbanks. (DMV 2004)
- In 2000, the National Park Service closed the former Mount McKinley National Park to snowmachine access.
- In 1995, the Department of the Air Force completed an EIS for the establishment of Military Operations Areas and Military Training Routes (MOAs and MTRs) in Alaska. This EIS included the Susitna MOA, which authorizes daily flights over a portion of the southwest Denali preserve and park additions south of the Alaska Range and east to the Tokositna area as depicted in Map 3-9 (U.S. Department of Defense 1995).

- Since 1980, new housing and commercial development has occurred in the Nenana Canyon north of the park entrance, the Yanert Valley east of the park boundary, in the eastern part of the Stampede Road corridor, around Cantwell, and along the Petersville Road. This development has resulted in minor expansion of local road networks or improvements of existing roads. The gradual development spreading out from the Parks Highway corridor is likely to continue, creating increased access to the eastern and southern boundaries of the national park, particularly the park additions.
- Concern for the safety of park visitors prompted the National Park Service to initiate a closure to the discharge of firearms in the Kantishna area in 2000. The restriction on the discharge of firearms applies on federal public lands within 1 mile of the Kantishna road right-of-way from the former Mount McKinley National Park boundary at mile 87.9 to the north end of the Kantishna airport. The firearm restriction is in effect from September 1 through September 15 each year. During the period of the firearms discharge restriction, subsistence harvests utilizing other methods and means of harvest may still take place according to federal subsistence management regulations.
- In 2005, the National Park Service determined that ORV's were traditionally employed for subsistence purposes in the Cantwell area under ANILCA 811(b) and the agency is presently developing a management plan for this use.

Commercial Services

- The National Park Service has awarded new concession contracts and allowed increased service levels for guided hiking and other activities associated with the expansion of private lodges in Kantishna. Additional activities are primarily in the Kantishna and Wonder Lake areas, but also include a road use authorization for the historic concession operator to travel into the Old Park for the purpose of interpretive hikes.
- Lodge owners or property owners in Kantishna have occasionally speculated that they might provide accommodations for winter visitors. Although there are no known plans, it remains a reasonably foreseeable action.
- During the 1990s, the number of glacier landings by air taxi operators significantly expanded, primarily in response to an increase in the number of park visitors interested in scenic tours rather than mountaineering. This rapid growth led to a conversion of the air taxi Incidental Business Permits to concession contracts in 1998 to limit the number of business enterprises able to offer this service.

- In 1998 and again in 2004, the NPS authorized three overnight guided dog-mushing concessions and one day-tour guided dog-mushing concession. Presently, only two of these concessions are active.
- In 1980, the NPS discontinued a permit for horse packing that had been issued originally in 1970. In the mid 1970s a dog-mushing concession was authorized to provide this freighting service; this service continues.
- Developing a winter tourism industry catering either to Alaskans in the major population centers of Anchorage, Fairbanks, and the Mat-Su Valley or to an out-of-state clientele is a possibility. This is a goal frequently expressed by the Healy-Denali Chamber of Commerce and some private business owners. The National Park Service and its partners have assisted in promoting winter visitation in the park entrance area by hosting an annual Winterfest that began in 2001. Further development of winter tourism could happen at many different scales and could involve both motorized and non-motorized recreation, including the potential for snowmachine rentals.

Facilities

- The National Park Service completed the *Entrance Area and Road Corridor Development Concept Plan* in 1997, which specified several new trails in the Old Park. Some of these trails have been constructed and the NPS intends to complete the remainder as funding allows.
- The National Park Service completed the *South Side Denali Development Concept Plan* in 1997, which specified new and improved road access and a visitor facility in the Peters Hills/Dutch Hills; new trails entering the park from the Peters Hills, Dunkle Hills, and Chelatna Lake area; and new campsites and six public use cabins in the Chelatna Lake and Peters Hills areas. A *South Denali Implementation Plan/Draft Environmental Impact Statement* is presently being finalized. This plan proposes a south Curry Ridge site for visitor facility development as an alternative to the Peters Hills area.
- In 2004 a “spring trail” was constructed from Park Headquarters to Mile 7 of the park road to allow for winter access from headquarters to tree line so that winter activities such as dog mushing and skiing can continue from Park Headquarters even if the road is plowed.
- Proposals have been advanced to clear an existing trail from Nenana to allow for winter access to Lake Minchumina. If the trail clearance occurs and services are provided at Minchumina, the community could become a much more popular jumping-off spot for winter trips into Denali.

Administration

- The National Park Service and its partners have greatly increased the amount of research, resource management, and monitoring activity taking place in the park since 1970. The first regular use of airplanes for research activity began in the early 1970s. In 1978, the first administrative airplane became available to the park, although it left in 1981. The summer of 1981 saw the first research use of helicopters, followed shortly afterwards by the stationing of a Firepro helicopter at Denali that has since been used for fire management and many other research and administrative projects. In the late 1980s, the park acquired two airplanes. The present aviation program expanded in 1991 with the annual contracting of a high-altitude Lama helicopter to support the mountaineering program on Mount McKinley and soon after with the increase in mountaineering patrols, which required additional contract aircraft to move rangers, volunteers, and temporary camps on and off the mountain.
- In the 1997 *Entrance Area and Road Corridor Development Concept Plan*, the National Park Service committed to establishing a center for research and education. The Murie Science and Learning Center program is now evolving, but presently includes field-based educational and research programs on trails as well as use of the backcountry. Future programs could include field research and other guided activities in the backcountry.
- The Bear-Human Conflict Management Plan of 1983 established methodologies for preventing conflicts between people and bears by prescribing appropriate methods of food storage and other behavior for people and by specifying protocols for addressing “problem” bears.

ICE-RICH PERMAFROST SOILS

The first part of this section provides an overview of the methodology used to evaluate impacts on ice-rich permafrost soils and water quality, including a literature review of the types of impacts that could result from actions proposed in the plan. The second part is an analysis of the impacts likely to occur under each alternative.

GENERAL IMPACTS BASED ON LITERATURE REVIEW

Analysis of impacts of recreational and administrative activities on ice-rich permafrost soils in Denali National Park and Preserve has relied primarily on a literature review of the types of impacts that can occur and on consultation with NPS subject matter experts and resource managers.

Ice-rich permafrost soils exist in the area between the Stampede mine, the Sushana River, and the Wyoming Hills. They also exist in the flat areas west of Kantishna and north of Purkeypile. Ice-rich permafrost soils could be affected in several ways by the actions proposed in the backcountry management plan and from the no-action alternative. Compaction of insulative surface cover, including vegetation and snow, over ice-rich permafrost soils can lead to premature warming of soils that can lead to ice degradation and thermokarsting. Melting of the ice in ice-rich permafrost soils can lead to a lowering of the ground level, creation of sag ponds and wetlands, thermokarst development, and associated changes in the vegetation regime.

Snowmachines may affect ice-rich permafrost soils indirectly by compacting snow, thereby altering snowmelt, increasing soil moisture, reducing the length of the growing season, and lowering soil temperatures beneath the trail and altering physical processes (Neumann and Merriam 1972; Pesant et al. 1985; Pesant 1987). Impacts on ice-rich permafrost soils from snowmachine use include temperature reductions in soil, which can change soil surface microstructure, which reduces the suitability of a site for seed germination and spring flower viability (Wanek and Schumacher 1975; Keddy et al. 1979). Soil compaction, because of snowmachine use, increases surface runoff, reduces infiltration, and impedes gas exchange between soil and air (Keddy et al. 1979). Compacted soils inhibit root growth and adversely affect soil organisms.

Dog-sled use may have a similar effect on ice-rich permafrost soils, by compaction of insulative layers (snow and soil), causing thermokarsting and ensuing changes in the vegetation regime. Impacts on soils from snowmachine use and dog-sled use would occur primarily in those areas that may become snow-free during certain periods in the winter or that have a thin snow cover that can be reduced further from snowmachine passes (Greller 1974). Areas of thin snow cover include mountain passes and exposed ridges. In addition, steep south-facing slopes tend to become snow-free sooner than other areas in the spring, and low snow years are common. Ice-rich permafrost soils that would normally be protected under snow may become exposed in areas with heavy snowmachine traffic.

IMPACTS OF THE MODIFIED PREFERRED ALTERNATIVE

The following analysis shows that there would be minor adverse impacts to ice-rich permafrost soils under this alternative. Impacts would be of low intensity, long-term duration, and would affect an important park resource. Use of snowmachines and dog sleds would increase above current levels, and repeated passes of snowmachines and dog sleds over ice-rich permafrost soils would damage these soils. However, use would be mitigated or restricted if standards outlined for Management Areas B, D, OP1, and OP2 are approached or exceeded.

Under this alternative, areas of the park that contain ice-rich permafrost soils would be zoned as Management Area B, D, OP1, or OP2. These management areas allow for very low to medium encounters, no landscape modifications, and low to medium trail and campsite disturbances (which include signs of social trails, campsites, or cut or broken vegetation). If standards in these categories are approached or exceeded, use would be curtailed or mitigated. Higher use levels would be accommodated along ~~147 linear miles of corridors in summer and 157 miles in winter. Since~~ 70 miles of summer Corridors and potentially 19.5 miles winter Corridors, but all of these higher use areas are ~~not~~ located where ice-rich permafrost soils are not abundant, so impacts to ice-rich permafrost soils would be minimal. ~~While the types of management areas assigned to areas of the park that contain ice-rich permafrost soils are similar to those in alternatives 2 and 3, the~~ The application of ~~these~~ management areas allows for overall ~~slightly~~ higher levels of use in areas of the park that contain ice-rich permafrost soils than occurs at present. Unless otherwise stated, all impacts would occur throughout the life of the plan.

Snowmachine use would increase over current numbers. Thus, localized impacts on ice-rich permafrost soils from snowmachine use would increase where ice-rich permafrost soils are prevalent (between the Stampede mine, Sushana River, and Wyoming Hills; and also in the flat areas west of Kantishna and north of Purkeypile). Impacts would be confined to routes where riders make multiple passes .

While the adequate snow cover requirement (see Chapter 3: Affected Environment) is intended to prevent these types of effects, they could occur because of the wide variety of terrain and climatic conditions of the park additions and preserve and because the determination of adequate snow cover applies to relatively large areas.

Most mushing in the park starts from the Healy area or the park entrance area to Wonder Lake either via the park road or via the Stampede/Clearwater/Moose Creek route. Use is also common from the Stampede area up the Toklat River. Except for the park road, these mushing routes cover extensive areas of permafrost soils. Impacts to ice-rich permafrost soils from dog sleds are similar to those described for snowmachines. Mushers tend to use established trails rather than construct new ones, and multiple passes over ice-rich permafrost soils damage insulating layers of snow, vegetation, and soil. This increases potential for permafrost degradation and the associated natural resource concerns of changes in hydrology and vegetation regimes.

Levels of dog-sled use could increase above current numbers. The Kantishna and Stampede areas would be zoned as Management Area B, which allows for very little evidence of modern human use and medium levels of encounters (visitors may encounter up to two parties per day). If impacts to ice-rich permafrost soils approach or exceed standards, use would be curtailed or mitigated to reduce impacts.~~Levels of dog-sled use could increase slightly above current numbers but impacts would be minimal because the Kantishna and Stampede areas would be zoned as Management Areas D and OP1, which accommodate low signs of human presence, and low trail and campsite disturbance. If impacts to ice-rich permafrost soils approach or exceed standards, use would be curtailed or mitigated to reduce impacts.~~

Cumulative Effects

Both technological improvements and community growth have led to an expansion of snowmachine use in the Denali park additions, including the northeastern additions west of Healy where ice-rich permafrost soils are found. In addition, the potential of trail clearance to Lake Minchumina could result in increasing snowmachine use in the northwestern park additions and preserve. The NPS authorization of dog freight and guided dog mushing concessions originating from the Stampede Road and Lake Minchumina also provided additional activity in the same ice-rich permafrost areas.

These actions have resulted in a moderate adverse impact to ice-rich permafrost soils. Implementing the preferred alternative alone would have minor adverse impacts on ice-rich permafrost soils. Together with the activities previously described, there would still be only moderate adverse impacts to these physical resources, few of which are attributable to the actions under this alternative.

Conclusion

Impacts to ice-rich permafrost soils under the preferred alternative would be minor. Use of snowmachines and dog sleds would increase above current levels, and repeated passes of snowmachines and dog sleds over ice-rich permafrost soils would damage these soils. However, use would be mitigated or restricted if standards are approached or exceeded. There would be moderate adverse cumulative impacts of the final plan plus the aforementioned past, present, and reasonably foreseeable actions. The level of impacts to physical resources anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are essential to the natural integrity of the park.

VEGETATION

This section analyzes the probable impacts to vegetation from the potential actions identified in this plan. For this analysis, vegetation includes vascular and non-vascular flora of Denali National Park and Preserve. The first part of this section provides an overview of the methodology used to evaluate impacts on vegetation, including a literature review of the types of impacts that could result from actions proposed in the plan. The second part is an analysis of the impacts likely to occur ~~under each alternative~~.

GENERAL IMPACTS BASED ON LITERATURE REVIEW

Analysis of impacts of recreational and administrative activities on vegetation in Denali National Park and Preserve has relied primarily on a literature review of the types of impacts that can occur and on consultation with NPS subject matter experts and resource managers.

Loss of Vegetation

A variety of activities can contribute to loss of vegetation in the Denali backcountry. In severely impacted areas, the direct effects to vegetation from snowmachine use include the creation of trails where vegetation has been eliminated. Hiking and overnight camping activities can create informal trails that become established. These trails are typically devoid of vegetation and may gully and impound (in lowland areas).

Impacts to vegetation and wetlands in the Denali backcountry from facility construction can be assessed based on several decades of experience elsewhere in the park. The principal impact of visitor facilities on vegetation is the loss of vegetation because of facility construction.

Vegetation can also be lost due to human-caused fires. After examining the Yellowstone Fire Reports from 1931–2000, Warthin (2002) concluded that incidents of human-caused fire in Yellowstone National Park were higher near trails, roads, and campsites because human use is focused in these places. Fire history at Denali National Park indicates a similar trend (Dan Warthin, pers. comm.).

Trampling and Damage

The direct impacts to vegetation from snowmachine use include structural damage to plant tissues (compression, abrasion, stem breakage) (Neumann et al. 1974, Roland 2000). In ice-rich permafrost areas, trails can form impoundments, which can change plant community composition and promote erosion. Indirect impacts of snowmachine use include changes in the distribution of snow cover and in the thermal properties of the snow from compaction (Pesant et al. 1985). These changes in snow properties can prematurely expose shrubs normally covered by snow; decrease snow density, reducing the insulating value of the snow (Wanek and Schumacher 1975); and increase the

duration of snow cover on trails, thereby shortening the growing season for plants in those areas (Pesant et al. 1985).

The plant species most sensitive to these impacts are those species whose canopy extends above the snowline and/or that are common in thin snow areas. These species include willows (*Salix* spp.) and shrub birch (*Betula glandulosa*), mountain avens (*Dryas octopetala*), and blueberries (*Vaccinium* spp). Although no quantitative studies have been completed on the impacts of snowmachine use on vegetation in the Denali National Park area, visual assessments of effects have been made in the Bull River/Foggy Pass area and the Windy–Foggy–Easy Pass area (Roland 2000). Broken shrub stems, stripped bark (from abrasion), trail development, and late-melting snow were evident in high-use snowmachine areas. A Canadian study of the ecological effects of snowmachines found that, after a single pass in a stand of tree saplings, over 78% of the saplings were damaged, and woody stems up to 2.5 cm in diameter were susceptible to damage (Neumann and Merriam 1972).

Hiking and overnight camping activities can affect vegetation in several different ways. In some cases, trails can widen eventually (Lance et al. 1989), especially in moist meadows and bogs, and trail braiding will develop with increased traffic on wet or steep slopes. Shrub-dominated communities are slower to recover than grass-dominated communities (Cloe and Trull 1992). Lichens are particularly sensitive to trampling (Tietz 1996) and may not recover for several years in high-use trail areas in the alpine zone. In areas where camping is frequent, bare mineral surfaces can form from compaction and trampling (Monti and Mackintosh 1979).

Some effects of hiker and horse trampling on various types of vegetation have been described in a 5-year study conducted at Denali (Reid and Schreiner 1985). In alpine tundra areas, total plant cover was reduced by 25% with less than 40 hiker passes per season. Total plant cover in the boreal forest was reduced by 75% under that same treatment level. Cover reduction of vascular plants in the shrub tundra was intermediate between these two types, but the predominant ground cover of nonvascular lichens and mosses was more severely affected than any of the other types of vegetation examined in the study. The recover rate of the graminoid alpine tundra plants was more rapid than the woody vegetation in either the boreal forest or shrub tundra. Impacts from horse use were higher in all vegetation types and recover of trampled sites was slower.

Introduction of Exotic Species

Densmore, et al. (2001) inventoried exotic species in Denali National Park and Preserve and found that the park maintains the very fortunate position of not having a serious exotic species problem. Unlike most parks outside Alaska, Denali currently does not endure the financial burden associated with eradication efforts.

Pack animals and trails contribute to the introduction and spread of exotic species (Campbell and Gibson 2001, Hammit and Cole 1987, Benniger 1989). Examples of exotic species that could be introduced into Denali National Park and Preserve include *Hordeum* and *Chenopodium album*, or any other variety of agricultural weed that could

end up in pack animal forage. Dust effects promote the establishment of invasive plant species, such as dandelion (*Taraxacum officinale*) that compete well in areas experiencing continued disturbance. Exotic plants have been seen on floatplanes in Alaska (pers comm. Carl Roland 3/14/05). *Myriophyllum spicatum* is one example of an aquatic plant that has been introduced via airplane.

Denali National Park and Preserve's invasive species control plan consists primarily of monitoring invasive species along the park road corridor. Resource specialists react to problems as they arise. For example, volunteers pull dandelions along the road corridor, and park staff have eradicated *Crepis tectorum* from the sewage lagoon area in the park's frontcountry.

Many natural landscapes in western North America are covered in exotic plant species, and that trend is starting to occur in Alaska. Resource experts believe that Alaska is on the cusp of a situation where species are starting to creep into interior Alaska at unprecedented rates (pers comm. Carl Roland 3/15/05). As exotic plants become more widespread, the probability of exotics spreading into Denali National Park and Preserve increases. Exotics currently exist at low densities in source areas like Fairbanks, but as densities of exotics increase in source areas, the probability of exotics spreading into the park increases. There are many indications that species are becoming invasive. Resource experts are particularly concerned about white sweet clover (*melilotus spp.*), which has become established on river bars on the Nenana River and Teklanika River outside the park, and about bird vetch (*Vicia cracca*), which has invaded natural areas around Fairbanks and has appeared three times in the park (pers comm. Carl Roland 3/15/05).

IMPACTS OF THE MODIFIED PREFERRED ALTERNATIVE

The following analysis shows that impacts to vegetation under this alternative would be moderate because some vegetation would be lost, trampling would occur in various locations throughout roughly eleven percent of the park, and the potential for introduction of exotic species is considerable. This alternative would provide a variety of appropriate wilderness recreational activities and experiences by establishing areas to serve those visitors who want to experience the wilderness resource values of the Denali backcountry but require services, or assistance, or ~~short~~ who are unable to make lengthy time-commitments. The areas would be focused along the park road; ~~in~~ in the Old Park and Kantishna ~~near the park road~~; at the Ruth, Tokositna, and Kahiltna Glaciers; and in the Dunkle Hills/~~Broad Pass~~ area.

Under this alternative, ~~55~~49% of the park (~~3,313,878~~52,903,388 acres) would be zoned as Management Area D or OP2. These management areas allow for low encounters, very little evidence of modern human use, no landscape modifications, and few, if any, trail and campsite disturbances (which include signs of social trails, campsites, or cut or broken vegetation). In addition, under this alternative, ~~29~~40% of the park (~~1,738,804~~2,383,710 acres) would be zoned as Management Area OP1 or Management Area B. These management areas allow for very little evidence of modern human use, no landscape modifications, and few encounters (visitors will almost always be alone). If

standards in these categories are approached or exceeded, use would be curtailed or mitigated. Therefore, minimal adverse impacts to vegetation are likely to occur in a large portion of the park (~~84~~89% of the total park area falls within one of the aforementioned management areas).

Under this alternative, ~~11~~6% of the park (~~668,314~~358,256 acres) would be designated as Management Area A, and ~~147~~70 linear miles of summer corridors and ~~157~~19.5 linear miles of winter corridors would be designated. The expectation in these areas would be to encounter up to five parties a day in Management Area A and up to ten parties a day along a corridor. These areas also allow for occasional trails, campsites, or cut or broken vegetation before use would be curtailed or the impacts mitigated. The remaining ~~four~~five percent of the park would be zoned as Management Area C; this area would accommodate higher use levels, but this region of the park is largely un-vegetated.

Unless otherwise stated, all impacts would occur throughout the life of the plan.

Loss of Vegetation

The National Park Service would designate ~~hiker~~Backcountry Hiker areas and (if needed) construct or improve the following:

- some of the existing social trails within Management Area A in Kantishna.
- the trail from Eielson Visitor Center to Gorge Creek
- the loop trail from the water tower above Wonder Lake Campground up to the bench west of Wonder Lake
- the Mount Healy trail extension
- the trail from the west end of Thorofare Bluffs down to the Thorofare River bar.
- ~~the area along Wildhorse Creek connecting to trails associated with the South Denali visitor facilities development.~~

Constructing trails in these areas would require removing vegetation.

Management area zoning would allow for increases in hiking and camping so some trampling and social trail formation would be expected around Kantishna and, near access corridors ~~along the park road, and in the upper Tokositna drainage on the south side of the park.~~ In these areas, social trails are likely to form, resulting in lost vegetation along the trail. Also, established trails and corridors tend to create pressure for new trails, which ~~would~~could result in additional losses to vegetation. ~~While these impacts would be noticeable in the Kantishna area and along the park road corridor, t~~The area of impact would be small on a parkwide scale.

Impacts would be mitigated by the requirement that all guided cross-country hikes would be subject to the group size limit of either 6 or 12 including guides and would be required to have a group leader who is trained in leave-no-trace principles for tundra environments generally and Denali National Park in particular. The strategy to prevent social trail formation (see chapter 2, Actions Common to All Action Alternatives) would help mitigate loss of vegetation by reducing the potential for social trail establishment.

Up to five designated ~~campsites~~ camping areas would be created in conjunction with the Corridor areas in the Kantishna Hills. Where trails and campsites are created, vegetation would be lost. Increased incidents of human-caused fire are likely to occur near trails and campsites, resulting in burned vegetation. Summer Corridor areas would receive high levels of use and social trails would form in these areas. Loss of vegetation would ~~occur~~ be very localized, primarily in the Kantishna area ~~and, along the park road corridor, and in the Wildhorse Creek drainage on the south side (impacts would occur at localized areas within about 163% of the total park area).~~

In the northern park additions, winter trails established by snowmachine or dog sled are slower to melt out than the surrounding area. Slower melt out reduces the length of the summer growing season along these trails. Over time, plants may not be able to be as viable in these areas.

Trampling

Under this alternative, access by snowmachine to the park additions and preserves would be allowed to continue and to grow. Designating corridors for winter use would focus snowmachine use ~~in the following places: from along the southern park boundary to the Old Park boundary near the West Fork Chulitna, Bull River, and Cantwell Creek to the Old Park boundary; to the toes of the Ruth, Tokositna, and Kanikula glaciers from the Tokositna River and along the Tokositna and Kanikula Rivers along the Yentna, Tokositna, and Kantishna/Muddy Rivers.~~ In a future wilderness proposal, accommodation would be made as necessary for recreational snowmachine access along 19.5 miles of winter season corridors ~~and throughout those areas designated as Management Area A (11% of the total park area and along 157 linear miles of corridors).~~ Trampling of vegetation from snowmachine use would increase as use increases. Vegetation in these high-use areas would be trampled and compacted by repeated passes of snowmachines. The peat lands along the southern boundary of the park would be especially susceptible because they are inherently susceptible to trampling and because use in these areas is expected to increase.

Heavily used routes can have long-term effects on vegetation due to crushing and elimination of vegetation, and, in the most severe cases, changes in vegetation community structure. While the adequate snow cover requirement (see Chapter 3: Affected Environment) is intended to prevent these types of impacts, they are still possible in some places because of the wide variety of terrain and climatic conditions of the park additions and preserve and because the determination of adequate snow cover applies to relatively large areas.

Registration would likely become required for overnight use east of and including the Kahiltna Glacier. The registration requirement, along with operating a public lands information center at Broad Pass, would allow park staff to better educate the visitor about low-impact techniques, thereby helping to mitigate adverse impacts to vegetation from hiking and winter uses such as snowmachine use and dog mushing. Registration would provide information that could be used to correlate visitation trends with impacts

to vegetation and help managers choose an appropriate access management tool if impacts exceed standards.

Damage to vegetation from mountain bike use would be minimal since very little off-trail riding would be expected to occur due to difficulty of riding off-trail. If standards in the trail disturbance category are approached or exceeded, use would be curtailed or mitigated.

Most mushing in the park starts from the Healy area or the park entrance area to Wonder Lake via the park road or the Stampede/Clearwater/Moose Creek route. Some mushing also occurs in the northwest preserve, in the Windy/Riley drainages, and from the Stampede area up the Toklat River. Impacts to vegetation from dog sleds would be similar to those described for snowmachines, except that the extent of the disturbance would be less because dog sleds glide over the surface more easily than heavier snowmachines and do not spin tracks. Stem breakage and abrasion are the most common impacts. Mushers tend to use established trails rather than construct new ones, so the impacts would be confined to a smaller total area. In addition, mushing typically is confined to valleys and passes, rather than high alpine areas, thus travel in windswept, snow-free areas is limited (Karen Fortier, pers. comm.). Consequently, alpine tundra is less affected by dog sleds than it would be by snowmachines.

Dog sleds would crush vegetation along the park road corridor and along the north boundary of the park, but the impact would be focused on a small area of the park. Use in areas such as Stampede and Kantishna that currently see the most use would not reach levels high enough to cause substantial impacts. Levels of dog-sled use would increase slightly above current numbers but impacts would be minimal because most of the Kantishna and Stampede areas would be zoned as Management Area B, which accommodates medium encounters, low signs of human presence, and low trail and campsite disturbance. If impacts to vegetation approach or exceed standards, use would be curtailed or mitigated.

Skiers generally use the park road and the Riley/Windy area. Levels of skier use would increase to slightly more than current numbers, but impacts would be minimal because much of the park would be zoned as Management Area B, D, OP1 or OP2, which accommodates low to medium encounters and low or medium trail and campsite disturbance. If impacts to vegetation approach or exceed standards, use would be curtailed or mitigated.

Operating a public lands information center at Broad Pass would provide an opportunity to educate winter recreationists about low-impact techniques, thereby helping to mitigate adverse impacts to vegetation from winter uses like snowmachine use and dog mushing.

Introduction of Exotic Species

Through management area zoning, this alternative would allow for increases in levels of use throughout the park additions and preserve. Increased use from pack animals, hikers, and boats, and airplanes would increase the potential for introduction of exotic species. ~~However, the park would have a formal process to determine when impacts from the introduction of exotic species via pack animals and other vectors become severe enough to warrant management action.~~ The most severe adverse impact to vegetation would result from the introduction of exotic plant species from airplane landings. Introduction of aquatic exotic species could become especially problematic in the northern addition where increases in motorboat use and floatplane landings could increase the spread of exotics. Exotics could also be carried in by airplanes landing on dry ridges or at non-glaciated landing areas in the Dunkle, Yentna, Tokositna, Stampede, and Kantishna areas.

Trail construction would also contribute to the potential for introduction of exotics because materials used in trail construction could contain exotic species. The National Park Service would designate ~~hiker~~ Backcountry Hiker areas and (if needed) construct or improve the following:

- some of the existing social trails within Management Area A in Kantishna.
- the trail from Eielson Visitor Center to Gorge Creek
- the area from the water tower above Wonder Lake Campground up to the bench west of Wonder Lake
- the Mount Healy trail extension
- the trail from the west end of Thorofare Bluffs down to the Thorofare River bar.
- ~~the area along Wildhorse Creek connecting to trails associated with the South Denali visitor facilities development.~~

Trails provide easier access so they typically attract greater numbers of people than off-trail areas. More trails equate to higher use and higher use creates a greater potential for the introduction of exotics. Trails are especially susceptible to colonization of exotics because exotics can more easily colonize disturbed areas that are free of vegetation. Trails that originate along the road corridor (at Eielson, Wonder Lake, and Kantishna) would connect a disturbed area (the park road corridor) to an undisturbed area, facilitating the spread of exotics into the backcountry. The introduction of exotic plant species could displace native vegetation, alter the composition of plant communities, and disrupt ecological functions.

~~Impacts from exotic species in a management scenario that uses a formal process, such as management area zoning and the use of indicators and standards that is proposed under, would be less than in a situation where no formal process exists and managers react to impacts on a case by case basis. A formal process to guide management decisions would allow managers to focus monitoring and mitigation efforts. Still, under this alternative, it could be difficult to monitor all areas that would be most susceptible to the spread of exotic species because there are many areas and some are very remote.~~

Cumulative Effects

The expansion of communities and local road networks near the park's eastern and southern boundaries combined with technology improvements have enhanced access by snowmachine and dog sled in winter, raising use levels and the associated potential for trampling vegetation. This trend is likely to continue in the future and will be supplemented by access improvements and increased visitation associated with South Side Denali plan implementation, and ~~possibly~~ some level of legal ORV use associated with subsistence use, all of which could increase the potential for introducing exotic species as well as increased trampling both summer and winter. Trail construction within the Old Park and additional planned trail construction associated with both the 1997 *South Side Denali* and the 1997 *Entrance Area and Road Corridor* plans has resulted (and will result) in the direct removal of vegetation. Timber harvest for subsistence also removes vegetation.

These actions will result in moderate adverse impacts to the vegetation resources of the park. Implementing this alternative would have moderate adverse impacts on vegetation. The cumulative adverse impact of this alternative plus the aforementioned past, present, and reasonably foreseeable actions would be major.

Conclusion

Under this alternative, impacts to vegetation would be moderate because some vegetation would be lost, trampling would occur in various areas throughout roughly ~~11~~6% of the park, and the potential for introduction of exotic species from new trail construction and airplane access is considerable. Increases in use would be expected ~~to increase~~ parkwide; however, use would be curtailed or mitigated if impacts to vegetation approach or exceed standards outlined in chapter 2. The cumulative adverse impact of this alternative plus the aforementioned past, present, and reasonably foreseeable actions would be major. The level of impacts to vegetation anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are essential to the natural integrity of the park.

WILDLIFE

The wildlife section presents a literature review of the types of impacts on wildlife that can result from the various visitor activities that could occur in the park and preserve, outlines the impacts thresholds used to determine the magnitude of effects on wildlife, and provides an analysis of the impacts likely to occur under ~~each~~ the modified preferred alternative.

GENERAL IMPACTS ON WILDLIFE

Analysis of impacts of recreational activities on wildlife in Denali National Park and Preserve has relied primarily on:

- studies and reports compiled for an environmental assessment of closure of the Old Park in Denali National Park and Preserve to snowmachine use
- a review of the effects of winter recreation on wildlife in Yellowstone National Park (Oliff et al. 1999)
- studies and reports cited in the draft environmental impact statement for the winter use plan for Yellowstone and Grand Teton National Parks
- studies and reports cited in *Effects of Recreation on Rocky Mountain Wildlife: A Review for Montana* (Joslin and Youmans, 1999)
- a book on wildlife and recreational use (Knight and Gutzwiller 1995)

In combination, these references provide an excellent summary of the available literature on effects of recreational activities on wildlife. The environmental consequences to wildlife of recreational activities outlined in the Denali Backcountry Management Plan would vary for different species and activities.

Specific research on the effects of backcountry recreational activities on wildlife in Denali National Park and Preserve includes a wolf study by Chapman (1977) and several analyses of the effects of visitor use along the road corridor. Research on the effects of the park road and vehicular traffic with its associated human activities includes several studies over the past 25 years: Tracy 1977, Dean and Tracy 1979, Singer and Beattie 1986, Dalle-Molle and Van Horn 1991, Taylor et al. 1997, and Burson et al. 2000.

Snowmachine Use and other Winter Activities

Several studies have been conducted that show the direct impact of repeated snowmachine use on wildlife behavior and levels of physiological stress (Aune 1981; Dorrance et al., 1975; Freddy et al., 1986; Moen et al., 1982; Neumann and Merriam, 1972; Rudd and Irwin, 1985; Simpson 1987; Tyler 1991; Voyageurs National Park 1996). These studies indicate that exposure of wildlife to snowmachine use can result in behavioral alteration, habitat avoidance, and increased energy expenditures. These changes could occur at critical times when animals are under extreme stress, especially during winter, when energy conservation is crucial. As winter progresses, animals can experience an energy deficit, as more energy is used to survive than is replenished. The

survival of individual animals depends on the severity of energy expenditures as well as the animal's energy stores.

Ungulates: Caribou, Dall Sheep, Moose

Creel et al. (2002) completed a study of the effects of snowmachine activity on elk and wolves, focusing on the occurrence of stress-related hormones (glucocorticoids [GCs]) in fecal samples in areas with differing levels of snowmachine use in Yellowstone, Voyageurs, and Isle Royale national parks. Chronically elevated GC levels have been associated with a variety of problems including reduced reproduction, ulcers, muscle wasting, and immune suppression. This study found significantly higher levels of GCs in elk in Yellowstone during the snowmachine season and when daily numbers of snowmachines increased. In summary, Creel et al. (2002: 812) reports that the data "...show that stress-hormone levels correlate with snowmobile usage on both short (daily) and long (annual) time scales." Although these increased GC levels indicate a clear physiological stress response to snowmachines, no perceptible impacts on population size have been recorded in these parks, which the authors suggest indicates that the elk and wolf populations are able to compensate for the current levels of snowmachine activity.

Observations by Alaska Department of Fish and Game biologists in the Talkeetna Mountains near Denali National Park and Preserve indicate that increasing recreational snowmachine use is beginning to alter moose use of preferred tree line willow habitats (Herman Griesse, pers. comm.). Dog-sled use and snowshoeing can also increase negative interactions of human visitors with moose encountered on the trails.

Several sources cite the loss of habitat and the use of traditional migration routes as concerns associated with bighorn sheep (Constan 1975; Horejsi 1976; Reisenhoover et al. 1988; EPFW 1993). Various recreational activities are known to cause displacement from preferred habitats (Horejsi 1976; Hicks and Elder 1979) and fleeing when approached by people (MacArthur et al. 1982). Similar reactions by Dall sheep could be expected when confronted with other forms of human activity, such as the presence of snowmachines, snowshoers, skiers, and dog teams.

Compacted trails also change distribution patterns of animals by providing energy efficient travel ways that alter winter survival rates, predation rates, distribution patterns, availability of carrion for use by other species, and levels of human conflict (Meager et al. 1994). Compaction of snow in forage areas can also have other negative effects on wildlife foraging. It increases energy expenditures by ungulates, such as caribou, that must dig for vegetation in extremely stressful winter months (Fancy and White 1995).

Research at Denali also indicates that snow depth and winter travel conditions are important factors in winter survival for ungulates and the predators that depend on them (Adams and Dale 1998). Traveling through snow compacted by a snowmachine can cost caribou 2–4 times as much energy as traveling through uncrusted snow (Fancy and White 1985).

In certain situations, a snowmachine can be less disturbing than a cross-country skier. As referenced by Joslin and Youmans (1999), Parker et al. (1984:484) observed, “Flight distances decline from early to late winter as the animals become habituated and as body energy reserves are depleted. Greater flight distances occur in response to skiers or individuals on foot than to snowmachines, suggesting that the most detrimental disturbance to the wintering animal is that which is unanticipated.” Observations in locations other than well-used trails, where all types of use were equally unfamiliar to animals or not restricted to trails, such as the Denali situation, demonstrate equal or greater responses to snowmachines (Aune 1981). More importantly, the speed and range of snowmachines mean that they have the potential to disturb wildlife over a much larger geographic range than non-motorized travel.

The lack of an overt behavioral response does not necessarily indicate an absence of disturbance. According to Chabot (1991), elk heart rate data showed an increase in heart rates even when their behavior did not demonstrate a response.

Large Carnivores: Black Bear, Brown/Grizzly Bear, Wolf

Research indicates that additional stress from disturbance by increased human activity could have a detrimental effect on bears during critical times (Goodrich and Berger 1994; Watts and Jonkel 1989). Goodrich and Berger (1994) showed that some bears abandoned dens and cubs in response to disturbance.

A four-year study at Voyageurs National Park, Minnesota, found that snowmachines were adversely affecting wolves through displacement and disturbance (Voyageurs National Park 1996). Creel et al. (2002) completed a study of the effects of snowmachine activity on elk and wolves, focusing on the occurrence of stress-related hormones (glucocorticoids [GCs]) in fecal samples in areas with differing levels of snowmachine use in Yellowstone, Voyageurs, and Isle Royale national parks. Chronically elevated GC levels have been associated with a variety of problems including reduced reproduction, ulcers, muscle wasting, and immune suppression. In Voyageurs National Park, a 37% decrease in snowmachine use was accompanied by a 37% decrease in GC levels in wolves, indicating a strong relationship between these parameters. In summary, Creel et al. (2002: 812) reports that the data “...show that stress-hormone levels correlate with snowmobile usage on both short (daily) and long (annual) time scales.” Although these increased GC levels indicate a clear physiological stress response to snowmachines, no perceptible impacts on population size have been recorded in these parks, which the authors suggest indicates that the elk and wolf populations are able to compensate for the current levels of snowmachine activity.

Compacted trails also change distribution patterns of animals by providing energy efficient travel ways that alter winter survival rates, predation rates, distribution patterns, availability of carrion for use by other species, and levels of human conflict (Meager et al. 1994). Some activities, such as dog-sledding and snowshoeing, may change movement patterns of some wildlife species such as wolves that use the packed trails.

Joslin and Youmans (1996) referenced several studies to summarize how wolves use snowmachine trails:

Wolves often take advantage of easy travel on compacted snowmobile trails. Traveling on human-compact routes has both positive and negative impacts on wolves. Human activities that compact snow (e.g., snowmobiling, cross-country skiing, road-plowing) provide easy travel routes for wolves into areas that would otherwise be difficult to reach in deep snow (Paquet et al. 1996). Wolves have a lighter foot loading than most ungulates (Telfer and Kelsall 1984) and often travel on snow that will not support their prey (Peterson 1977, Paquet 1989). Wolves have difficulty moving in snow deeper than 50 cm (Pulliainen 1965) and normally avoid areas of consistently deep snow. The ease of travel along travel routes compacted by humans may increase the effects of predation on ungulates (O'Karma et al. 1995) as previously unexploited ungulate ranges are discovered by wolves.

Domestic dogs in backcountry areas can negatively affect wildlife by disturbance and disease transmission (Mech and Goyal, 1993; Sime 1999).

Small and Mid-sized Carnivores: Lynx, Coyote, Fox, Mustelids

Hornocker and Hash (1981) suggested that human access via snowmachine or all-terrain vehicles in winter or early spring could disturb wolverines, and in the Lolo National Forest, Montana, denning wolverines appear sensitive to the slightest human disturbance in the denning area (USDA Forest Service 1998). Copeland (1996) believes that technological advances in over-snow vehicles and increased interest in winter recreation has likely displaced wolverines from potential denning habitat and will continue to threaten a possibly limited resource. This could result in lower reproductive success and/or kit survival. In the Lolo National Forest, female wolverines in the area are presumed to have abandoned any potential denning areas that experience snowmachine use (USDA Forest Service 1998). Copeland (1996) also found that snowshoers caused den abandonment in a cirque basin.

Characteristics of snowmachine use, including dispersal over the landscape, operation at night when lynx are active, alteration of the mobility and distribution of snowshoe hares, and winter operations all point to this form of recreation as being potentially adverse to lynx (Olliff et al. 1999). Snowmachine use has affected red fox mobility (Schmid 1983). Dog-sledding and snowshoeing may change movement patterns of coyotes, and foxes that use the packed trails.

Lynx are specialized deep-snow predators, an adaptation that permits them to live year-round at high elevations, thereby minimizing competition during the physically stressful winter months. Snowmachine or cross-country ski trails allow lynx competitors to infiltrate high-elevation habitats during winter, thereby increasing competition for a limited food supply (Idaho Department of Fish and Game et al. 1995).

Compacted trails also change distribution patterns of animals by providing energy efficient travel ways that alter winter survival rates, predation rates, distribution patterns,

availability of carrion for use by other species, and levels of human conflict (Meagher et al. 1994).

Rodents, Lagomorphs, and Insectivores

Snowmachine use has affected snowshoe hare mobility (Schmid 1983). Neumann and Merriam (1972) found snowshoe hares reducing their use of habitat near snowmachine trails.

Small mammals inhabiting the subnivean environment are adversely affected by snowmachine use. Jarvinen and Schmid (1971) noted increased small mammal mortality beneath compacted snow. Some of the possible changes in snow conditions resulting from snow compaction include a decrease in subnivean air space, a change in temperature, and accumulation of toxic air under the snow (Jarvinen and Schmid 1971, Schmid 1971a and b). Multiple passes over the same track will have more impact than a single pass, and the larger the area of compaction, the greater the possible affect to subnivean fauna (Halfpenny and Ozanne 1989).

Fish and Aquatic Life

Snowmachine use could affect fish and other aquatic species through increased use, including at stream crossings, and the possibility of contaminants [fuel spills and unburned fuel deposited by two-stroke engines (EPA, 2001)]. Pollutants from snowmachine emissions, including highly persistent polycyclic aromatic hydrocarbons, can remain within the snow pack until they are released during snowmelt, causing elevated acidity levels in surrounding waterways, which could result in adverse effects on fish (Adams 1975) or higher death rates for aquatic insects. The severity of these occurrences would depend on the level of use near waterways.

Non-motorized forms of winter recreation, such as dog sledding, skijoring, cross-country skiing, and snowshoeing, would cause minimal levels of noise and physical disturbance to aquatic habitats under adequate snow and ice cover.

Hiking, Backpacking and Camping

Knight and Cole (1995b) reviewed literature on the effects to wildlife by humans on foot and found that most responses of wildlife are behavioral and of short duration.

Ungulates: Caribou, Dall Sheep, Moose

Studies of the effects of hikers on large mammals have included several studies on species of horned sheep (Dall sheep and relatives). MacArthur et al. (1982), in a study of the differences in response of mountain sheep in Alberta, found little reaction of sheep to hikers approaching from parked vehicles, but responses increased markedly when sheep were approached from above (from out of view). Papouchis et al. (2001) found that hikers in Canyonlands National Park elicited more severe responses from bighorn sheep (animals fled in 61% of encounters) than did either vehicles (17%) or mountain bikers (6%), and they speculated that part of the reason for the difference in response was that approaches by hikers were more unpredictable.

Large Carnivores: Black Bear, Brown/Grizzly Bear, Wolf

Grizzly bears are sensitive to human disturbance. However, they will readily habituate to ongoing and predictable human activity. Habituation can be both negative and positive. Habituation can be positive in that human activity will not displace bears from preferred foraging areas or disrupt crucial life processes. Habituation can be negative in areas where human activity is not closely regulated because habituation is usually accompanied by food conditioning. Habituated and food-conditioned bears are dangerous because they have come to associate humans with food (Joslin and Youmans 1999).

In several parks and other protected areas, backcountry units have been closed to hiking and other recreation to protect wolf dens and wolf pups from human disturbance and habituation (Chapman 1977, Fritts, et al. 2003, NPS 2002e, NPS 2003).

Birds

Some recent research has focused on the effects of hiking and recreational trails on bird populations, where effects of disturbance may be subtler, such as changes in diversity, nesting success, or distribution. In Colorado, recreational trails adversely affected both the numbers and breeding success of some bird species using habitats adjacent to trails, although it was not clear whether those effects were due primarily to the edge effect of the trail or to human disturbance (Miller et al. 1998). Visitor levels in Colorado were significantly higher (more than 1 million visits per year) than would be expected in Denali National Park and Preserve. In contrast, Miller and Hobbs (2000) found that nest predation was less near trails along a riparian area in Colorado (use averaged 16–22 people/hectare) but increased in adjacent habitats, apparently because of mammalian predators being displaced from areas near the trail. These studies suggest that the habitats likely to receive the greatest disturbance are those where hikers are concentrated, such as at trailheads, or where larger party sizes return frequently, such as with guided tours.

Steidl et al. (1993) found that human disturbance (such as camping at 400 m from nests) negatively affected nesting behaviors of golden eagles. Adults spent less time near their nests, fed their young less frequently, and fed themselves and their young up to 67% less food when observers were camped 400 m from nests than when observers were camped 800 m from nests. The potential impacts from the reduction in food alone could have substantial long-term effects on the golden eagle population (Steidl et al. 1993).

Aircraft

The primary disturbance to wildlife from aircraft (fixed-wing and helicopter) operations is noise. Noise generated by airplanes can be separated into two general components: (1) noise associated with take-offs, landings, and taxiing, where maximum noise levels are generated relatively close to the ground and on the airstrip, and (2) noise generated by airplanes flying over the park.

Ungulates: Caribou, Dall Sheep, Moose

Research on the effects of low-altitude military aircraft on caribou concluded that behavioral impacts generally were mild, but that female caribou reacted to the noise of jet aircraft overflights by lying less and moving more, and that these responses were most

prevalent in June when newborn calves were present (Murphy et al. 1993). Other research on northern mammals has focused on low-flying helicopters and the effects of low-level aerial surveys (Klein 1973, McCourt and Horstman 1974, Calef et al. 1976). These studies provide a framework for how different species are affected by aircraft noise and aircraft activity in general.

Although rare, collisions of aircraft with wildlife are possible either while landing or taking-off at airstrips and while in flight (Cleary et al. 2002). Some animals may be attracted to airstrips by forage availability (willows for moose) or insect-relief habitat (caribou) that places them in locations where aircraft strikes are possible during landings or take-offs.

Watercraft

Motorized boating on rivers can have localized impacts on some wildlife species. Knight and Cole (1995b) found that motorized boating tended to be more disturbing to wildlife than non-motorized boating because it presented not only a visual stimulus (movement), but caused noise as well, which increased disturbance to wildlife.

Birds

Motorized and non-motorized boating on lakes, ponds, and rivers can disturb nesting waterfowl and shorebirds that use those wetlands. Reactions of waterfowl to boating activities can range from swimming away from the disturbance to flying (Hockin et al. 1992, Madsen 1998). Bald eagles were sensitive to boating activities along narrow river corridors and to noisy boats, but responses varied seasonally (Anthony et al. 1995). Motorboat traffic can have negative impacts on loon nests and nesting success (Vermeer 1973).

Fish and Aquatic Life

Motorboat use may cause degradation of fish and wildlife habitats in heavily used areas by destroying vegetation, introducing invasive species, degrading soils, or adversely affecting water quality.

Sport Hunting and Fishing

Sport hunting and fishing (including guided hunting and fishing) result in mortalities (and occasionally injuries) for target animal and fish species. In addition, non-target wildlife may experience short-term behavioral disturbance or displacement from noise and human activity associated with guided hunts.

IMPACTS OF THE MODIFIED PREFERRED ALTERNATIVE

There would generally be minor to moderate adverse impacts to wildlife populations and habitats under this alternative, primarily because of the impacts of increased

snowmachine and motorboat use ~~on various wildlife species~~ and to a lesser extent from non-motorized recreational activities.

General Impacts: Wildlife

Under this alternative, snowmachine use would continue to increase and expand into more locations in the park additions and preserve. Use would expand in area (as 64% of the total park area would be open to snowmachine use) and in density. In addition to dispersed use, winter corridors ~~would~~ could be established ~~from the southern park boundary to the Old Park boundary near~~ along the West Fork Chulitna, Bull River, and Cantwell Creek up to the Old Park boundary and ~~. If demand is sufficient, this alternative also allows for the establishment of winter corridors to the toes of the Ruth, Tokositna, and Kanikula glaciers from the Tokositna River~~ up the Tokositna to the mouth of Wildhorse Creek. Winter corridors would result in areas of more concentrated snowmachine use and areas designated as Management Area A (~~11~~ 16% of the park and preserve) would allow for an encounter rate of up to five parties per day, including two parties of up to six people. Areas designated Management Area B (~~5~~ 16%) would allow an encounter rate of up to two parties per day, including parties of up to six people.

Several different impacts to wildlife populations and habitats could be expected from the increased numbers and density of snowmachine use. Encounters with wildlife in the backcountry would cause behavioral disturbance, increase stress levels, and temporarily displace wildlife from areas where snowmachines are regularly used. In some cases, wildlife mortality or injury to species would occur from wildlife-snowmachine collisions. Snowmachine trails would enhance or modify movements of wildlife by providing packed trails that make movements easier and that allow access to new areas. There would be short-term changes in wildlife populations and habitats at several distinct locations in the park and preserve over the next 20 years.

~~Under Alternative 4, scenic air tour landings would be allowed on all glaciers in areas designated as Management Area A, with no daily time restrictions. Noise standards would require overflights to diminish or disperse in some areas, such as over the Old Park. Disturbances would generally be noise-related and short-term (five minutes or less each time).~~

The types of impacts to wildlife that could occur from hiking and camping would include behavioral reactions of short duration and low intensity that would not have long-term impacts on wildlife populations. Areas designated as Management Area A (~~11~~ 16% of the park and preserve) would allow for encounter rates of up to five parties per day, with two parties of up to six people. A large part of this management area covers glaciated areas that have little wildlife, but the increased density of visitors in these lowland areas could result in increased wildlife disturbance, habituation, and food-conditioning. These impacts would occur only occasionally at localized areas throughout the life of the plan.

Wildlife populations, demography, and distribution would be monitored and management action taken if statistically significant changes in these variables could be correlated to

changes in visitor use. Assuming that monitoring is successful at detecting changes and management action is successful at managing visitor use, the degree of impact should be minimized. However, the reactive nature of this approach would still allow some of the adverse impacts to occur although they might later be reversed.

Ungulates: Caribou, Dall Sheep, Moose. Snowmachine use under this alternative would cause behavioral disturbance, increase stress levels, and temporarily displace ungulates, particularly moose and caribou, from areas where snowmachines are regularly used. In some cases, ungulate mortality or injury would occur from wildlife-snowmachine collisions. Because of existing regulations, wildlife populations would not be adversely affected by harvest from guided hunts. Encounters of ungulates with dog teams and skiers would cause short-term displacement, but the limited number of users and the typically short distance covered would limit this impact. There would be short-term changes in wildlife populations and habitats at several distinct locations in the park and preserve over the next 20 years.

Large Carnivores: Black Bear, Brown/Grizzly Bear, Wolf. Snowmachine use under this alternative would cause behavioral disturbance, increase stress levels, and temporarily displace large carnivores from areas where snowmachines are regularly used. In some cases, mortality or injury would occur from wildlife-snowmachine collisions. Snowmachine trails would enhance or modify movements of large carnivores, such as wolves, by providing packed trails that make movements easier and that allow access to new areas. Snowmachine use would displace denning bears and lead to den abandonment. Because of existing regulations, wildlife populations would not be adversely affected by harvest from guided hunts. There would be short-term changes in wildlife populations and habitats at several distinct locations in the park and preserve over the next 20 years.

Small and Mid-sized Carnivores: Lynx, Coyote, Fox, Mustelids. Snowmachine use under this alternative would cause behavioral disturbance, increase stress levels, and temporarily displace small and mid-sized carnivores from areas where snowmachines are regularly used. In some cases, mortality or injury would occur from wildlife-snowmachine collisions. Snowmachine trails would enhance or modify movements of some species, such as lynx and their competitors (coyotes and foxes), by providing packed trails that make movements easier and that allow access to new areas. There would be short-term changes in wildlife populations and habitats at several distinct locations in the park and preserve over the next 20 years.

Birds. Increased motorboat use could be expected and would increase disturbance and displacement of waterfowl, which could lead to increased nest abandonment and predation. There would be short-term changes in waterfowl populations and habitats at distinct locations in the park and preserve, but long-term impacts to certain species, such as swans, could occur in the designated corridors of the Tokositna, ~~Yentna~~ and Kantishna/Muddy Rivers.

Fish. Under this alternative, growth in snowmachine use in the areas of highest present use, such as near Broad Pass and on the upper Tokositna River, would be constrained or dispersed. This would minimize adverse impacts to fish and other aquatic species by reducing potential contaminant fuel spills and unburned fuel deposited by two-stroke engines. Snowmachine use in the proposed access corridors, such as near Broad Pass and the upper Tokositna River, would require additional monitoring to protect aquatic resources. Use in other areas would gradually increase over present use levels, but periodic monitoring of areas would alert managers to any changes in resource health.

Sport fishing in the park and preserve would not result in adverse impacts on fish populations. Dispersed use, restricted use areas, and fish regulations all decrease the relative magnitude of these effects in the park.

Cumulative Effects

Impacts to wildlife in the vicinity of Denali National Park and Preserve are expected to increase as additional development occurs along the Parks Highway corridor and private and commercial activities increase at the southern end of the park. Development on the south side is likely to continue in and adjacent to Denali State Park and in gateway communities such as Petersville, Trapper Creek, and Talkeetna. Continued residential growth, recreational use, and ~~sport~~ hunting from the Healy area west along the Stampede Trail could also result in moderate impacts to wildlife. Commercial rafting on the Nenana River and non-commercial boating on some park rivers and lakes would generate noise and cause temporary displacement of wildlife along the riparian zone, resulting in a minor impact.

Subsistence hunting and trapping, including the potential use of off-road vehicles for subsistence uses (along Cantwell and Windy Creeks) would result in minor adverse impacts on wildlife abundance because of short-term reductions in population of some species such as marten or moose in small areas. Motorized uses, including where permitted for access (Dunkle Hills, Kantishna Hills), can cause noise and visual stimuli that result in behavioral disturbance and temporary displacement of some wildlife species on a seasonal basis. These effects on wildlife species would continue at specific locations throughout the life of the plan.

These activities would result in loss of habitat, behavioral changes such as avoiding developed areas, human-generated noise, and other disturbances to wildlife in the vicinity of Denali National Park and Preserve. (Other disturbances could include introduction of parvovirus and other diseases to wildlife species in Denali from outside sources.)

The combination of impacts from other activities, including those outside the park that directly affect park wildlife, and the management provisions under this alternative, would result in moderate impacts overall, since there would be medium intensity, long-term changes in important wildlife resources. The types and levels of use proposed under this alternative would contribute a minor portion of the overall cumulative impacts to wildlife.

Conclusion

There would be minor to moderate adverse impacts to wildlife populations and habitats under this alternative because of the effects of increased snowmachine and motorboat use on various wildlife species. The level of impacts to wildlife anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the enabling legislation or that are essential to the natural integrity of the park.

NATURAL SOUNDSCAPES

As described in chapter 1, NPS Management Policies and Directors Order #47 establish that natural soundscapes are intrinsic elements of the park environment, and thus are part of the resources and values that the NPS is responsible for protecting, no less so than wildlife or other natural features of the parks. At Denali, the sounds of wolves howling, marmots whistling, white-crowned sparrows singing, water rushing through streambeds, wind in the aspen trees, and absolute stillness and quiet are among the natural sounds that are potentially impacted by actions proposed in the alternatives for this plan. Intrusions on the natural soundscape are sounds generated by human activity, much of which qualifies as “noise” under the definition provided by Directors Order #47 that reads, “noise is generally defined as an unwanted or undesired sound, often unpleasant in quality, intensity or repetition.” Noises that obscure natural sounds are of particular concern, primarily those generated by mechanical and motorized devices such as aircraft, snowmachines, motorboats, or chainsaws.

METHODOLOGY

Although the science of measuring noise impacts from motorized vehicles, aircraft, or other equipment is well developed, the research applies mostly to industrial and urban situations and is not particularly useful in evaluating impacts to national parks or other natural areas. Three relevant research approaches have been used:

- 1) Impacts on the natural sound environment, which can be determined by acoustics alone
- 2) Impacts on visitor enjoyment (e.g. Andersen 1993, Gramann 1999);
- 3) Impacts on wildlife (e.g. Fletcher 1978, Radle 1997).

This analysis addresses only the first of these topics, impacts to the natural sound environment itself. The other two topics are addressed in the Recreational Opportunity and the Wildlife sections of this chapter as appropriate.

The analysis explores the questions of intensity, duration, and context for this topic by answering three questions for each alternative:

- How much motorized noise disturbance is allowed? This information is specified by standards associated with management area designations.
- How do these desired future conditions compare to current conditions? Information about current conditions is incomplete, but sufficient data is available to at least indicate the relationship if not to draw firm conclusions.
- How much motorized noise disturbance is likely to occur? This information is derived from trends described in chapter 3 and the Assumptions listed at the beginning of this chapter, combined with the guidance from management area designations and other access management actions.

Natural sounds are a component of Denali's wilderness resource values, which are identified as resources in the park's enabling legislation. In some park locations, such as the Old Park, natural sounds are a unique resource; in other park locations natural sounds are at least an "important" resource in terms of the definitions provided at the beginning of the chapter. Natural sound disturbances do not represent permanent changes in park resources; however, if plan actions allow indefinitely recurring seasonal disturbances the affects would be considered long term.

Sound Monitoring Stations

As a resource for the analysis, Table 4-1 shows how existing data for several locations in Denali National Park and Preserve matches the desired future conditions of each management area. The data were collected through the placement of automated sound stations that measure sound levels and make 5-second digital recordings every 5 minutes (12 samples per hour). The numbers in the table are expressed as a percentage of the samples that exceed desired future conditions for natural sounds. Except for some of the Portal areas, each of these locations has at least two possible designations presented in the alternatives. While the data are illustrative, the sample sizes are generally small and most of the areas sampled are known to have among the highest levels of motorized access (such as established airplane landing areas at Kahiltna Base Camp and the Ruth Amphitheater).

Table 4-1: Percentage of Sample Hours, Days, or Events for which Measured Condition Exceeds Standard, by Location and Management Area

Desired Noise Condition Management Areas	Low D, E, OP1, OP2				Medium B, C				High A, Portal, Corridor West Buttress SUA				Very High Ruth Glacier SUA Portal – Major Landing Area			
	% time audible ¹		# motor noises ²		max sound level ³		% time audible ¹		# motor noises ²		max sound level ³		% time audible ¹		# motor noises ²	
Location/Sample Size																
Kahilna Base Camp 5 days 5/02	40%	80%	80%	31%	31%	80%	31%	80%	80%	24%	80%	2%	6%	0%	0%	2%
Dunkle Hills 5 days 5/01	24%	40%	40%	6%	6%	0%	16%	0%	0%	8%	0%	0%	0%	0%	0%	0%
Dunkle Hills 5 days 2-3/02	38%	100%	100%	3%	3%	60%	30%	60%	3%	21%	0%	0%	6%	0%	0%	0%
Dunkle Hills 6 days 8/02	28%	83%	83%	8%	8%	0%	16%	0%	0%	10%	0%	0%	2%	0%	0%	0%
Pika Glacier 4 days 7/02	8%	100%	100%	27%	27%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Pika Glacier 9 days 8/02	21%	100%	100%	19%	19%	11%	14%	11%	11%	11%	3%	3%	3%	0%	0%	3%
Ruth Amphitheater 9 days 5/02	45%	89%	89%	33%	33%	89%	40%	89%	33%	34%	89%	4%	18%	0%	0%	4%
Ruth Amphitheater 7 days 6/02	36%	86%	86%	38%	38%	57%	31%	57%	38%	30%	57%	5%	23%	29%	5%	5%
Ruth Amphitheater 7 days 7/02	43%	100%	100%	34%	34%	100%	40%	100%	34%	38%	71%	4%	24%	57%	4%	4%
Stampede Airstrip 13 days 9/02	9%	62%	62%	11%	11%	0%	6%	0%	11%	3%	0%	4%	1%	0%	0%	4%
Stampede Airstrip 31 days 10/02	4%	13%	13%	6%	6%	0%	2%	0%	6%	1%	0%	0%	0%	0%	0%	0%
Stampede Airstrip 20 days 11/02	8%	35%	35%	3%	3%	0%	4%	0%	3%	2%	0%	0%	1%	0%	0%	0%
Stampede Airstrip 15 days 4/03	3%	53%	53%	10%	10%	0%	2%	0%	10%	1%	0%	0%	0%	0%	0%	0%
Stampede Airstrip 31 days 5/03	3%	32%	32%	9%	9%	0%	1%	0%	9%	0%	0%	0%	0%	0%	0%	0%
Stampede Airstrip 29 days 6/03	2%	34%	34%	18%	18%	0%	1%	0%	18%	0%	0%	3%	0%	0%	0%	0%

¹The indicator is the percentage of each hour that a motorized noise is heard. Because the data collection method presently used records five seconds out of every five minutes, the indicator essentially refers to the percentage of 5-second samples during which a motorized noise is heard, with 12 such samples each hour. The number in this column refers to the percentage of hours when the standard for the management area would be exceeded.

²The indicator is the number of motorized noises heard during the course of a 24-hour day. The number in this column reflects the percentage of days when the standard for the management area would be exceeded.

³The indicator is the maximum measured sound level of a motorized event. The number in this column reflects the percentage of motorized events for which the sound level would exceed the standard for the management area.

For all locations except the Dunkle Hills area, all of the identifiable motorized noises were aircraft. For the Dunkle Hills in February–March, 37% of the identifiable noises were aircraft, 34% were snowmachines, and 29% were trains. In May, 94% of the noises were aircraft, 5% were snowmachines, and 1% was trains. In August, 66% of the noises were aircraft, 19% were vehicles, and 15% were trains.

Backcountry Ranger Observational Data

In addition to the information collected at automated sound stations, backcountry rangers made systematic observations of motorized noise intrusions during the summer seasons of 1999 and 2000 in the backcountry of the Old Park (Morgan and Van Horn 2001). Although not reported in the same format as this plan's indicators and standards, these observations provide some information by which to evaluate the application of standards in this part of the park and preserve, where no data is yet available from automated sound stations.

Data were collected from 6/12/99 to 9/5/99 and again from 5/28/2000 to 9/5/2000 within the Denali Wilderness, primarily from patrols from the park road corridor, and are thus primarily relevant to the eastern side of the Old Park. Rangers were instructed to listen for aircraft throughout as much of the patrol day as possible, including periods of time when they were around their camp. Each patrol recorded the overall time of the sample period that they (the rangers were usually in pairs) were actively listening for aircraft. While the sampling was opportunistic and statistically non-random, it did parallel the times and locations that park visitors travel through the backcountry.

Within the overall sample period, the observers recorded the start and stop times of audible aircraft noise. This period of time, which could include overlapping noise from several successive aircraft, was labeled an "overflight event." The observers recorded the number and type of aircraft for each overflight event. They also rated the intensity of the noise for each overflight event. The rating for each overflight event was based on the peak noise level that occurred during the event. Key statistics included the following:

- There was an average of 19.5 overflight events (25 aircraft) per patrol, an average of 9.1 overflight events (11.7 aircraft) per day, and an average of 1.4 events (1.8 aircraft) per hour.
- The average duration of overflight events per day of sampling was 32.1 minutes.
- An average sampling day lasted 6.6 hours.
- The average duration of overflight events per hour of sampling was 4.8 minutes.
- The average duration of a single overflight event was 3.4 minutes.

Maximums noted included:

- 8 overflights in an hour that lasted for nearly 30% of that hour
- 31 overflight events (51 separate aircraft) in a day
- Aircraft noise audible for 30% of the time during an afternoon hike

The patrol rangers rated sound level on a three-part scale as follows:

- 1 – Faint, barely audible, aircraft might be only heard and difficult to locate visually.
- 2 – Clearly audible above-normal background noise.
- 3 – Distracting for conversation, completely dominates soundscape drowning out even loud sounds of nature such as wind or sounds of water.

Table 4-2 summarizes the sound level observations of aircraft events.

Table 4-2: Number of Overflight Events by Intensity Rating.

Intensity Rating	Number of Events	Percentage of Total
1	660	43.4
2	695	45.7
3	160	10.5

Backcountry Visitor Survey

One further study provides data about the amount of noise heard in the Denali backcountry. *A Survey of Overnight Backcountry Visitors to Denali National Park and Preserve* conducted in 2000 asked questions of respondents about the number of aircraft encountered while hiking in the backcountry. Because the universe of survey respondents was limited to visitors who obtain a permit for overnight camping during summer months, the response primarily reflects conditions in the backcountry of the eastern side of the Old Park.

Out of 190 hiking parties surveyed, the average number of aircraft seen per day of the trip was 4.87. The average number of aircraft seen or heard per day as a percentage of hiking parties were as follows:

Table 4-3: Average Number Of Aircraft Seen Per Trip Day By Percent Of Hiking Parties	
Average Number of Aircraft Seen Per Trip Day	Percent of Hiking Parties*
10 or more	11.1%
6 to 9.99	21.7%
3 to 5.99	33.6%
1 to 2.99	22.1%
less than 1	11.5%
*Survey response included 190 hiking parties. The number indicated reflects the percent of the total that experienced the average number of aircraft per day in the left hand column.	

IMPACTS OF THE MODIFIED PREFERRED ALTERNATIVE

This alternative would have negligible overall impacts on the natural sound environment of the Denali backcountry. Standards that would require improvements in sound conditions in some areas, such as the Old Park, would be offset by increasing noise in other locations in the southern additions. There would ~~still~~ continue to be major cumulative adverse impacts because of the high intensity of airplane and snowmachine noise in large portions of the park additions.

In this alternative, there would be new soundscape standards established for management areas throughout the national park and preserve and a set of tools identified for managing access to achieve the standards. The proportion of the park and preserve that falls within each standard would be as follows:

Natural Sound Disturbance	% of park backcountry
Very High	32 %
High	94 %
Medium	92 1%
Low	79 73%

In addition, there would be ~~year-round corridors designated on the Kantishna, Muddy, and east and west fork of the Yentna Rivers~~ summer season Corridors designated on the Kantishna, Muddy Rivers, and lower Tokositna Rivers. While other corridor designation in the Dunkle Hills, and on two mining access routes in the Kantishna Hills. There would also potentially be winter season Corridors designated in the Tokositna River and Dunkle Hills areas, and Tokositna valley areas. While Corridors in the Dunkle Hills and Tokositna River areas would not differ in allowed natural sound disturbance from the surrounding area, these ~~109-70 miles of year-round~~ Corridors and 3.5 miles of winter Corridor along Cantwell Creek would allow a High level of natural sound disturbance that could have border impacts on the surrounding management areas, where a lesser degree of disturbance would be expected.

As demonstrated by the table below, where standards can be compared to available data there would be a mixture of results. The amount of motorized noise in the Old Park should decline substantially, as should some localized areas such as the Ruth Amphitheater landing area. Access management tools would be applied to bring conditions into standard. However, the amount of motorized noise in areas such as the northern additions or localized areas like Kahiltna Base Camp could remain the same or even accommodate some additional noise.

Location	Natural Sound Disturbance Standard	Comparison of Existing Conditions to Standard
Eastern portion of Old Park	Low	Both the NPS patrol observations and the report from the 2000 backpacker survey demonstrate that the eastern portion of the Old Park receives considerably more airplane noise than the Low standard for natural sound disturbance would permit. The standard would allow only 1 motorized noise per day louder than natural ambient, while the average for one survey is 9.1 per day, for the other 4.9 per day. Some of these airplane noises may not reach the natural ambient threshold, but from the sound level rating system used by the ranger patrols, at least 56% of the motorized noise likely reaches that level. In addition, 10.5% may exceed the maximum sound level of 40 dBA.
Stampede Airstrip	Medium	Data from the airstrip at Stampede Mine show that the level of natural sound disturbance generally falls within the range of variation allowed by Medium standards. One exception was the maximum sound level, which for five out of six months exceeded the standard of 40 dBA in between 6% and 18% of motorized noise samples.
Dunkle Hills	High	Data from the Dunkle Hills during winter months demonstrate that the standard for a High level of natural sound disturbance is exceeded at times. Existing samples from the area show that about 21% of hours exceed the standard for time audible during late winter months, which allows motorized noise for 25% of any hour. During summer months, the percentage of hours exceeding the standard was only 8% to 10%.
Ruth Amphitheater landing area	Very High	Data from the Ruth Amphitheater show that the Very High standards for the Ruth Glacier Special Use Area are exceeded between 18% and 24% of measured hours for the percent time motorized noise is audible. Standards are also sometimes exceeded for the number of motorized noises louder than natural ambient heard during the course of the day, up to 57% of days during a July sample period. Conditions at the landing area are likely to be considerably noisier than the surrounding area, however.
Kahiltna Base Camp	Very High	The small data sample at Kahiltna Base Camp shows that the Very High standard is generally met.
Pika Glacier	High Medium	Measurements taken near the airplane landing area on the Pika Glacier—within the Portal area— show that all standards for a High <u>Medium</u> level of natural sound disturbance were met during a July sampling period; however, 11% of both sample hours (for percent time audible) and sample days (for number of motorized noises over natural ambient) exceeded standard in an August sampling period. <u>exceeded in an August sampling period. Samples show that the 14% of hours exceed the standard for time audible, and 11% of days (one day of the nine sampled) had more than the standard for the number of motorized noises louder than natural ambient. In both July and August sample periods the maximum sound level of 40 dBA was frequently exceeded, 19% and 27% of noise events respectively.</u>

General aviation landings would continue to be allowed throughout the park additions and preserve consistent with existing regulations. This method of access is not expected to grow substantially over time, but this alternative would allow infrequent loud noise associated with take-offs and landings at lakes suitable for float plane landings and other scattered off-airport landing locations.

Scenic air tour landings would be restricted to glaciers in Management Area A ~~and to the Pika and Eldridge Glaciers when climbers and mountaineers are not present~~ and would be allowed to a lesser extent on the Pika and Eldridge Glaciers. ~~Present use levels by climbers and mountaineers on the Pika and Eldridge would allow an increase in scenic tour landings over current numbers. However, as climbing and mountaineering use grows, scenic tour use could be limited.~~ Between 1999 and 2004, only two scenic air tour landings took place outside the allowable area under this alternative, thus, there would be little immediate impact on existing airplane landings or the accompanying noise. Large numbers of scenic air tour overflights could continue to produce high intensity levels of noise between the Kanikula, ~~Buckskin,~~ and upper Ruth and Kahiltna glaciers in the southern additions, with a particular concentration of noise over the Ruth and Tokositna Glaciers. This noise would be the most distinctive part of the sound environment during the summer visitor season.

A limit of 1,500 per season on climbing Mount McKinley would indirectly restrict growth in air taxi access to Kahiltna Base Camp, ~~and although~~ growth in climber demand is unlikely to reach the limit within the life of the plan. The 1,500 limit would allow 22% more climbers than in 2002, when a small sample of days showed that noise standards were exceeded in this area. As a result, other access management tools are likely to be applied before restrictions on climber numbers would affect the amount of noise.

Snowmachine access would be managed through the application of access management tools to achieve natural sound disturbance standards set for each management area. Snowmachine noise would likely reach those standards on weekend days in late winter during the course of the plan in the Dunkle Hills/~~Broad Pass~~ area as well as the lowlands, lower glaciated areas, and foothills around the Ruth, Tokositna, and Kanikula Glaciers, all of which are designated for a High standard of natural sound disturbance. Noise would also increase during late winter weekdays over the duration of the plan as winter visitation in Alaska increases, although it would not be expected to reach the High standard.

Rivers that support existing use of motorboats (Kantishna, Muddy, and Tokositna, Yentna) are designated corridors under this alternative. Noise levels from motorboats are likely to remain below levels allowed under the standard for a High level of natural sound disturbance during the life of the plan. The highest level of noise would be experienced on the lower Tokositna River during the summer visitor season and on the Kantishna and Muddy Rivers during subsistence and ~~sport~~ general hunting seasons. The Yentna River may also have some motorboat use, but the use level is believed to be small and could be accommodated even within the Low natural sound disturbance standard applied to the southwest Preserve.

In this alternative, the Tokositna River also falls into the Ruth Glacier Special Use Area, which allows a Very High standard for natural sound disturbance. This river is likely to have growth in recreational motorboat traffic particularly accessing private visitor facilities along the lower section of the river. During the summer visitor season when

motorboat use occurs, motorboat noise would continue to have relatively little impact compared to airplane noise in this area.

Under this alternative, the park road would be maintained to mile 7 during winter months for administrative purposes only to remove ice from the park road, although a snow-covered surface would remain for winter recreation. This action would result in heavy road equipment traveling up four miles of the park road between October and March. Experimentation has proved that the required maintenance can generally be accomplished before 10am and is required only occasionally. Natural sound disturbance would be minimal and would likely fit within the range allowable for a Low standard of natural sound disturbance.

Several additional trails would be constructed in Kantishna along with designated campsites and single trails ~~that~~ would be constructed at Wonder Lake, Eielson Visitor Center, Healy Overlook, and ~~Wildhorse Creek~~ Thorofare Bluffs. Trail construction could include the use of motorized equipment such as power wheelbarrows or chainsaws as well as aerial delivery of material if the minimum tool requirement is met, all of which would create noise disturbances. The same might also be required for trail maintenance in future years. The noise disturbances would be localized in impact to the places near where construction or maintenance was occurring, and could temporarily exceed standards.

The National Park Service would apply the minimum requirement process to the entire backcountry and would develop methodologies for minimizing aircraft use for administrative and research purposes. These actions should improve natural soundscape conditions in the backcountry.

Cumulative Impacts

Denali National Park and Preserve has become a noisier place since the park expansion in 1980. Aircraft are primarily responsible for increased natural sound disturbance, particularly the expansion of scenic air tours since the late 1980s, which produce much of the existing motorized noise over the eastern portion of the Old Park, around Mount McKinley, and along the south side of the Alaska Range between the Kahiltna and Eldridge Glaciers. The National Park Service has contributed by authorizing concessionaire aircraft to land on glaciers, affecting primarily the area between the Kahiltna and Eldridge Glaciers, and through its own gradual expansion of airplane and helicopter use to support research and administrative activities, which has impacts park wide. Military use of the Susitna Military Operations Area, which has been occurring at present levels since 1995, also has a substantial adverse impact on the southwestern park and preserve extending east to the Ruth Glacier.

Snowmachine access plays a role during winter months, particularly in the Broad Pass/Dunkle Hills region and low-lying areas in and around the Tokositna River valley, which have become popular riding destinations from the Parks Highway as power and range have increased and ownership has become more common. The closure of the Old

Park to snowmachine access in 2000 restricted areas that were only lightly used and primarily served to inhibit future expansion of snowmachine access and accompanying noise to new areas.

If one or more lodges in Kantishna began operating in the winter and supported snowmachine access, this alternative would allow such access to occur. In the ~~southern~~ Kantishna Hills, there would be a ~~High-Medium~~ standard for motorized noise. Depending on the scale of service provided by the lodges, this threshold could be reached in some parts of the southern Kantishna Hills within the life of the plan. Much of the noise impact would occur during late winter months. ~~Adjacent areas would have a Low or Medium standard for natural sound disturbance, which would require dispersal of snowmachine access in these areas.~~

If a trail were cleared from Nenana to Lake Minchumina and services were offered to support snowmachine access, this alternative would allow only a Low standard of natural sound disturbance within the park and preserve. During late winter months, there would likely be some additional natural sound disturbance, although it would be limited by the standard.

Collectively, these actions have had (and would have) a major adverse impact on the natural soundscape of Denali because of high intensity, long-term motorized disturbances in the Old Park, around Mount McKinley, in the Dunkle Hills/Broad Pass area, and over the southern glaciers. The actions in this alternative provide a negligible impact to the overall natural sound environment, mitigating the impacts of some past actions, but allowing motorized noise to increase in other locations. Overall, there would continue to be a major adverse cumulative impact to the natural soundscape of the park and preserve from the actions in this alternative combined with other past and possible future actions, but this alternative contributes only a minor portion of those impacts.

Conclusion

This alternative would have negligible overall impacts on the natural sound environment of the Denali backcountry. Although the amount of motorized noise would substantially decline in the Old Park, these actions would allow medium to high intensity, long-term increases in motorized noise in other locations, including ~~the portions of the northern additions east of the Kantishna Hills,~~ the Dunkle Hills and Tokositna River areas during winter months at times that use is presently low, and over portions of the southern additions between the Kahiltna and Eldridge Glaciers during summer months. Some temporary noise would be added because of trail and campsite construction. There would still be major cumulative adverse impacts because of the high intensity airplane noise in the Ruth Amphitheater, over the southern glaciers, lowland areas between the Kahiltna and Ruth Glaciers, and in the Dunkle Hills/~~Broad Pass~~ area.

The level of impacts to the natural soundscape anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are essential to the natural integrity of the park.

WILDERNESS RESOURCES

The Alaska National Interest Lands Conservation Act designated most of the Old Park as the Denali Wilderness, to be managed under the provisions of the Wilderness Act. ANILCA also identified the protection of “wilderness resource values” and the provision of associated “wilderness recreational opportunities” to be important purposes of the park additions and preserves. In addition, a wilderness suitability review conducted as part of the 1986 General Management Plan concluded that 3.73 million acres of the park additions were also suitable for wilderness designation, and NPS Management Policies direct the NPS to “take no action that would diminish the wilderness suitability of an area possessing wilderness characteristics until the legislative process of wilderness designation has been completed.” The extent of impact to the wilderness resources of Denali, including both wilderness character and wilderness experience, is therefore a central concern of this analysis.

METHODOLOGY

Working from the definitions given in the Wilderness Act, the clarifications (including ANILCA provisions) under the Wilderness Management section of chapter 2, and the tradition of wilderness preservation at Denali described in chapter 3, the following “wilderness resource values” have been identified for Denali National Park and Preserve.

- Perpetuation of natural ecological relationships and processes and the continued existence of native wildlife populations in largely natural condition
- Absence of permanent human structures, including buildings, roads, trails, dams, and communications facilities
- Opportunities for solitude including:
 - Freedom from the reminders of society
 - Privacy and isolation
 - Absence of distractions such as large groups, mechanization, unnatural noise, signs, and other modern artifacts
- Opportunities for primitive and unconfined recreation, which have the following characteristics:
 - Self-sufficiency, absence of support facilities or motorized transportation
 - Direct experience of weather, terrain, and wildlife with minimal shelter or assistance from devices of modern civilization
 - Lack of restriction on movement; freedom to explore in the way that is desirable given conditions of weather, terrain, and personal ability; ability to be spontaneous
 - Minimal formal regulatory requirements

Impacts on wildlife, soundscapes, and other natural resources are addressed in the Wildlife, Vegetation, Soil and Water, and Natural Soundscapes sections. The analysis in this section will focus on wilderness character and wilderness experience, which are

integrally related because much of wilderness character can only be subjectively determined by the visitor's experience (for example, solitude or freedom of movement).

Impacts on wilderness character and experience are determined by comparing the desired future conditions described by management area standards to current conditions and to likely future conditions given predicted changes in use and varying management area designations among alternatives.

IMPACTS OF THE MODIFIED PREFERRED ALTERNATIVE

The actions in this alternative would have negligible new impacts on wilderness resources in the Denali backcountry, protecting and improving conditions in some areas while allowing the loss of some quality in others. There would still be major adverse cumulative impacts because of ongoing motorized access in parts of the southern additions and the absence of opportunities for solitude on the West Buttress route of Mount McKinley.

Absence of Permanent Structures

There would be new trails and limited designated campsite development in this alternative, bringing not only permanent facilities – potentially including food storage and sanitation facilities at up to five sites in the Kantishna area – but also the noise and human presence associated with trail construction and maintenance.

However, in the Kantishna Hills area the trails would generally either replace or improve existing social trails or old community and mining access trails. The actions would take place outside of areas determined suitable for wilderness designation.

Short sections of trail would be constructed within the Old Park at Wonder Lake, at Eielson Visitor Center, Thorofare Bluffs, and at the Healy Overlook, but they would replace existing obvious social trails and fall partly within the Backcountry Day Use area, outside the designated wilderness.

~~Most impacted would be the Wildhorse Creek area, where an area determined suitable for wilderness designation would have new trail construction in an area that presently has no signs of human structures or ongoing human presence. However, the trail would occupy only part of a single creek valley.~~

Opportunities for Solitude

This alternative establishes a variety of standards that would protect opportunities for solitude. Important among these are the following standards.

Standards for the number of encounters with other parties in this alternative provide a balance between areas that emphasize privacy and isolation and areas that allow more use while still protecting wilderness qualities, as the table below demonstrates.

Number of Encounters with Other Parties				
Descriptor	Low	Medium	High	Very High
Standard	3 0/week	2/day	5/day	10/day
% of Park & Preserve	44 49%	29 40%	15 11%	128-70 miles summer Corridors, 135-19.5 miles winter Corridors, <u>Backcountry Hiker</u> , <u>West Buttress SUA</u>
There is no standard for the number of encounters with other parties at 9 Portals and in the West Buttress Special Use Area.				

Standards for encounters with large groups limit impacts on vegetation, wildlife, and the solitude of other visitors, as well as mitigate the impacts of adding group educational and guided activities in areas where allowed.

Possible to Encounter Large Groups?			
Descriptor	No	Yes	
Standard	0 groups	1 group/ day	2 groups/ day
% of Park & Preserve	56 49%	29 40%	15 11%
“Large groups” are parties larger than 6 people.			

Standards for camping density assure that visitors throughout almost the entire backcountry would have the opportunity to camp out of sight and sound of other visitors.

Possible to Camp Out of Sight and Sound of Others?			
Descriptor	Low	Medium	High
Standard	Yes, always	Not always at peak season	No, during peak season
% of Park & Preserve	99%	128-70 miles summer Corridors, 135-19.5 miles winter Corridors, 5 Portals	3-2 Portals, West Buttress Special Use Area

Standards for the number of encounters with evidence of modern human use ensure that in most of the backcountry visitors would continue to encounter few or no signs of modern equipment, as demonstrated by the table below. Some exceptions occur in the West Buttress Special Use area, corridors, Portals, and backcountry hiker areas.

Number of Encounters with Evidence of Modern Human Use			
Descriptor	Low	Medium	High
Standard	1/backcountry trip	3/day	5/day
% of Park & Preserve	85 89%	15 11% + 5 Portals	3-2 Portals, BC Hiker Areas, West Buttress SUA, 128-70 miles summer Corridors, 135-19.5 miles winter Corridors

As visitation to the park increases, these standards protect wilderness character and experience by triggering management action to disperse or limit the density of visitors in locations where ~~problems arise~~ wilderness resource values are jeopardized. While Backcountry Hiker areas, Corridors, Portals, and the West Buttress Special Use area allow higher levels of visitor use and landscape impact than is typical of the Denali backcountry, collectively these represent a small area of the park and preserve.

Application of these standards primarily affects the park additions and preserve, since the Denali Wilderness was already managed to achieve similar standards. However, for the Old Park these standards do provide more definition for qualities such as evidence of modern human use, and they do distinguish the western portion of the Old Park (OP2) as an area that should protect current conditions of very low use density.

The amount of motorized equipment used for access and the attendant noise expected under this alternative is described in detail in the Natural Soundscapes section of this chapter. As documented in that section, ~~80~~73% of the park and preserve would be designated within a management area that allows Low levels of natural sound disturbance, ~~92~~91% in areas that allow Medium sound disturbance, and ~~96~~% in areas that allow a High level of sound disturbance. In addition, there are ~~128~~70 miles of corridor in the summer and ~~135~~19.5 miles in winter along with five Portals that would allow a High level of sound disturbance, and ~~3~~2 Major Landing Areas plus 2.5% of the park and preserve in the seasonal Ruth Glacier Special Use Area that would allow a Very High level of natural sound disturbance. Overall, under this alternative there would be negligible impacts on the natural soundscape at Denali; although conditions over the designated wilderness of the Old Park should improve, they would likely worsen in other areas that have been determined suitable for wilderness designation, particularly those areas designated as Management Area A.

The park road would be maintained to mile 7 during winter months for ice removal only. This action would retain noise and signs of heavy equipment to a 4-mile stretch of road for approximately 6 months, but the impact can be mitigated to a degree by short hours of operation. Only a small portion of the park and preserve and no designated wilderness is affected except for cross-boundary noise.

There would be up to ~~135~~19.5 miles of corridors in winter, some of which could be marked with route markers. This action would provide more guidance and add more signs of management and human presence than is typical of the wilderness experience at Denali, but they would be used only if the minimum tool requirement is met and other, less intrusive measures (such as providing maps, guidance with natural land features) are ineffective.

Opportunities for Primitive and Unconfined Recreation

There would be a limit of 1,500 climbers per season on Mount McKinley. Within the 20-year life of the plan, demand would grow to an estimated 1,405-1,470 climbers per year.

Thus, the expectation is that the limit would not be reached and it would serve primarily to establish a ceiling on visitors if growth is faster than anticipated.

Mountaineers would be required to carry out human waste from the West Buttress above the 14,000-foot camp ~~feet~~ and from campsites within one-half mile of air taxi landing locations on glaciers. At present, this would require visiting the NPS ranger station at Talkeetna to obtain a Clean Mountain Can and to return it after use, although other options may be available within the life of the plan.

There would initially be no new registration requirements, but new requirements would be added if certain criteria were met. It is anticipated that these criteria would trigger new requirements on overnight and winter day-use activities from the Kahiltna Glacier east to Cantwell in the near future.

None of these actions would result in restrictions on freedom of movement once the visitor has entered the backcountry. The burden on visitors prior to entering the backcountry is expected to be light if the National Park Service is successful in making registration convenient and simple.

Cumulative Impacts

The establishment of unit quotas in the 1976 Backcountry Management Plan protected wilderness experience in the backcountry of the Old Park by limiting encounters, dispersing visitors and visitor impacts, and insuring that the great majority of visitors could camp out of sight and sound of others. The permit requirement for the Old Park does restrict freedom of movement since visitors must camp in the unit for which they have a permit on any given night. However, day users are not similarly restricted. The 60-day registration requirement for climbing Mount McKinley and Mount Foraker does not restrict freedom of movement once climbers enter the park.

The authorization of commercial air taxi landings for climbers on the Kahiltna glacier at the Denali Wilderness boundary, combined with improvements in climbing equipment and the popularization of the West Buttress as a mostly non-technical route to the summit of Mount McKinley, has led to large increases in the number of climbers in this area, from 124 in 1970 to a peak of 1,305 in 2001. Because each expedition takes 17 days on average and the primary climbing season is only 2-3 months long, a large amount of visitors concentrate on the West Buttress every year, during which time opportunities for solitude are not available.

The increase in snowmachine access particularly in accessible areas of the park additions in the Broad Pass/Dunkle Hills area and the Tokositna River valley has greatly increased the number of encounters with other parties, the evidence of modern human use, and natural sound disturbance, detracting from the wilderness qualities of these areas. Likewise, the expansion of scenic air tour access in response to changes in visitor demand has increased motorized noise across large areas of the Old Park wilderness and the glaciated area between the Kahiltna and Ruth glaciers. This alteration in wilderness

resources is long-term, occurring every season, and is consistently observable over large portions of the backcountry and therefore a high-intensity change to wilderness resources.

The National Park Service has constructed trails that extend into the Congressionally designated wilderness of the Old Park, and will construct additional trails as specified by the 1997 *Entrance Area and Road Corridor DCP*. These trails are permanent new structures in the wilderness area, but total fewer than 20 miles within the 1.9-million-acre Denali Wilderness, and therefore represent a low intensity change in wilderness character. The National Park Service has also established seasonal administrative camps at Kahiltna Base Camp and at the 14,000-foot level on Mount McKinley, and generally increased the amount of research and administrative activity in the backcountry, including the use of aircraft and other motorized equipment and some temporary and long-term installations of research equipment. This heightened administrative presence is observable to the visitor but generally is not a consistent change over any particular area of the park except for the administrative camps, and is therefore a medium intensity, long-term alteration in the wilderness resources of the park and preserve.

These past, present, and future actions have had a major adverse impact on the wilderness resources of the park and preserve, largely because of the long-term, high-intensity changes caused by airplane and snowmachine access over a large portion of the park and preserve and the loss of opportunities for solitude on the West Buttress of Mount McKinley during the primary climbing season. The actions in this alternative constrain these impacts from spreading and may offer limited improvement in some areas because of the imposition of management area standards. However, there would still be major adverse cumulative impacts. This alternative would be responsible only for only small, isolated adverse impacts such as the few additional structures (trails) and the maintenance of a short section of the park road during winter months.

Conclusion

Under this alternative, there would be negligible new impacts to the wilderness resources of the Denali backcountry. Positive changes would occur in some locations, such as in the designated wilderness of the Old Park, but other areas that have wilderness qualities would likely lose some opportunities for solitude. The proposed standards for encounters with other parties, encounters with large groups, ability to camp out of sight and sound of others, and evidence of modern human use would protect wilderness resource values in much of the park as visitation grows, but would generally still allow increases in visitor use across most of the western portion of the Old Park, park additions, and preserve. There are minor adverse impacts from the construction of new trails and campsites and very limited restrictions on freedom of movement. However, there would still be major adverse cumulative impacts because of the ongoing absence of solitude on the West Buttress route of Mount McKinley during the primary climbing season and high levels of encounters, noise, and motorized transport in ~~areas such as the Kantishna Hills, Dunkle Hills, and the area~~ between the Kanikula and Ruth Glaciers in the southern park additions.

The level of impacts to wilderness character and experience anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are essential to the natural integrity of the park.

SUBSISTENCE RESOURCES AND OPPORTUNITIES

The 1980 additions to Denali National Park and Preserve are open to subsistence uses in accordance with Section 202(3)(a) of ANILCA. Lands within the former Mount McKinley National Park are closed to subsistence activities. Congress found and declared in Title VIII, Subsistence Management and Use, Section 801(3), that the continuation of the opportunity for subsistence uses of resources on public and other lands in Alaska is threatened by the increasing population of Alaska, with resultant pressure on subsistence resources, by sudden decline in the populations of some wildlife species that are crucial subsistence resources, by increased accessibility of remote areas containing subsistence resources, and by the taking of fish and wildlife in a manner inconsistent with recognized principles of fish and wildlife management.

Furthermore, Congress declared it to be the policy in Section 802(1), that, consistent with sound management principles and the conservation of healthy populations of fish and wildlife, the utilization of the public lands in Alaska is to cause the least adverse impact possible on rural residents who depend upon subsistence uses of resources of such lands; consistent with management of fish and wildlife in accordance with recognized scientific principles and the purposes for each unit established, designated, or expanded by Title II; it is the purpose of Title VIII to provide the opportunity for rural residents engaged in a subsistence way of life to do so.

Guided by the enabling legislation and mandates for Denali National Park and Preserve, and policies and Congressional intent of ANILCA Title VIII, the following section presents an analysis of the impacts likely to occur under the preferred alternative.

METHODOLOGY

Methodology for assessing impacts to subsistence consisted of literature review and consultation with subject matter experts.

This analysis focuses on the three key subsistence areas of the park: the northwestern park and preserve region near Lake Minchumina; the southeastern park region near Cantwell; and the southern Kantishna Hills region near Kantishna. This analysis assumes that adverse impacts to subsistence resources and opportunities from subsistence users are negligible because subsistence use is very low, especially compared to recreational use of the park.

IMPACTS OF THE MODIFIED PREFERRED ALTERNATIVE

This alternative would have minor to moderate adverse impacts on subsistence resources and opportunities because it would result in increases in non-subsistence snowmachine use and generally higher levels of recreation use particularly along trails and corridors in

subsistence areas, both of which would create unfavorable conditions for subsistence wildlife populations and increase conflicts between recreational and subsistence users.

Under this alternative, access by snowmachine to the park and preserve additions would continue to grow. Designating corridors for winter use would focus use in the following places: from the southern park boundary to the Old Park boundary near the West Fork Chulitna, Cantwell Creek, and Bull River; ~~to the toes of the Ruth, Tokositna, and Kanikula glaciers from the Tokositna River; along the Yentna, Tokositna, and Kantishna/Muddy Rivers.~~ and along the lower and upper Tokositna River as far as the mouth of Wildhorse Creek. In a future wilderness proposal, accommodation would be made as necessary for recreational snowmachine access along these 19.5 miles of winter corridors and throughout those areas designated as Management Area A (11% of the total park area and along 135 linear miles of winter corridors). Winter corridors would result in areas of more concentrated snowmachine use and areas designated as Management Area A would allow for an encounter rate of up to five parties per day, including two parties more than to six people. However, the only places these high use areas would overlap with areas. ~~Nearly all of the winter corridors overlap with areas currently or traditionally used for subsistence activities~~ would be along Cantwell Creek and Bull River, and the Corridors would be designated only if there is sufficient demand.

Except for the ~~Kantishna area and the Broad Pass area between Cantwell Creek and the West Fork of the Chulitna River (which are zoned as Management Area A), all other corridors,~~ all subsistence use areas would be zoned as Management Area B or D. These management areas allow for low to medium encounters with other people, very little evidence of modern human use, and low to medium disturbance of natural sounds. If standards in these categories are approached or exceeded, non-subsistence use would be curtailed or mitigated. If non-subsistence use is curtailed or mitigated, it could have less of an impact on subsistence resources and opportunities. The types of impacts that could be mitigated are described throughout this section.

Cantwell

The Cantwell subsistence area would be zoned as Management Area B, and there could be two winter season Corridors in the vicinity of Cantwell Creek and Bull River. Management Area B allows for medium encounters with other people, very little evidence of modern human use, and medium disturbance of natural sounds. The Corridors allow very high levels of encounters and high levels of natural sound disturbance and evidence of modern human use. If standards in these categories are approached or exceeded, non-subsistence use would be curtailed or mitigated. If non-subsistence use is curtailed or mitigated, it could have less of an impact on subsistence resources and opportunities. The types of impacts that could be mitigated are described throughout this section. ~~Under Alternative 4, the Broad Pass area between Cantwell Creek and the West Fork of the Chulitna River would be designated as Management Area A, allowing for high disturbance to natural sounds and an encounter rate of up to five parties per day, including two parties of six people. Increased recreational use in the Broad Pass~~

~~area could negatively affect subsistence hunters who rely on this area for subsistence purposes.~~

Several different impacts to subsistence wildlife populations and subsistence use activities could be expected as documented by the Denali Subsistence Resource Commission. For several years, subsistence users have expressed concerns about the impacts and conflicts of increasing recreational use and increasing non-subsistence snowmachine use on subsistence resources and subsistence activities. Members of Denali's Subsistence Resource Commission have specifically expressed concerns regarding the effects of increasing levels of snowmachine use in the Broad Pass/Cantwell area upon moose, furbearers, and ptarmigan populations and their distributions (Denali Subsistence Resource Commission Meeting Minutes, April 30, 2001; April 29, 1996; August 9, 1996; and June 28, 1993). The Denali Subsistence Resource Commission Meeting Minutes (June 1993) document high levels of non-subsistence related snowmachine use in the Cantwell area. It was noted that riders were primarily using drainages and basins, essentially saturating the area and displacing furbearers, causing local trappers to pull their traps prematurely in December of that year. This trend has persisted in subsequent years (pers comm. Hollis Twitchell 1/13/05). As the range of non-subsistence snowmachine use overlaps with subsistence use areas, the potential for conflict between these user groups increases.

Non-subsistence snowmachine users would interfere with subsistence traplines, displace furbearers, and create paths that encourage animals to travel farther from places where subsistence activities typically occur. ~~Trappers begin trapping as early as November 1. The trapping season closes by the end of February; however, increasing levels of non-subsistence snowmachine use in the Cantwell/Broad Pass area would continue to displace wildlife, and~~ Trappers would continue to pull their traps by December because it would be inefficient to set traps in an area in which furbearers have been displaced. This would constitute a loss of an opportunity for subsistence users in that area.

Increased use of the park, particularly non-subsistence snowmachine use, would likely displace moose and caribou from critical wintering areas on park lands in the Windy Creek, Bull River and Cantwell Creek drainages. Local moose populations and the Cantwell group of the Nelchina Caribou herd use areas within the former Mount McKinley National Park and the ANILCA park additions of Windy Creek, Cantwell Creek, and the Bull River drainages during winter. These areas provide important winter habitat for moose and caribou because snow depths associated with the pass area are less than in other areas.

Non-subsistence snowmachine use is often concentrated in these high-elevation basins where riders spend many hours at a time. These basins provide critical winter habitat for moose and caribou. Moose and caribou would continue to be displaced from these critical wintering areas as non-subsistence snowmachine use increases. This could significantly increase the stress and nutritional demands upon moose and caribou and result in some

moose or caribou mortality, depending on the environmental conditions and the body reserves of moose or caribou in a given year.

Non-subsistence snowmachine use originating in Cantwell begins when adequate snow cover is present, and during early winter, use is relatively low. As snow pack increases so does snowmachine use. In late winter when the days are lighter, warmer, and there is adequate snow cover, non-subsistence snowmachine use is highest. This corresponds with the time of the year when moose and caribou are at their lowest nutritional states. Non-subsistence snowmachine use would continue to induce stress on moose and caribou ~~in the Windy Creek,~~ particularly in the Bull River, and Cantwell drainages, especially in late winter when the animals are in a nutritional deficit. The magnitude of the impact would depend on snow depth. Die off would be greater as snow depth increases because displaced animals would have a more difficult time moving through the snow to forage and to get away from snowmachine use.

In addition, the State issues a limited number of permits for the Tier II hunt for the Nelchina Caribou herd, and local Cantwell residents must compete with residents statewide for the permits. Local residents rely on federal permits to hunt caribou in the Cantwell area. Under this alternative, non-subsistence snowmachine use would continue to increase and would either displace caribou from the Windy Creek, Bull River, and Cantwell Creek drainages or it would prevent caribou from going there altogether. If caribou do not travel onto these federal lands, subsistence hunters from Cantwell would not have an opportunity to hunt them. This opportunity would be lost for as long as the caribou remain on lands outside the national park.

Kantishna

Under this alternative, the Kantishna area would be designated as Management Area ~~AB~~, allowing for ~~high~~ medium disturbance to natural sounds and an encounter rate of up to ~~five~~ two parties per day, including ~~two parties of six people~~ one large party per day. ~~Up~~ A trail system would be formalized and ~~to~~ five designated campsites would be created in conjunction with the summer Corridor areas in the Kantishna Hills. ~~There could be up to 10 encounters per day on the Corridors and trails.~~ Increased recreational use in the Kantishna area, particularly on Corridors and trails, could negatively affect subsistence hunters who rely on this area for subsistence purposes. During the peak summer season there are approximately 300 overnight visitors to the Kantishna area. Increasing numbers of visitors on trails could necessitate an expansion of the firearms discharge closure to protect public safety in Kantishna. The decision to extend the closure would be evaluated in a separate public process. If the closure were extended, it would have adverse impacts on moose hunters in the Upper and Lower Moose Creek drainages, ~~Eldorado~~, and Skyline Drive area by severely restricting opportunities to hunt moose in those areas because they would not be permitted to use firearms.

Minchumina

~~Year round recreational corridors would be designated in the northwest part of the park (Muddy/Kantishna Rivers).~~ A summer season Corridor would be designated along the Muddy and Kantishna Rivers, inviting allowing more additional use along these corridors ~~these rivers~~ and potentially increasing user conflicts and the risk of theft and vandalism at subsistence cabins ~~along these corridors~~. Lake Minchumina area residents mentioned concerns about the impacts of increasing non-subsistence uses during public scoping (see also letter from Collins, 3/3/01).

There are at least five usable subsistence cabins along the Muddy and Kantishna Rivers and many others scattered throughout the preserve. This has been an issue of concern raised by the Subsistence Resource Commission because theft and vandalism have been reported on lands adjacent to the park (Hollis Twitchell, pers. comm. 1/13/05).

Cumulative Effects

The following actions increase the potential for adverse impacts to subsistence:

- In the last five years, non-subsistence snowmachine use has expanded dramatically in and adjacent to the southeastern areas of the park, particularly in the area near Cantwell and Broad Pass. Along with increasing popularity for snowmachining have come dramatic improvements in snowmachine technology. Because of the increased reliability, power and flotation ability of the newer snowmachines, snowmachine users have been accessing more distant areas and operating in significantly steeper and higher terrain than in past years.

Open habitat, mountain slopes, and reasonably good snow deposition in the Broad Pass area have attracted increasing numbers of snowmachine users from areas of the state accessible to the Parks Highway. Typically, non-subsistence snowmachine groups tend to travel in larger numbers and spend more time traveling in basins and drainages.

Increases in types and levels of recreation interfere with subsistence activities. Visitors, especially those who travel via motorized means, may disturb wildlife and interfere with subsistence users who are hunting or scouting for subsistence resources. As popular places become crowded, it is expected that recreational use will disperse into more remote or infrequently used places. Potential restrictions to subsistence may occur if visitors frequent areas used for subsistence. Visitors, especially those who travel via motorized means, may disturb wildlife and interfere with subsistence users who are hunting or scouting for subsistence resources.

- New housing and commercial development has occurred in the Nenana Canyon north of the park entrance, the Yanert Valley east of the park, in the eastern part of the Stampede Road corridor, around Cantwell, and along Petersville Road. This

development has resulted in minor expansion of local road networks or improvements of existing roads. This development is likely to continue, creating increased access to the eastern and southern boundaries of the park. Increases in types and levels of recreation can interfere with subsistence activities.

- While brushing a trail from Nenana to Minchumina for snowmachine use is opposed by locals in Minchumina and Telida, there is a reasonable chance that it would happen in the future. This trail would provide easier access to the northwestern part of the park. Increased access means higher use levels and greater potential for impacts to subsistence resources and opportunities.
- Continued growth in commercial developments in Kantishna would attract more visitors to that area, thereby increasing the potential for conflicts between subsistence and non-subsistence users, or increasing the potential for restrictions or conditions on subsistence use in the Kantishna area.
- Concern for the safety of park visitors prompted the National Park Service to initiate a closure to the discharge of firearms in the Kantishna area. This developed area has a large number of summer visitors using the facilities and surrounding area to engage in outdoor activities that could put them at risk of a firearm-related injury. The restriction on the discharge of firearms applies on federal public lands within one mile of the Kantishna road right-of-way from the former Mount McKinley National Park boundary at mile 87.9 to the north end of the Kantishna airport. The firearm discharge restriction is in effect during summer when the Kantishna lodges are in operation. During the closure period, subsistence harvests utilizing other methods and means of harvest may still take place according to federal subsistence management regulations.
- Restrictions and conditions associated with travel on the park road affect subsistence access. Subsistence users are required to obtain a permit, adhere to camping requirements and food storage requirements, and other conditions associated with backcountry use in the Old Park. Park road restrictions and backcountry requirements do not prevent subsistence access; however, subsistence users must be cognizant of and adhere to this additional requirement.

The combined combination of these impact of these actions would be major actions would cause a major adverse impact to subsistence resources and opportunities in Cantwell where conflicts between recreation and subsistence already exist and are predicted to increase, moderate adverse impacts in Kantishna where a high level of recreation and infrastructure exists, and minor adverse impacts in Minchumina where low levels of visitation are expected due to its remote location. Implementing this alternative alone would have minor to moderate adverse impacts on subsistence resources and opportunities. There would be a major cumulative adverse impact of this alternative plus the aforementioned past, present, and reasonably foreseeable actions would be major.

Conclusion

This alternative would have minor to moderate adverse impacts on subsistence resources and opportunities because it would result in increases in ~~non-subsistence snowmachine~~ use, especially in the Cantwell area, and ~~generally higher levels of recreation use in subsistence areas,~~ incompatible activities, primarily on trails and corridors in the Cantwell, Kantishna, and Minchumina areas. These activities, including use of snowmachines, ~~both of which~~ would create unfavorable conditions for subsistence wildlife populations and increase conflicts between recreational and subsistence users. The severity of the impact from this alternative would be mitigated by restricting high intensity uses to narrow trails and corridors, and the impact would certainly be minor if increased use levels do not result in additional firearm closures in Kantishna or the Corridor designation does not increase use along the Muddy and Kantishna Rivers. There would still be a cumulative major adverse impact of this alternative plus the aforementioned past, present, and reasonably foreseeable actions ~~would be major.~~ The level of impacts to subsistence resources anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are essential to the integrity of the park.

CULTURAL RESOURCES

Cultural resources at Denali include archaeological resources, ethnographic resources, cultural landscapes, and historic structures. While there is some potential for impacts to any of these resources from plan actions, the archaeological resources and historic structures are most at risk while impacts to the other categories are anticipated to be negligible in all alternatives and were dismissed from further analysis (see chapter 1).

METHODOLOGY

The potential for increased pressure on cultural sites increases as the number of visitors increases. Impacts from visitor use can include modification, defacement, displacement, or removal of objects from cultural sites. Management actions to manage visitor use could also result in adverse impacts (for example, disturbing sites during trail construction). However, without site-specific information it is difficult to determine impacts. When specific actions are taken within any alternative further analysis will be required to comply with the requirements of Section 106 of the National Historic Preservation Act (NHPA) in accordance with the Advisory Council on Historic Preservation's regulations implementing Section 106 (36 CFR Part 800, "Protection of Historic Properties").

IMPACTS OF THE MODIFIED PREFERRED ALTERNATIVE

Actions proposed under this alternative would result in increased pressure on cultural resources because of the likelihood of increased visitation to cultural resource sites in the backcountry.

~~Snowmobile~~ There would be dispersed snowmachine use ~~under Alternative 4 would allow dispersed use~~ allowed throughout the park additions and preserve and on established winter corridors. ~~Snowmobile~~ Snowmachine use would continue to increase and cultural sites would be more prone to increased visitation throughout the winter months. Under this alternative, the Kantishna area would be designated as Management Area ~~AB~~, allowing for an encounter rate of up to ~~five~~ two parties per day, including ~~two parties of six people~~ one party of more than six people. ~~A portion of the Kantishna Hills, including the Stampede Mine (a site determined to be eligible for the National Register of Historic Places), would be designated Management Area B, allowing for an encounter rate of up to two parties per day. This area would include~~ The Stampede Mine site, which is one of very few antimony mines to have operated in the state. Cultural resources at this site are therefore unique, and any damage or loss would be significant. Several historic sites in the Kantishna Hills could experience an increase in visitation because of increased recreational use, although this risk could be mitigated by routing trails away from sensitive sites. ~~Year-round recreational corridors would be designated in the northwest part of the park (Muddy/Kantishna Rivers) and the southwest (Yentna and Tokositna Rivers).~~ Summer season recreational corridors would be designated along the

Muddy/Kantishna Rivers and the lower Tokositna River, inviting more use along these corridors and potentially increasing the pressure on cultural resources along these rivers. Potential adverse impacts are those described in the Methodology section.

Because the increased recreation use would facilitate or encourage more people to visit areas where cultural resources exist, the potential exists for increased pressure on those resources, particularly in the backcountry.

Cumulative Effects

Adverse impacts on cultural resources could be expected from land development in the Kantishna Hills and increases in regional recreational activities. As outlined in the analysis, the preferred alternative would result in increased pressure on cultural resources. This would not add to overall effects from other past, present, and reasonably foreseeable future actions.

Conclusion

Actions proposed under the preferred alternative could result in minor to major adverse impacts on cultural resources because of the likelihood of increased visitation to cultural resource sites in the backcountry, although determining specific impacts would require site-specific information. This would be the case throughout the life of the plan.

The level of impacts to cultural resources anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

SOCIOECONOMICS

The first part of this section provides a literature review of the types of impacts that can result from the various visitor and administrative activities that could occur in the park and preserve. The second part is an analysis of the impacts likely to occur under ~~each~~ the modified preferred alternative.

GENERAL IMPACTS BASED ON LITERATURE REVIEW

Impacts can be analyzed in terms of direct and indirect effects on social and economic values. Values of the social environment mainly include quality of life in the Denali region, which usually includes factors such as the ability to lead a rural lifestyle, availability of schools, libraries, and other basic community amenities, and personal safety (particularly a low incidence of crime). Economic values include direct and indirect economic benefits or losses to local communities, business and employment opportunities, ecosystem services, and less tangible values such as existence value. These values are defined and further explained in the following sections.

Economic Values of Denali National Park and Preserve

Visitor use in Denali National Park and Preserve represents one part of the economic value of the park. Businesses in gateway communities near the park benefit from visitors' requiring food, lodging, and other services. Studies conducted in Alaska provide an indication of the economic value of these services. For example, Fletcher et al. (2000) estimated that current residents with snowmachines spent about \$297 per machine for gas for tow vehicles and machines and \$286 per household for lodging, meals, snacks, and beverages in 1999. Non-residents were estimated to have spent about \$154 per day for tow vehicle and snowmachine rental, and \$149 per person per day for lodging, food, and beverages—assuming a 5-day trip—in 1999.

The large expanse of protected land in Denali National Park and Preserve also provides other types of direct and indirect economic benefits. Costanza et al. (1997) and others have recently attempted calculating the economic value of ecosystem services performed by natural systems. Economic values have been assigned to ecosystem services such as nutrient cycling, water supply, climate regulation, erosion control and sediment retention, and many others in addition to commonly recognized values such as recreation. While no specific economic values have been assigned to Denali National Park and Preserve, such a measurement may be possible in the future as its value as a natural, intact, functioning sub-arctic ecosystem is fully assessed and quantified.

Another economic value of Denali National Park and Preserve that has not yet been measured is its value in amenities to the local communities. In analyzing counties in the western U.S. that are close to wilderness areas, Lorah (2000) found that the presence of wilderness is correlated with income, employment, and population growth. According to Power (1995), natural landscapes “often may generate more new jobs and income by

providing the natural resource amenities—water and air quality, recreational opportunities, scenic beauty and the fish and wildlife—that make the...[area] an attractive place to live, work, and do business.” In addition, Fausold and Lilieholm (1996) found that real estate prices increase around open space.

Existence and Use Values of Denali National Park and Preserve and the Wilderness Recreational Experience

The existence value of a park or protected area is often phrased as “just knowing it is there.” Colt (2001) estimated the economic importance of Alaska’s ecosystems and concluded that “the ‘existence value’ of Alaska’s undisturbed lands and waters is likely to become increasingly important in the future, as world population, education, and income continue to grow and ecosystems in other places continue to be degraded.”

A number of contingent valuation studies have been conducted over the last 20 years. The purpose of such studies is to determine and compare the socioeconomic values of active and passive use. Active use involves having a wilderness recreational experience by going to the place and setting foot within the boundaries. Passive use involves knowing that such a potential experience exists even if one elects not to participate in wilderness recreational activities (or plans to do so sometime in the future). The results of some of these studies provide a basis for understanding the socioeconomic values affected by different types of wilderness experiences.

Contingent valuation studies have shown that the average household would be willing to invest in passive, non-use of wilderness areas (Gilbert, Glass and More 1991; Barrick and Beazley 1990; Pope and Jones 1990; Walsh, Loomis, and Gillman 1984; Diamond et al. 1993, Kahneman and Knetsch 1992; Vincent et al. 1995; Bjornstad and Kahn 1996). This research indicates that U.S. citizens not only value the existence of wilderness areas because of their importance as a national resource, but also because of the value in having them available in the event that those citizens would like to participate in wilderness recreational activities in the future. In many cases, the passive use value makes up a substantial proportion of the total value (combined use and non-use values) that is placed on wilderness areas.

Impact Thresholds

The following thresholds were used to determine the magnitude of effects on the socioeconomic environment.

- Negligible:** Little or no noticeable change in economic activity, employment and income levels, or population migration or immigration.
- Minor:** Local (limited to one community and vicinity) changes in economic activity, employment and income levels, or population migration or immigration.

- Moderate:** Regional (involves two or more communities in an area) changes in overall economic activity, employment and income levels, or population migration or immigration.
- Major:** Widespread (may involve a substantial region of the State, such as Interior Alaska) changes in overall economic activity, employment and income levels, or population migration or immigration.

IMPACTS OF THE MODIFIED PREFERRED ALTERNATIVE

Economic Impacts

Summer Season

Under this alternative scenic air tour and air taxi operators would have a variety of options for reducing aircraft noise, only one of which would be rerouting tours to avoid sensitive areas in the park and preserve. Air tour companies could expect continued increases in visitor demand and continued growth in business income throughout the life of the plan.

Management actions proposed as part of this alternative would allow for scenic tour airplane landings throughout much of the south additions between the Kahiltna and Eldridge Glaciers ~~(including the Eldridge and Pika Glaciers when climbers are not present)~~. Based on data from 1999 through 2004, only two scenic air tour landings took place outside of this area. Businesses providing scenic flights could therefore be expected to experience steady growth in income from this activity during the near future and throughout the 20-year life of the plan. The high quality of the scenic air tour experience would result in high demand for the activity throughout the life of the plan. Examples of benefits to scenic air tour operators include decreasing advertising costs as “word of mouth” becomes adequate to market the activity and the competitive advantages realized by providers of quality scenic air tours over Denali as compared to operators elsewhere in the region.

Economic benefits—specifically for business operators serving backcountry users—from other summer backcountry activities such as hiking, camping, and mountaineering, would continue under this alternative. Steady increases in business could be expected over the next 20 years commensurate with increased numbers of visitors. Visitor capacity determinations and management action to protect the overall quality of the wilderness experience would benefit visitors participating in all activities; therefore, continued growth would be likely. Providers of services to these users would benefit from steadily increasing business for the life of the plan. Economic benefits to area communities from these types of park uses would tend to increase eventually because of the quality of the experience and the increasing numbers of users. A higher level of benefit would be likely in Talkeetna, a primary staging area for mountaineering activities.

Winter Season

Snowmachine use in the park additions and preserve would increase moderately under this alternative, especially ~~in the Bull River Unit southwest of Cantwell~~between the Bull River and West Fork Chulitna River and along the upper and lower Tokositna River.

There would be a steady increase in overall numbers passing through Denali area communities. Businesses serving these users (lodges, hotels, restaurants, gas stations, and retail businesses) in the Denali area, especially at popular destinations such as Cantwell and Trapper Creek, would benefit from increased income throughout the life of the plan.

The benefits to retail activity and profits, employment, and income from other winter uses, such as skiing and dog mushing, would steadily increase throughout the life of the plan. This plan includes provisions to protect the quality of these experiences for growing numbers of users in the entrance area and for operating a visitor contact center south of Cantwell that could help in encouraging and directing this type of use. Benefits would be attributable to the increasing numbers of winter visitors and the likelihood of visitors spending more time in the park area, both of which can be expected if the variety and quality of recreational opportunities increase.

Population and Housing Impacts

Summer Season

The overall increasing recreational use and associated employment over the next several years in which the plan would be in effect would likely lead to some level of seasonal influx of people to provide the needed retail services, such as lodging, restaurants, gas stations, and retail stores. Increases in the recreational use levels and local seasonal population would likely result in the need for additional community public support services and facilities over the next several years. These impacts would increase eventually and would be attributable to increasing backcountry visitor use, as well as growth in overall park visitation.

Winter Season

The steady increases in winter recreational uses in the park and preserve would result in similar increases in employment opportunities, income, and population in communities near the park throughout the life of the plan. There would be a continued steady increase in demand for emergency services, such as responses to incidents involving injuries and the need for search and rescue. This would affect emergency service providers in area communities for the next several years by requiring continued increases in their capacity.

Other Economic Values

While providing for expanded opportunities for wilderness recreation, this alternative also emphasizes protecting the wilderness character of Denali National Park and Preserve over the long term. There would be similar protection of other economic values such as the value of ecosystem services provided by the park. Ecosystem services values accrue from an undisturbed, expansive subarctic ecosystem, so the park and preserve would have higher value with the managed recreational types and use levels under this alternative that prevent or minimize human impacts on the landscape.

Based on the above descriptions of impacts to the area economy, population and housing, and other economic values, overall impacts to economic values of the park and preserve would be minor in the short term (next several years), but moderate over the life of the plan.

Quality of Life

Summer Season

Increasing numbers of recreational users in the backcountry of Denali over the next several years would likely result in corresponding increases in traffic, demands for parking, and the generally higher level of human activity in gateway communities. Long-term effects could include increased population levels from the influx of people from elsewhere in Alaska and the United States, employment of non-local residents, and development of new businesses by non-local residents. This could reduce the overall rural quality of life for some area residents.

Winter Season

Minor changes are likely to occur in the quality of life for permanent residents near the park. Increased use of snowmachines in the area and the presence of increasing numbers of visitors from other areas could result in increased noise levels for local residents and current users, as well as signs of greater human presence from snowmachine tracks. This would likely result in a minor reduction in the rural and wilderness quality of life currently experienced by area residents over the life of the plan. It would also result in a slight decrease in the overall quality of the remote lifestyle valued by owners of second homes and recreational properties.

Another impact of expanding winter use would be increasing traffic in local communities, especially along the George Parks Highway and the Petersville Road. Residents of Cantwell, for example, have reported safety concerns with the increasing traffic along the Parks Highway through their community.

Existence and Use Values

Actions proposed under this alternative would protect both existence values and the types of recreational use values sought by visitors who desire extended experiences in remote locations. This would correspond with a high level of resource protection because of visitor capacity limits in the park additions and preserve. Existence values could increase eventually if the pristine condition of the park became a more rare and highly valued commodity. Use values for wilderness recreation in a remote setting, including motorized uses such as snowmachine touring, would increase throughout the life of the plan.

Cumulative Impacts

The steady increase in recreational uses up to visitor capacity limits under this alternative would be a moderate contributor to increases in overall economic activity, development, and employment in the Denali region. As stated in the Assumptions section at the

beginning of the Environmental Consequences chapter, the NPS expects an average annual increase of about 2% in overall visitation, including backcountry use, to Denali National Park and Preserve in the reasonably foreseeable future. Regional recreational uses would continue to increase, possibly at a faster rate than park visitor use; and at popular destinations outside the park boundary, the increasing levels of use could be significant. This would result in increased economic activity and employment. Development would likely continue along the Petersville Road, in Trapper Creek and Talkeetna, in the Healy area and on private inholdings and Native allotments, resulting in an increased need for housing and public services, as well as a greater loss in the current rural to wilderness quality of life in these areas. As a result, with backcountry uses under this alternative a moderate contributor, there would be moderate cumulative impacts from increased tourism and economic activity, employment, and population levels in communities and private lands near Denali National Park and Preserve and along the George Parks Highway.

Conclusion

Because of steady increases in a wide variety of recreational uses throughout the park and preserve, this alternative would result in moderate increases in income for many existing businesses throughout the life of the plan. There would be increasing opportunities for new businesses to be initiated as a result of anticipated growth in recreational use levels in the park. These changes would also lead to increased employment opportunities and income levels, commensurate with the levels of increases of recreational use, for concessionaires and other recreation-oriented businesses near Denali National Park and Preserve. The increase in economic activity would result in minor increases in population and the need for additional housing and public services.

Minor impacts to the rural quality of life in communities near the park and preserve could be expected over the life span of the plan. Existence values would be protected and could increase eventually, as would use values for most activities. A moderate increase in the value of ecosystem services possibly contributed by Denali National Park and Preserve could be expected throughout the life of the plan. Overall impacts on social and economic values from the management actions under this alternative would be minor over the short term (next several years) and moderate over the life of the plan.

RECREATIONAL OPPORTUNITY & VISITOR SAFETY

The actions presented in ~~the alternatives~~ the modified preferred alternative could affect the type, amount, and diversity of recreational opportunities in the Denali backcountry and the Denali region, and could affect visitor safety. “Recreational opportunities” include all the potential types of recreation that visitors might engage in while within the boundaries of Denali National Park and Preserve, but do not include subsistence activities.

METHODOLOGY

Recreational Opportunity

Recreational opportunities are defined by examining the management prescriptions under each alternative, including the following:

- The type of experience provided for through the allocation of management areas and accompanying standards;
- The type of access that is possible;
- The extent of facilities and services provided.

The opportunities are considered in light of the park’s legislative purposes. For the entire park and preserve, the relevant purposes include “preserve wilderness resource values and related recreational opportunities such as hiking, canoeing, fishing, and sport hunting.” For the park additions and preserve, ANILCA 202(3)(a) specifies as a purpose to “provide continued opportunities, including reasonable access, for mountain climbing, mountaineering, and other wilderness recreational activities.” The Old Park is a legislatively designated wilderness area, so its recreational purposes include those indicated by the Wilderness Act as discussed in chapter 1.

A useful framework for examining recreational opportunities at Denali is provided by the authors of *Wilderness Management* (Hendee and Dawson, 2002). They characterize various activities in wilderness areas by the degree to which the activities are “wilderness dependent,” identifying three categories that apply to recreational activities. They are presented here in increasing order of wilderness dependence:

- 1) Recreational activities that take place outdoors but that do not require wilderness conditions (for example, naturalness and solitude), such as playing catch or a competitive track meet.
- 2) Recreational activities that are enhanced by a wilderness setting but do not require it, such as fishing or observing wildlife.
- 3) Recreational activities that depend on wilderness conditions, such as experiencing solitude and isolation, observing natural ecological processes, or challenging oneself with wilderness travel.

In the Denali backcountry, activities that do not require wilderness conditions include such activities as racing or high-marking with snowmachines, which would fall under the first category of wilderness dependence; that is, not dependent at all and not appropriate at Denali given the park's statutory guidance. Sightseeing for the purpose primarily of witnessing scenic vistas or wildlife falls in the second category, scenic air tours are an example. These activities are appropriate in Denali's backcountry because the wilderness setting enhances them, but they do not require wilderness. The third category comprises those activities that are most consistent with Denali's statutory guidance, and are the most wilderness-dependent, such as the challenge of mounting a mountaineering or backpacking expedition in an area that has no roads or facilities, or seeking the solitude of deep winter on a dog mushing expedition.

Visitor Safety

Visitor safety is also a concern for the recreational experience at Denali. Chapter 3 provides details of past successes the National Park Service has had in addressing visitor safety issues, although additional ones are possible as visitor use increases. For example, in some locations, particularly on glaciers where there are high levels of visitation, drinking water quality could be affected primarily through biological hazards associated with human waste, and unburned vehicle fuel. The severity and causes of recreation-related water pollution problems are poorly known, although health hazards due to fecal contamination have been identified as a potential concern (Temple et al. 1982; Herman and Williams 1987; Cole et al. 1987). Inadequate disposal of human waste has been implicated in the spread of water-borne intestinal parasites (*Giardia* spp.), even in watersheds that receive little recreational use (Suk et al. 1987).

Impact Thresholds

- Negligible:** There would be little or no change in recreational opportunities or visitor safety.
- Minor:** There would be a change in recreational opportunities or visitor safety, however it would affect relatively few visitors, or would not affect any wilderness-dependent recreational activities.
- Moderate:** There would be substantial changes in recreational opportunities or visitor safety, however these changes would not affect the majority of visitors in a wilderness-dependent user group.
- Major:** There would be substantial changes in wilderness-dependent recreational activities or visitor safety that would affect opportunities for the majority of one or more user groups.

Impairment: Unique opportunities for wilderness-dependent recreational activities would cease to be available at Denali. Uniqueness refers only to uniqueness within Denali National Park and Preserve, and is determined by such characteristics as the type of activity, landscape setting, and ease of access.

IMPACTS OF THE MODIFIED PREFERRED ALTERNATIVE

Recreational Opportunity

This alternative would have a minor beneficial impact on recreational opportunities at Denali because it would allow for growth in a carefully managed set of appropriate backcountry activities to serve individuals who need more assistance with access, facilities, and services, while still protecting the recreational activities that are dependent upon Denali's wilderness resources and which the NPS is legislatively obligated to provide. Visitor safety would be improved by education associated with required registration for some common activities.

The application of management areas and accompanying standards throughout the park and preserve would assure the continuation of a spectrum of recreational opportunity at Denali, with an emphasis on providing continued opportunities for growth in all kinds of appropriate recreational activities.

Approximately ~~11~~⁶% of the park and preserve plus areas ~~along the park road~~ would accommodate those visitors that need additional facilities or assistance with access to wilderness recreational activities. Some areas along the park road in the Old Park and Kantishna would also have opportunities for some assisted activities, but at a low level of use. About ~~29~~⁴⁰% would serve those visitors seeking an experience similar to what is presently available along in the Denali Wilderness in terms of the amount of crowding and signs of human presence, and 5% would provide for high-use mountaineering areas. ~~Another 49% would preserve an opportunity to have a remote experience at Denali. About 11% would seek to preserve the experience of visitors who do not wish to encounter any other people during their exploration.~~

In the busy, accessible area between the Kahiltna and Eldridge Glaciers, management area designations would protect 5% as high use but low noise, providing an area where the climbing and mountaineering experience could avoid conflicts with other uses, such as scenic air tour traffic. However, there would be many popular climbing areas in the Ruth Amphitheater, Kahiltna Glacier, and Tokositna Glacier that would continue to have multiple uses; opportunities for climbers to have an undisturbed experience would diminish.

The standards proposed in the plan may reduce some future opportunities for recreation involving some forms of access. For example, standards that limit social trail development would make it difficult for the National Park Service to allow significant backcountry access by bicycle or pack animal, because either would quickly damage

vegetation and lead to social trail development in most parts of the national park and preserve, excepting harder surfaces such as gravel river bars. The standard could lead to prohibiting those activities in the future if such damage were to become likely.

Summer recreational access in the Old Park would require travel by foot from the park road, roads outside of park boundaries, or personal (non-commercial) airplane. Summer access in the remainder of the park and preserve would be facilitated by ongoing opportunities to use motorboats and airplanes, including commercial air taxis, to reach remote areas at established landing areas, glaciers, or lakes. No area would preserve places that would require lengthy overland travel to reach.

Winter recreational access would be facilitated by ongoing opportunities to use ski-equipped airplanes park wide and commercial air taxis in the park additions and preserve to reach remote areas. There would be an ongoing opportunity to use snowmachines for traditional activities in the park additions and preserve. If in the future the term “traditional activities” were defined to exclude ~~recreational non-consumptive use~~ activities as for the Old Park, ~~such utilizing a snowmachine recreational use for those activities~~ would be prohibited by existing NPS regulation. The level of motorized access could be limited in the future if necessary to achieve management area standards.

The management of motorized access in this alternative would ~~protect~~ allow some adverse impacts to wilderness-dependent opportunities on the Eldridge Glacier and in Little Switzerland ~~and the Rampart Mountains~~. To a lesser degree, some opportunities for non-motorized winter use would be protected in the accessible park additions on the south side of the Alaska Range where snow conditions are more reliable, but only in ~~limited areas east of Cantwell Creek~~ the Bull River.

This alternative would allow the development of more guided opportunities than are presently available at Denali and expansion of some existing activities, although the constraints on these activities would be more carefully defined than at present. Guided day hiking in the Old Park would ~~be restricted to existing levels and locations~~ generally be restricted to the levels and locations where it occurs now; however, more than 20 miles of entrance area trails (some still to be constructed) would be opened to guided hiking. Scenic air tour landings – an appropriate but not wilderness-dependent activity – would be restricted to glaciers in Management Area A and designated landing areas on the Eldridge and Pika Glaciers, and constrained by natural sound disturbance standards, which would allow some growth but limit some locations where landings presently occur. Guided sport hunting opportunities would be enhanced by extending the two current guide areas across the entire southwest preserve, thereby creating larger guide areas that have a more viable opportunity for regular hunts.

There would also be the opportunity to offer additional types of guided activities, but these would be restricted only to the ~~Kantishna Hills~~, Dunkle Hills, and southern glaciers and lowland areas designated as Management Area A, about ~~44~~ 6% of the park and preserve backcountry. In addition to the guided activities, there would be additional

opportunities for new and expanded educational programs throughout the park and preserve.

The addition of a formalized trail system in the Kantishna Hills would add the opportunity for visitors to hike in a more traditional format, providing an option for those uncomfortable with cross-country travel. However, the opportunity would be largely limited to those who have the ability to stay overnight at the western end of the park in the backcountry, at a campground, in a private lodge, or in the hostel provided for in the 1997 *Entrance Area and Road Corridor Development Concept Plan*. Designated campsites in the Kantishna Hills would also offer a different experience than is presently available which would appeal to some visitors who prefer to reduce uncertainty and difficulty in selecting a backcountry campsite.

~~The Wildhorse Creek trail would provide an additional trail-hiking opportunity and access option on the south side of the park. The other trails provided for in this alternative largely address resource damage and add little opportunity for backcountry travel.~~

Gaining public access to the 17(b) easement between Cantwell and the park boundary at Windy Creek would benefit recreational opportunities by providing an additional point of access to the park that is road accessible.

Visitor Safety

Experience has demonstrated that the park's mountaineering program can safely accommodate the present number of climbers attempting to climb Mount McKinley. NPS mountaineering rangers believe that current levels of education and rescue services could safely accommodate up to 1,500 visitors.

It is likely that some overnight camping and winter day-use in the southern park additions would trigger registration requirements in the near future. These requirements would enable better visitor education, enhancing visitor safety through better knowledge of common backcountry hazards such as bears, rivers, glaciers, avalanches, and potentially hazardous conflicts with other visitors (e.g., people camping too close to landing areas on glaciers). These new requirements, if implemented, would apply to a substantial but unknown number of visitors who presently do not register. There are presently about 500 overnight mountaineering users per year on south side glaciers that voluntarily register.

Continued increases in climbers attempting Mount McKinley and neighboring peaks would lead to an increase in unconfined human waste and the potential for degrading water quality as ice melts on the Kahiltna, Pika, Ruth, and Eldridge Glaciers. Although most human waste deposition typically is on ice, snow, or rocky soils well away from surface or groundwater movement, the long-term impacts of this practice are unknown. Contamination of water resources could cause health problems for climbers and other visitors in areas drained by these glaciers.

In this management scenario, all of the park's popular climbing areas (West Buttress, Kahiltna Base Camp, and the Ruth Glacier) are zoned as Management Area A, C, Portals or Special Use Areas, which allow for higher levels of encounters with people and with evidence of modern human use. Evidence of human waste should still be low in these areas because NPS staff would continue to educate climbers about waste disposal, conduct regular patrols on the West Buttress, and encourage climbers to use Clean Mountain Cans to dispose of their human waste, which have been shown in the past to reduce waste problems on the West Buttress.

Under this alternative, limiting the number of climbers on Mount McKinley to 1,500 per season would allow use levels to increase by over 15%. Removal of human waste from the park would be required on the West Buttress Route on Mount McKinley ~~at and~~ above the 14,000-foot camp, and at campsites within one-half mile of air taxi landing locations on glaciers. If new registration requirements were imposed in the popular mountaineering areas, they would allow NPS staff to further educate visitors about proper disposal of human waste in other glaciated areas that receive considerable use. These actions would be expected to mitigate most of the potential negative impacts that increased use, and subsequently increased human waste, could have on drinking water quality and human health in these high use areas. Realistically, not all impacts would be mitigated, and impacts to water quality could persist for several years.

Cumulative Impacts

The National Park Service has generally allowed the growth of backcountry recreational activities and encouraged it by authorizing guided activities such as dog sled tours, scenic air tour landings and air taxi services, guided day hiking, and guided mountaineering. Some activities have been constrained to protect park resources by prohibiting snowmachine access to the Old Park in 2000 and imposing quotas on overnight backcountry use in 1976. However, these actions have served to preserve the diversity of recreational opportunity at Denali, particularly for wilderness-dependent activities. Meanwhile, increasing snowmachine access to the southern park additions and the expansion of aircraft overflights on the south side of the Alaska Range and the eastern portion of the Old Park associated with increasing scenic air tour traffic have had an adverse impact on wilderness-dependent activities.

The actions in this alternative would mitigate the adverse impacts of actions originating outside of NPS control and preserve the diversity of recreational opportunity in the face of further changes in recreation demand. Overall, the actions in this alternative combined with these other actions would have a minor beneficial impact on the recreational opportunities in the Denali backcountry. The actions proposed would be responsible for a substantial portion of the benefit, although the previous efforts to limit overnight use and restrict snowmachine access also play an important role.

Conclusion

This alternative would have a minor beneficial impact on recreational opportunities at Denali because it would allow for a carefully managed set of appropriate backcountry activities to serve individuals who need more assistance with access, facilities, and services, while still protecting the recreational activities that are dependent upon Denali's wilderness resources and which the NPS is legislatively obligated to provide. However, there would be limited opportunities for some wilderness-dependent activities to expand in accessible areas. Visitor safety would be improved by education associated with required registration for some common activities, while adverse impacts to water quality would be minimized.

The level of impacts to recreational opportunities anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are essential to the integrity of the park.

PARK OPERATIONS AND MANAGEMENT

This section addresses impacts to park operations and management, including needs for staffing, equipment, and facilities within all divisions of the National Park Service at Denali.

METHODOLOGY

Previous management actions in Denali National Park and Preserve and management actions in other units of the national park system (such as those from Rocky Mountain National Park, Zion National Park, Mount Rainier National Park, and Shenandoah National Park) were used to determine impacts to park management from each of the alternatives. For example, examination of operations of Denali's current backcountry quota system indicates the National Park Service can expect impacts of an expanded registration system to be similar to those that have occurred during the last 25 years that the current quota system has been in place.

IMPACTS OF THE MODIFIED PREFERRED ALTERNATIVE

The National Park Service would follow through with its commitment to conduct ecological monitoring and research to implement the plan. Additional park staff and funding will be needed to carry out the baseline studies, research, and subsequent monitoring that is an inherent requirement of the successful implementation of the adaptive management approach that is promoted by this plan. The complexity of monitoring to determine if desired resource conditions are being met is greater than simply regulating a carrying capacity limit such as the number of permits.

Approximately a 25% increase in research and monitoring staffing and funding would ~~need be needed~~ to implement the level of research and monitoring that is required by this alternative. The allowance for motorized access and higher levels of scenic air tour activity would increase the need for the research and monitoring information on natural soundscapes, wildlife disturbance, vegetation damage, and visitor capacity. Four new permanent positions and four new seasonal positions in these disciplines would be ~~needed to help meet the obligations in this alternative for adaptive management~~ required to implement plan provisions. Four new seasonal positions to assist in monitoring implementation would be required. Funding sufficient to conduct concurrent contracted research studies on soundscape, vegetation, wildlife, and sociological topics would be required given that the use levels and types of use allowed by this alternative would require more immediate information.

The continuation of recreational snowmachine, airplane, and motorboat use throughout the park and preserve additions as well as continued use of airplanes, motorboats, ~~stock~~ pack animals, and bicycles in the Old Park implies major new management responsibilities and operational impacts ~~that are not a consequence of either Alternatives~~

~~2 or 3.~~ A well-staffed and funded backcountry management operation along with a research and resource management program that is specifically assigned to address backcountry visitor use related issues would be necessary to implement the actions of this alternative and the resource protection strategies described in this plan.

Higher levels of use in the backcountry, particularly during the winter from snowmachine use, would require 400 flight hours of aerial patrols to enforce regulations and gather resource monitoring information. The infrastructure and staffing exist to absorb this increase with only minor impacts on park operations, but increased funding would be required to pay for flight time.

Three additional permanent positions and 12 additional seasonal positions distributed between visitor contact stations at Park Headquarters, Broad Pass, Talkeetna, and perhaps along the Petersville Road or at Trapper Creek would eventually be necessary to provide visitor information and registration services. An additional supervisory Park Ranger would be needed to oversee a backcountry district that would include four backcountry law-enforcement field Rangers. Two additional staff, one permanent, and one seasonal would be necessary to increase the winter patrol coverage capabilities of the park kennels operation. The establishment of this comprehensive program, which is essential to the accomplishment of the adaptive management strategy inherent in this plan, would be a major impact on park operations.

An important long-term beneficial impact on park operations is the plan's documentation and formalization of standards, limits, guidance, and policies for actions in the backcountry. Park administration and personnel change eventually, and the proposed plan would provide for continuity and consistency of management, decreasing variability and uncertainty about appropriate activities, including commercial activities, in the backcountry.

The addition of one permanent park planner or management assistant would be required to coordinate the implementation of proposals in this alternative such as working with air taxi and scenic air tour operators to reduce aircraft noise, accomplishing required updates to the plan, and carrying out the evaluation of information from required monitoring. The position would also lead the planning for any subsequent adaptive management actions that may be necessary. An additional 50% of a permanent position would be required to work with concessions management to develop provisions for future commercial use authorizations and monitor the increased level of commercial activity.

The National Park Service would maintain the same level of administrative presence on Mount McKinley and the overall impacts to park operations and management would be negligible over 5-10 years of plan implementation.

An additional seasonal trail crew on the north side of the park would be required to construct and maintain trails that are included within this plan. Given the current scale of the trails program, this would be a minor impact.

Maintenance of new facilities such as the new contact station in the Cantwell/Broad Pass area and structures to support winter use in the park headquarters area would require additional operating funds for contract services as well as the addition of one permanent and one seasonal employee.

The additional staff required to implement the plan would exceed ~~the existing~~ administrative capabilities and would therefore trigger additional expenses for office space, administrative staff, vehicles, and parking~~of existing administrative and facility infrastructure~~ and create related impacts to other aspects of park operations, and as a result represent a major impact to park operations overall.

Cumulative Effects

Past, present, and reasonably foreseeable future actions, such as the private and commercial development in and near the park and regional increases in recreational uses will require additional time and effort from park management for the next 20 years. Impacts to park management would be major because these projects will have serious ramifications on the visitor experience and condition of the park. Existing staff are fully utilized with existing projects; therefore, new duties would require new staff. To work effectively on these and other projects, more funding would be necessary and/or existing staff would have to shift priorities.

Conclusion

Despite the fact that there would be increases in park staff and funding to manage increased use and additional facilities, and that proactive management would negate the need for a reactive (and thus, a more costly and effort-intensive) approach to management, major impacts to park operations and management would still occur in several important aspects of park operations during 5-10 years of plan implementation. These changes would be of a degree that cannot be absorbed within existing infrastructure. The required staffing and funding are of a magnitude that would trigger the need for major secondary responses in support services such as administration, (particularly human resources), support facilities and equipment such as office space and vehicles, and as well as facility maintenance activities. Overall, there would ~~still~~ be major impacts to park operations as a consequence of this alternative. Without the staffing and funding increases described above, it would not be possible to prevent impairment of park resource values given the use increases called for by this alternative.

SUSTAINABILITY

MODIFIED PREFERRED ALTERNATIVE

Relationship Between Short-Term Uses and Long-Term Productivity

The dispersed motorized access that would continue and grow in the Dunkle Hills/Broad Pass and lowland areas around the bases of the Kahiltna, Tokositna, and Ruth Glaciers could compromise the ability of the park to sustain wildlife resources, which could be displaced. Close to Cantwell, these wildlife resources are also subsistence resources. The same displacement could occur in other areas of the park and preserve, particularly ~~Kantishna~~, if snowmachine access became popular in the future. In addition, these areas could decline in their ability to provide wilderness recreational opportunities because of the high levels of motorized equipment and noise that would make it difficult for visitors to find solitude.

Irretrievable or Irreversible Commitments of Resources

There would be no irreversible or irretrievable commitments of resources made under this alternative.

Unavoidable Adverse Environmental Impacts

There would be unavoidable adverse environmental impacts to natural soundscape and wilderness resources in areas where motorized access would be common, such the southern glaciers between the Kanikula/upper Kahiltna and Ruth glaciers because of airplane access and the Corridors in the Broad Pass/Dunkle Hills and Tokositna River areas. There would also be damage to vegetation and ice-rich permafrost soils in ~~Corridors and other~~ areas where snowmachines commonly travel. All of these impacts would be mitigated by the standards provided by management areas.