RESOURCE MANAGEMENT PLAN

Denali National Park and Preserve
Alaska

1998

Approved by: _____ 9/27/98
Superintendent Date
Denali National Park and Preserve

Table of Contents

Executive Summary 1

Plan Purpose, Organization, and Implementation 3

Part One: Introduction

A. **Purpose of the Park and Preserve** 7

B. **Description of the Park Environment and Resources** 9

C. **Legislative and Administrative Constraints** 16

D. **Context and Themes** 27

E. **References** 35

Part Two: Present Resource Status

A. **Natural Resource Baseline Information** 37

B. **Natural Resource Conditions** 49

C. **Cultural Resource Baseline Information** 57

D. **Cultural Resource Conditions** 59

E. **Subsistence Resource Baseline Information** 61

F. **Subsistence Resource Conditions** 65

G. **Collection Condition** 70

H. **References** 71

Part Three: Management Objectives & Guiding Principles

A. **Management Objectives** 75

B. Program Philosophy or Guiding Principles 76

C. References 77

Part Four: Park Resource Program

A. Programmmatic Needs and High Priority Recommendations 79

B. References 96

C. Project Statement Organization and Content 96

1. Interdisciplinary Project Statements

Program Management

Program Management DENA-I-100

Inventory and Monitoring

Long-Term Ecological Monitoring DENA-I-210
Resource Inventory and Mapping DENA-I-220

Collection Management

Curation DENA-I-300

Research

Research Administration & Management DENA-I-410
Biosphere Reserve Management DENA-I-420

Land & Water Resources

Lands Management DENA-I-500
Navigability DENA-I-510*

Visitor Uses

Frontcountry Management DENA-I-610

Wilderness and Backcountry Management	DENA-I-620
River Recreation	DENA-I-630
Winter Recreation	DENA-I-640
Aircraft Management	DENA-I-650
Mountaineering	DENA-I-660
Road Use Impacts	DENA-I-670
Hazardous Materials Management	
Hazardous Materials & Waste Management	DENA-I-700
Administrative Use of Resources	
Administrative Use of Resources	DENA-I-800

2. Natural Resource Project Statements

Atmospheric Resources	
Air Quality	DENA-N-110
Meteorology	DENA-N-120
Aquatic Resources	
Water Resources Management	DENA-N-210
Non-vascular Aquatic Plants	DENA-N-220*
Vascular Aquatic Plants	DENA-N-230*
Aquatic Invertebrates	DENA-N-240
Fisheries	DENA-N-250
Sport Fishing	DENA-N-251*
Subsistence Fishing	DENA-N-252*
Amphibians	DENA-N-260*
Geologic Resources	
Geology	DENA-N-311
Geologic Hazards	DENA-N-312
Minerals Management	DENA-N-313
Glaciology	DENA-N-314

Soil Resources

Soil Resources	DENA-N-320

Terrestrial Biota

Terrestrial Vegetation	DENA-N-330
Hazardous Tree Management	DENA-N-341
Exotic Plant Management	DENA-N-342
Rare Plant Management	DENA-N-343*
Firewood and Cabin Log Management	DENA-N-344
Terrestrial Invertebrates	DENA-N-350*
Passerines	DENA-N-361.1
Shorebirds	DENA-N-361.2
Waterfowl	DENA-N-361.3
Raptors	DENA-N-361.4
Ptarmigan and Grouse	DENA-N-361.5
Dall Sheep	DENA-N-362.1
Moose	DENA-N-362.2
Caribou	DENA-N-362.3
Furbearers	DENA-N-363
Wolves	DENA-N-364.1
Grizzly and Black Bears	DENA-N-364.2
Rodents, Lagamorphs, Bats, Shrews	DENA-N-366*
Trapping and Sport Hunting	DENA-N-367
Subsistence Trapline Management	DENA-N-368
Subsistence Hunting Management	DENA-N-369

Paleontological Resources

Paleontology	DENA-N-400

Integrated/Multi-resource Activities

Natural Resource Program Management	DENA-N-500
Integrated Pest Management	DENA-N-510
Wildland Fire Ecology and Management	DENA-N-520
Ecological Restoration/Reclamation	DENA-N-530
Threatened/Endangered Species	DENA-N-540*
Plant and Animal Diseases	DENA-N-550*

3. Cultural Resource Project Statements

Program Management

Cultural Resource Program Management — DENA-C-100

Archeology

Archeological Resources — DENA-C-200

Ethnography

Ethnographic Resources — DENA-C-300

Cultural Landscapes

Cultural Landscapes — DENA-C-400

Park History

Park History — DENA-C-500

Historic Structures

Historic Structures — DENA-C-600

4. Subsistence Resource Project Statements

Program Management

Subsistence Program Management — DENA-S-100
Customary and Traditional Use Patterns — DENA-S-110
Traditional Access — DENA-S-120

* Reserved for Future Preparation

Appendices

A. **Table 1 - Personnel**

B. **Table 2 - Funding**

C. **Programming Sheet 1 - Ongoing and Funded Activities**

D. **Programming Sheet 2 - Unfunded Activities**

E. **Cultural Resource Documentation Checklist**

F. **Cultural Resource Status Summary Charts**

G. **Object Status Summary Chart**

H. **Annual Project Status and Accomplishments Reports**

I. **List of Related Action Plans**

J. **List of Persons and Agencies Consulted**

K. **Planning Team**

List of Tables

Table 1	Summary - Natural Resource Baseline Information	48
Table 2	Natural Resource Conditions	56
Table 3	Summary- Subsistence Resource Baseline Information	65
Table 4	Subsistence Resource Conditions	69
Table 5	Crosswalk Between Park Strategic Plan and Resource Management Plan	83
Table 6	High Priority Actions	90
Table 7	FY92-FY96 Resource Management Funding	I-100 - 8
Table 8	Funded Interdisciplinary Actions	I-100 - 12
Table 9	Alaska Hunting Seasons	N-367 - 9
Table 10	Alaska Trapping Seasons	N-367 - 12
Table 11	Subsistence Trapping Seasons	In preparation
Table 12	Subsistence Hunting Seasons	In preparation
Table 13	Funded Natural Resource Actions	N-500 - 2
Table 14	Funded Cultural Resource Actions	C-100 - 3
Table 15	Funded Subsistence Resource Actions	S-100 - 4

Executive Summary

Plan Purpose

This resource management plan (RMP) describes Denali National Park and Preserve's resource management vision/objectives and the actions necessary to achieve that vision. The RMP documents knowledge and status of the park/preserve's natural, cultural, and subsistence resources; describes and evaluates current resource management activities; prescribes an action program; and identifies funding and personnel needs. Furthermore, a report from the General Accounting Office (GAO 1994) calls for the RMP to include the following: (1) the number, type, and source of external threats and priorities for addressing those threats; (2) project statements for each external threat, describing the mitigation actions that can be taken; and (3) the status of threat mitigation actions. Although this GAO report focused on the need to document "external threats", those threats must be evaluated in the context of the vast acreages of undeveloped resources that surround Denali National Park and Preserve. In addition, internal (on park land and water) threats also exist. This plan strives to address all of these issues recognizing the current well protected conditions but anticipating that internal and external pressures will only increase in the future.

Plan Organization

The RMP is divided into four primary sections. Part One, the Introduction, provides the purposes for which the park was established, a description of park resources, and the legal and administrative constraints that govern the management of those resources. Part Two, the Present Resource Status, summarizes the comprehensive baseline of information on park resources and describes the condition of those resources. This section is the basis for the management actions proposed in the plan and is the context for assessing individual Project Statements. Part Three, the Vision, outlines the long range goals of the park's resources management program. Part Four, the Park Resource Program, is split into two major components. The first, an Overview of the Current Program and Needs, outlines priorities for action or a prospectus and links this plan to the park's strategic plan. The second component is a compilation of Project Statements that provide detailed information about resource issues and threats as well as proposed actions that are proposed to resolve those. A multitude of actions are identified amongst all of the Project Statements, more than can feasibly be accomplished with current funding and personnel constraints. Enumeration of all conceivable actions helps in priority setting and is instructive in establishing program direction. Although budget tables associated with each Project Statement display four funding years, revisions of RMPs rarely occur more often than every five years and more frequently every ten years. Descriptions of many actions in the plan will extend its utility. Project Statements are written such that they can stand alone and be used in various funding initiatives. Some redundancy between Project Statements therefore exists.

Eleven appendices give detailed, supplemental information about funding, staff, resource baseline information, and so forth.

Park staff, Alaska System Support Office staff, state agency personnel, and others have contributed to the development of this document.

This plan will guide the park's resource management program and will be amended each year with progress reports. Priorities will be reevaluated periodically.

Vision for Resource Protection

The Resource Management Plan is the vehicle that park staff use to evaluate park resources and determine program priorities. This formal mechanism should lead to a scientifically founded and well-thought-out resource program. Recognizing the dynamic nature of park resources and public enjoyment of those resources, the resource program must be flexible and responsive. A full description of the Vision for the resource program is contained in Part Three of this plan.

High Priority Resource Programs

Despite the inherent dynamics and need for flexibility in the resource program, a four-to-five year prospectus has been developed that enumerates specific program areas that must be dealt with. These can be grossly grouped into two categories - actions that develop resource information necessary for sound decision making and actions that resolve specific high priority resource issues. The identified actions may now be used in the development of annual work plans in compliance with the Government Performance and Results Act.

Plan Purpose, Organization, and Implementation

Purpose

This resource management plan (RMP) documents Denali National Park and Preserve's natural, cultural, and subsistence resources; describes and evaluates current resource management activities; prescribes an action program; and identifies funding and personnel needs. Furthermore, a report from the General Accounting Office (GAO 1994) calls for the RMP to include the following: (1) the number, type, and source of external threats are specifically identified, an inventory is established, and priorities are set for addressing the threats; (2) project statements are prepared for each external threat, describing the mitigation actions that can be taken; and (3) the status of threat mitigation actions is monitored and revised as needed.

The RMP is both short- and long-range in nature and identifies problems and needs regardless of the time in which an action will be initiated.

The RMP is one of several documents used to guide park staff in decision making and problem solving.

Organization

This Resource Management Plan was prepared according to the Resource Management Plan Guidelines (December, 1994) and guidance found in the National Park Service Management Policies (Chapter 4.2, 1988). The plan is also based on legislative mandates and executive orders.

The RMP is divided into four primary sections:

1. Introduction - This section states the purpose for which the park was established, describes natural, cultural, and subsistence resources, values, and special designations and explains legislative and administrative constraints that influence resource management activities. This section also explains context and identifies resource themes that help park staff to focus on the most important issues and activities.

2. Present Resource Status - This section outlines the status of baseline information about the park and gives commentary on the condition of park resources.

3. Vision and Objectives - This section summarizes current resource-related

management objectives within the context of broader park objectives developed in compliance with the Government Performance and Results Act.

4. Park Resource Program - This section briefly describes the current resources management program and outlines proposals for future short and long term actions.

The RMP documents the park's operating program to attain natural, cultural, and subsistence resource objectives. To accomplish this, the RMP seeks to provide a program so managers can:

Inventory. Identify, inventory, and understand the resources and processes that give meaning to the park.

Monitor, Predict. Establish and monitor baseline measurements of the resource conditions and processes so impacts can be detected before they cause serious damage and to provide a standard against which management performances can be measured. Institute a system for predicting potential threats to park values early enough before their occurrence that budgeting and programming is done to accomplish timely research and/or management to prevent or mitigate them.

Research. Identify and conduct scientific investigations to answer questions about park resources and processes.

Mitigate, Interpret, Protect. Describe ongoing and needed mitigation, interpretation, and protection actions aimed at resolving resource related problems.

Administer Programs and Plan. Identify all planning and administrative actions necessary to support a well developed resources preservation program.

Each project statement contains recommendations that are grouped in these categories. It is intended that these groups be extracted from the RMP and strategic plans be written around each group to achieve a programmatic approach to resource preservation.

Whenever appropriate, specific action plans will be developed. These documents focus solely on single activities and provide day-to-day guidance for park operations. Examples of such include the park's fire management plan and the bear-human interactions plan.

The RMP will be updated annually to reflect operations evaluations, periodic assessments of resource status, actions taken to date, and changing impacts, threats, and legal constraints. It sets priorities and helps guide managers in requesting funding.

Consultation

To enhance the opportunities for cooperation and coordination of resource management activities, the National Park Service (NPS) has established formal procedures to involve the State of Alaska in developing and reviewing resource management plans for national park system units in Alaska. Comments from other Federal agencies and Native groups with park-related resource management concerns will also be solicited.

Our goal is to involve knowledgeable individuals and cooperating agencies during planning and project development. A list of people and agencies contacted during the development or revision of the plan is appended. The final draft will be available for public review at park headquarters during an announced 30 day review period. The review period will be publicized in the local media. Upon completion of public and agency reviews, the final Resource Management Plan is approved by the park Superintendent.

Relationship to Other Plans

Planning within the NPS is undergoing change as a result of passage of the Government Results and Performance Act. Relationships between planning documents are therefore less clear than they once were. In general, the general management plan (GMP) provides overall guidance to park management for approximately ten years. Stepped down from the GMP is the park's strategic plan which summarizes the GMP and outlines park management programs and activities for roughly five years. The resource management plan also steps off of the GMP, providing detailed descriptions of resource management programs. Goals and objectives identified in the strategic plan are used to establish priorities in the resource management plan.

Compliance

Park staff is in the process of preparing a detailed procedure for completing compliance requirements. That process will be applied to all actions proposed in this plan.

When necessary, environmental assessments will be prepared in accordance with the National Environmental Policy Act (NEPA). Categorical exclusions will be on file for each applicable project proposal before implementation.

Federal activities that may affect register-eligible cultural resources require consultation with the Alaska State Historic Preservation Office and Advisory Council on Historic Preservation in compliance with Section 106 of the National Historic Preservation Act (NHPA). Specific recommendations of the State Historic Preservation Office will be sought and incorporated

before the action's final approval.

Section 7 of the Endangered Species Act requires further consultation with the U.S. Fish and Wildlife Service if a proposed action may affect endangered species or their habitat.

Various other legal and regulatory requirements such as wetland and floodplain findings and Corps of Engineers permits will be obtained as appropriate.

Finally, Section 810 of ANILCA (Alaska National Interest Lands Conservation Act) requires an evaluation of potential impacts of proposed actions on subsistence uses and needs.

Plan Version

The RMP is a dynamic document that is intended to be responsive to new information. Many components of the document should be updated regularly. Thorough reviews of the plan are mandatory every four years.

Park staff completed an RMP for Denali in 1982. Revisions, primarily to proposals for funding, were completed in 1987. This version of the RMP is a complete update of the document.

INTRODUCTION

Part One: Introduction

This section briefly describes the variety and significance of park resources and the mandates that govern their management. It also outlines important resource themes that help focus what could otherwise be a diffuse resource management program.

A. Purpose of the Park and Preserve

The overall purpose of Denali National Park and Preserve is to protect natural and cultural resources and provision of opportunities for human enjoyment of those resources in such a way that alteration by humans is minimized. Specific purposes for the park and preserve vary somewhat among the three legislatively authorized units: the Denali Wilderness (formerly Mount McKinley National Park), the park additions of 1980, and the preserve of 1980.

The original goal of Charles Sheldon and the Boone and Crockett Club in recommending that Congress establish the park in 1915 was protection of wildlife (Grant 1925). The Act of February 26, 1917 (39 Stat. 938) establishing Mount McKinley National Park stated it was:

> ... set apart as a public park for the benefit and enjoyment of the people...for recreation purposes by the public and for the preservation of animals, birds, and fish and for the preservation of the natural curiosities and scenic beauties thereof...said park shall be, and is hereby established as a game refuge.

Legislative history associated with development of the Alaska National Interest Lands Conservation Act (ANILCA), (PL 96-487, December 2, 1980) states that:

> Four units in large part - ... Mount McKinley ... - are intended to be large sanctuaries where fish and wildlife may roam freely, developing their social structures and evolving over long periods of time as nearly as possible without the changes that extensive human activities would cause. (U.S. Senate, 1979)

In addition, ANILCA contained the following language pertaining to Denali:

> ... to protect and interpret the entire mountain massif, and additional scenic mountain peaks and formations, and to protect habitat for, and populations of fish and wildlife including, but not limited to, brown/grizzly bears, moose, caribou, Dall sheep, wolves, swans and other waterfowl; and to provide continued opportunities, including reasonable access, for mountain climbing, mountaineering and other wilderness recreational activities.

Clearly, protection of resource values has been of paramount concern to Congress. ANILCA also redesignated Mount McKinley National Park as Denali National Park, expanded the size of the park, and established Denali National Preserve.

Section 101 of ANILCA described the broad purposes of new Alaska park and preserve areas:

- Preserve lands and waters for the benefit, use, education, and inspiration of present and future generations.
- Preserve unrivaled scenic and geological values associated with natural landscapes.
- Maintain sound populations of, and habitat for, wildlife species.
- Preserve extensive, unaltered ecosystems in their natural state.
- Protect resources to provide the opportunity for rural residents engaged in a subsistence way of life to continue to do so consistent with recognized scientific fish and wildlife management principles, and the purposes for which the area was established.
- Protect and preserve historic and archeological sites.
- Preserve wilderness resource values and related recreational opportunities.
- Maintain opportunities for scientific research in undisturbed ecosystems.

Congress in ANILCA also directed that the park/preserve lands be administered "pursuant to the provisions of the Act of August 25, 1916 (39 Stat. 535)," which created the National Park Service.

In the park additions and preserve, Congress stipulated certain objectives that are not found in most older parks. In the additions, traditional subsistence harvests are authorized; in the preserve, both subsistence and sport harvests are explicitly allowed.

Clearly, Congressional deliberation pointed out that both park and preserve lands added via ANILCA should be managed differently from similar units of the park system in the contiguous 48 states:

National Preserves are to be managed exactly as are the National Parks...Congress intends that the Secretary shall manage National Park System units in Alaska to assure the optimum functioning of entire ecological systems in undisturbed natural habitats...the preeminent natural values of the Park System shall be protected in perpetuity, and shall not be jeopardized by human use. These are very special lands, and this standard must be set very high: the objective for Park System lands must always be to maintain the health of the ecosystem, and the yield of fish and wildlife for hunting and trapping must be consistent with this requirement. (Congressional Record-House, H10549, November 12, 1980).

B. Description of the Park Environment and Resources

Denali National Park and Preserve is located in southcentral Alaska and comprises 6,028,091 acres.

Ecoregional Context

Using Bailey's ecoregions of the United States (Bailey 1996), Denali straddles both the Polar Domain (Subarctic Division) and the Humid Temperate Domain (Marine Division). Application of the classification scheme found in "Ecoregions of Alaska" (Gallant 1995) reveals that the park includes portions of the following regions:

Interior Bottomlands
Interior Highlands
Interior Forested Lowlands and Uplands
Alaska Range
Cook Inlet

Physiographic Context

Much of the park is in the Alaska Range section of the Alaska-Aleutian physiographic province of the Pacific Mountain System. Portions of the northern foothills of the Alaska Range are in the central and eastern sections of the park while the western section of the park and preserve occupies the Tanana-Kuskokwim Lowlands of the Western Alaska province. Elevations range from 200 feet to 20,320 feet at the top of Mt. McKinley, the highest peak in North America. Approximately one-third of the park/preserve consists of mountains and ridges above 4,000 feet elevation.

The northwestern section of the park/preserve, a relatively flat area of lowlands covered by spruce forest, contrasts strikingly with the mountainous areas.

Climate

The park is located in two climatic zones of Alaska. Areas on the northern flanks of the Alaska Range and the lands farther north have a continental climate characterized by colder, drier winters and warmer, drier summers. Precipitation on the north side, at park headquarters (elevation 2,100') is approximately 15 inches of rain annually with 80 inches of snow. Snow depths average around 25 inches. More precipitation falls in summer than winter. Approximately half of the summer days are characterized by cloudy weather, which restricts the viewing of Mt. McKinley. Winter and spring tend to have clearer weather. Summer temperatures generally range from 35° F to 66° F and may go as high as 92° F. Normal winter temperatures range from -7° F to 27° F and may drop to -52° F at headquarters or -65° F to -75° F in western lowlands. The Alaska Range is a barrier to air movements and precipitation from the maritime influences to the south, thus creating a transitional climate. Areas on the south side of the range are significantly wetter, with twice the precipitation of the north side. There are more cloudy days on the south side throughout the year largely as a result of storms that develop in the Gulf of Alaska and are pushed up against the range. Temperatures on the south side of the range have less variation and tend to be warmer in winter and cooler in summer.

Geology

The geology of Denali National Park and Preserve consists primarily of Paleozoic and Mesozoic marine sediments in large strike-slip or thrust-slip slivers, which make up the bulk of the Central Alaska Range and foothills to the north and south. Some of these slivers of land, called terranes, are imported northerly by the Pacific Plate subducting at a southern Alaska coastline, at least since late Paleozoic time (300 million years ago). Most of the terranes were thrust onto a shallow seafloor in the area of the park about 100 million years ago. These were then cut by granitic plutons about 56 million years ago to create the lofty Mts. McKinley, Huntington, and Hunter.

The range is perpetually snowclad above 7,000 feet on the north and 6,000 feet on the south. Glaciers are numerous and tend to be larger and longer on the south side of the range than on the north. The larger glaciers range between 35 and 45 miles in long. These include the Kahiltna, Ruth, Eldridge, Tokositna, and Yentna. The largest glacier on the north side is the 34-mile-long Muldrow.

Additional magmatic intrusions and volcanic activity occurred about 38 million years ago to create the granite of Mt. Foraker and the Cantwell Volcanics, which are the principal rocks of the Polychrome Pass area. Tectonic pressure continued to build the present-day Alaska Range and created a major fault fracture complex called the Denali Fault System. This system is considered an extension of the more famous San Andreas Fault.

North of the Denali fault system, the area consists of metamorphosed Paleozoic and older sedimentary rocks. Much of the northern foothills are underlain by schist. Isolated hills jutting above the northern lowlands are composed of schist. Argillite, slate, graywacke, and limestone formations are common south of the Denali fault. South of the Alaska Range, the Cook Inlet-Susitna lowlands are covered by moraines, drumlin fields, eskers, and glacial outwash plains. Glacier-carved cirques and canyons form scenic walls, several thousand feet high, in numerous locations.

Mineralized areas, including the Kantishna Mining District, consist predominately of placer gold deposits and some antimony. Other areas include the Stampede district, consisting primarily of antimony, and the Chulitna (Dunkle) district with gold, limestone, and coal.

Soils

Soils of Denali have only been mapped on a broad scale. In general, the mountainous areas consist of steep, rocky slopes, icefields, and glaciers with very thin or no soils. Lower slopes and valleys consist mostly of pergelic cryorthods-histic pergelic cryaquepts. Soils in other areas of the park are primarily aquepts-pergelic cryaquepts, histic pergelic cryaquepts, pergelic cryochrepts, and typic cryofluvents. Most of these are characterized by poor drainage, shallow permafrost, and thick surface layers of partially decomposed organic matter.

Permafrost is intermittently present throughout the lowlands north of the Alaska Range and is continuous at higher elevations both north and south of the Range. Detailed studies of the extent of permafrost in lowland areas to the south of the range have not been made. Thicknesses up to 100 feet have been recorded on the north side, near the entrance to the park.

Hydrology

Many headwater drainage systems originate in the Alaska Range. Streams of glacial origin are common and are characterized by shallow, swift flows over gravel beds. Many of these streams and rivers are silty, braided, and have wide gravel floodplains filling mountain valleys. Some of the major drainages in the park are the Foraker, McKinley, Toklat, Teklanika, Savage, Chulitna, Kahiltna, and Yentna rivers. Clear streams, fed primarily by snowmelt and

precipitation, also occur throughout the area. Outside of the mountains, especially in the northwest lowlands, there are many meandering rivers and streams with slow currents. During summer months, many rivers carry heavy silt loads from glacial action or from cutting and eroding banks. Nearly all surface waters are potable, although *Giardia* is known to be present. Stream discharges typically increase during the warm summer weeks between early July and mid-August.

The mountains contain few lakes, although water-filled kettles on moraines and ponds from beaver-dammed creeks occur in places. Many lakes and ponds occur in the northwestern lowlands. A few small, rock-floored lakes occur throughout the area south of the Alaska Range. The largest is Chelatna Lake, which is seven miles long; but this lake is located just outside of the park. The eastern section of the park is bounded by the Nenana river, which bisects the Alaska Range.

Vegetation

Denali's vegetation is characteristic of subarctic areas where the growing season is less than 100 days and soils are poor in available nutrients. The taiga, or boreal forest, is found at the lowest elevations and consists of black spruce, with stands of white spruce, paper birch, and aspen on better drained sites. Tamarack, balsam poplar, little tree willow, flatleaf willow, resin birch, American green alder, thinleaf alder, Alaska rose, and red currant are also present in some places. Understory vegetation consists of low shrubs, (cranberry, blueberry, lingonberry) herbs, mosses, and lichens. Trees are slow growing and even the best sites seldom have trees taller than 50 feet except in lower elevations or floodplain areas where white spruce and balsam poplar can attain 80'-85'. Even trees of this height may not have ground diameters exceeding 15 inches.

Above 2,600 feet (timberline), the forests give way to shrublands consisting of moist tundra plants such as dwarf birch, willows, and sedges. Blueberry, Labrador tea, bearberry, alpine azalea, and crowberry are common. The shrubs in this zone are usually knee to waist high. Much of the shrubland is poorly drained.

Above 3,400 feet, the shrubland is replaced by alpine tundra, which consists of low growing mats of avens only a few inches high. Heather, cinquefoil, and saxifrage are also common. Lichens are abundant. In swales and along streams, willow shrubs and alder are common.

Numerous other vegetation communities exist, especially in localized situations such as river gravel bars where pea vine, willow, and avens are common. Many species of willow occur in Denali; it is one of the most common and important plants for wildlife forage.

Lightning-caused fires are an important process in the forest and shrublands in the northern section of the park/preserve. Fires aid productivity by releasing nutrients that would otherwise be bound in the vegetation cover, which does not easily decompose in the relatively dry, cold interior climate. Fires also contribute to the development of browse species important to wildlife.

Wildlife

There are 37 species of mammals, 155 species of birds, 10 species of fish and one amphibian known in the park/preserve. Mammalian species include moose, caribou, wolves, grizzly and black bears, Dall sheep, red fox, coyotes, lynx, wolverine, porcupine, snowshoe hares, marten, river otters, beaver, weasels, mink, muskrats, marmots, pikas, red squirrels, flying squirrels, and arctic ground squirrels. Voles, lemmings, and shrews are also present.

Many birds migrate long distances to regions in South America and Asia. About one-fourth of the birds that nest in Denali remain all year. These include gyrfalcons, ptarmigan, grouse, owls, woodpeckers, magpies, ravens, chickadees, dippers, redpolls, and crossbills. Golden eagles are the largest migratory raptor that nests commonly. Bald eagles are occasionally observed, but no nests are known. Peregrine falcons have been reported, but are probably migrating through the area. A handful of peregrine nests have been located in the northwestern preserve, and one has been located in the new park. Trumpeter swans, loons, ducks, some geese, shorebirds, and passerine birds commonly nest in the park. Thousands of sandhill cranes use the park for resting and are seen in great flocks passing overhead in the fall.

Only 10 species of fish have been reported for the park, including three species of salmon. Arctic grayling is the most common fish and is widely distributed throughout the park. A few streams are known to have salmon spawning areas.

The wood frog is the single amphibian present in the park. The species is widespread throughout Alaska and occupies forest, tundra, and muskeg areas.

Threatened and Endangered Species

Most sightings of American Peregrine falcons, an endangered species, are believed to occur during migration, although very limited nesting is known to occur in the northwestern preserve. The harlequin duck, the northern goshawk, the olive-sided flycatcher, and the North American lynx are present in the park and are considered species of concern by the U.S. Fish and Wildlife Service. No federally listed threatened or endangered plant species is known to exist in the

park. Two plant species in the park have been cited as candidate species. These are *Taraxacum carneocoloratum* and *Smelowskia pyriformis*.

Archeological Resources

There are approximately 208 known cultural sites and structural units or complexes in the park. Though this may constitute only a fraction of what actually exists with the park, these resources illustrate most major elements of the region's prehistory and history.

Many cultural sites relate to prehistoric occupation of hunters/gatherers who used the area on an intermittent basis, perhaps as early as 10,000 years ago. There are at least 80 prehistoric sites throughout the park. These sites contain lithic remains such as scrapers, microblades, and flakes. The Birch Creek site was a settlement site that has both prehistoric and historic elements. Two sites, Teklanika East and Teklanika West, comprise the Teklanika archeological district, which is listed on the National Register of Historic Places. Two additional prehistoric sites, one near Rainy Creek and another near Willow creek, contain lithic remains of early hunters. These sites have been determined potentially eligible for nomination to the national register.

Of additional archeological significance is an early man site at Dry Creek, just outside the park boundary. The existence of such a site in close proximity to the park suggests the potential for sites within the park boundary.

Historic Structures

Many of the historic structures in the park relate to two distinct but often interrelated themes: mining and subsistence hunting and trapping. The majority of these surviving structures, which date between 1905 and 1942, are located in the Kantishna mining district. The following structures or structure groups have been determined eligible for nomination to the national register:

Kantishna roadhouse
Fanny Quigley residence
Busia cabin
Banjo mill
Upper Caribou Creek
Glacier City
Stampede Mine
Old Eureka/Kantishna Historic Mining district

Two of these sites (Busia cabin, Banjo mill) are privately owned.

Additional cabins and other structures originally associated with railroad construction within the Nenana River corridor are also found within the park.

The administrative history of the park is represented by two complexes of structures. The park headquarters area comprises several buildings, including park headquarters (1935), the north district ranger office (1928), the warehouse (1932), the dog kennels (1929), the Superintendent's residence (1940) and the interpretive offices (1928). The second complex is a group of patrol cabins dating from 1924 to 1939. Both complexes are listed in the National Register.

Cultural Landscape

Cultural landscapes are cultural resource systems that reflect human land use and adaptation. The goal of a cultural landscape management program is the preservation of a cultural landscape's unique physical attributes, biotic systems, cultural associations and use, when that use contributes to its historical significance. Although no cultural landscapes have been formally identified or recorded in Denali, there is no question that qualified vernacular, archeological and ethnographic landscapes exist within the range of sites and time periods represented by the identified cultural resources and past land use in the park. Cultural landscapes should be considered an unevaluated category of cultural resources in Denali.

According to federal law and NPS policy, cultural landscapes are to be managed as cultural resources. Section 110 of the National Historic Preservation Act requires the NPS to identify and nominate to the national register all resources under its jurisdiction that appear eligible, including cultural landscapes. The cultural landscape program focuses on landscapes listed in, or eligible for the National Register of Historic Places. Resources under discussion for development as cultural landscapes include the Kantishna mining district, the Geese House and specific fishing sites (traditional ethnographic landscapes), and subsistence cabins, the park road, and the park headquarters historic district.

Ethnographic Resources

The NPS ethnographic program seeks to identify traditionally associated groups and the resources that are part of their cultural systems and establish collaborative relationships between the service and the peoples whose customary ways of life affect, and are affected by, park resource management. From an ethnographic perspective, Denali is virtually a blank map, with little synthesized information available to assist park management.

Although research specifically designed to identify ethnographic resources has not been conducted in Denali, use of the park and surrounding area by different cultural groups and communities predates park development and is documented by past research. The best documented of these groups are five different Athabaskan groups. It is possible that other occupational groups who have figured in Denali's history (mountaineers, pilots, park employees, subsistence users, miners, etc.) may be identified as defined ethnographic groups as well.

Subsistence Resources and Management

Congress recognized the uniqueness and importance of a subsistence way of life to rural residents by identifying it as one of the purposes of the Alaska National Interest Lands Conservation Act (ANILCA). Through Title VIII of ANILCA, Congress established a policy that rural residents engaged in a subsistence way of life be provided the opportunity to do so, consistent with sound management principles and the conservation of healthy fish and wildlife populations; that the utilization of public lands in Alaska is to cause the least adverse impact possible on rural residents who depend upon subsistence resources; that the non-wasteful subsistence use of fish and wildlife be the priority consumptive use should it become necessary to restrict the taking; and that in managing subsistence activities the federal land managing agencies shall cooperate with adjacent landowners and land managers, including Native corporations, state and federal agencies.

Language in ANILCA specific to Denali states that subsistence uses by local residents shall be permitted in the park additions, where such uses are traditional, in accordance with the provisions of Title VIII. As such, subsistence uses are also allowed in Denali National Preserve (ANILCA 201(3)(a), 203).

C. Legislative and Administrative Constraints

Introduction

Park management decisions and resource management activities are founded on a wide variety of legislative and administrative decisions. These must be understood to provide the context for the resource management program presented in this document.

Organic Legislation

In 1916, Congress created the National Park Service within the Department of the Interior to "...promote and regulate the use... by such means and measures to conform to the fundamental purposes... to conserve the scenery and the natural and historic objects and the wildlife therein

and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." (NPS Organic Act, 16 USC 1).

Resource management philosophies and policies stem from this founding language and supplemental Congressional declarations. The General Authorities Act of 1970 further defined the national park system. The act stated that "each area... shall be administered in accordance with the provisions of any statute made specifically applicable to the area" (16 U.S.C.), as well as with various authorities relating to NPS areas, as long as the general legislation does not conflict with specific provisions.

Wide variations exist in the degree to which laws and proclamations creating individual units prohibit or mandate specific management actions. The Alaska National Interest Lands Conservation Act (16 USC 3101 et al.), popularly known as ANILCA, contained extensive specific exceptions for the Alaska park areas. Absent such specific legislative exceptions, general NPS legal mandates and policies apply (NPS Management Policies, 1988).

Redwoods Act

The Redwoods Act of 1978 (which clarified, amended, and strengthened the NPS Organic Act) states a requirement for conservation of resource values of national parks and directs that "The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established ... ."

Alaska National Interest Lands Conservation Act

On December 2, 1980, Congress enacted ANILCA with the following purposes:

1. "... to preserve for the benefit, use, education, and inspiration of present and future generations certain lands and waters in the State of Alaska that contain nationally significant natural, scenic, historic, archeological, geological, scientific, wilderness, cultural, recreational, and wildlife values, the units described in the following titles are hereby established."

2. "... to preserve unrivaled scenic and geological values associated with natural landscapes; to provide for the maintenance of sound populations of, and habitat for, wildlife species of inestimable value to the citizens of Alaska and the Nation, including those species dependent on vast relatively undeveloped areas; to preserve in their natural state extensive unaltered arctic tundra, boreal forest, ...; to protect the resources related to subsistence needs; to protect and

preserve historic and archeological sites, rivers, and lands, and to preserve wilderness resource values and related recreational opportunities including but not limited to hiking, canoeing, fishing, and sport hunting, within large arctic and subarctic wildlands and on freeflowing rivers; and to maintain opportunities for scientific research and undisturbed ecosystems."

3. "It is further the intent and purpose of this Act consistent with management of fish and wildlife in accordance with recognized scientific principles and the purposes for which each conservation system unit is established, ... , to provide the opportunity for rural residents engaged in a subsistence way of life to continue to do so."

Land and Water Conservation Fund Act

The Land and Water Conservation Fund Act (LWCFA) (16 U.S.C. 4601-4 et seq. (1988), 78 Stat. 897, PL 88-578) was enacted "to assist the States and Federal agencies in meeting present and future outdoor recreation demands and needs of the American people." The act stipulates that not less than 40% of every annual appropriation from the Land and Water Conservation Fund (LWCF) goes toward acquisition of recreation and conservation lands specifically authorized by Congress within national parks and other public land units. The act prohibits conversion of sites assisted with LWCFA grants to non-recreational use except where approved by the National Park Service and replaced with lands of equal market value and usefulness for recreation.

Grants may be made available through states, which must prepare comprehensive plans that identify needs for conservation and development of outdoor recreation resources and set forth action programs to the goals defined. Authority for payment to the states is given to the secretary of the interior. The National Park Service administers the LWCF program through regional offices and the cooperating states.

Endangered Species Act

The Endangered Species Act of 1973 (16 U.S.C. 1531 et seq., particularly Section 7), Federal Regulations (50 CFR 402) that implement provisions of Section 7, and National Park Service policy (U.S. NPS 1978: IV-11) require the park to consult with the secretary of the interior (through the U.S. Fish and Wildlife Service) to ensure that their actions are "... not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of (critical) habitat of such species..." After consultation, the secretary is directed to prepare a written (biological) opinion concerning the potential impact of the proposed action on the identified species, and to suggest alternatives if the proposed action

will jeopardize the species or adversely modify its habitat. Furthermore, the Act prohibits private activity that would constitute a "taking" of protected species.

While only one listed species is present in Denali currently, completion of inventories may result in discovery of species that are either listed or should be listed. Should that happen, park staff would develop management programs within the scope and provisions of the Endangered Species Act.

While the Endangered Species Act does not provide the Department of the Interior with authority to stop the activities of other agencies that conflict with or threaten the natural resources of the park, it does assure that alternatives and mitigation measures are examined. Park staff will work diligently with U.S. Fish and Wildlife Service personnel in reviews of projects to assess their impact on listed species.

Clean Air Act

Two purposes of the Clean Air Act (CAA) as amended in 1977 (42 U.S.C. 1857 et seq.) are to: (1) "... protect and enhance the quality of the nation's air resources so as to promote the public health and welfare and the productive capacity of its population ..." (CAA, Section 101(b)(1)); and (2) "... preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments ... and other areas of special national or regional natural, recreational, scenic, or historic value ..." (CAA, Section 160(2)).

Denali National Park and Preserve is a mandatory Class I area under Sections 160-169A of the Clean Air Act. Under "Prevention of Significant Deterioration (PSD)" rules (40 CFR 52.21), there can only be an extremely small increment of new pollution in a Class I area. Any new major source of pollution that has the potential to emit more than 250 tons per year of any pollutant regulated under the CAA must undergo a PSD new source permit review process, which has several standards that must be met: (1) National Ambient Air Quality Standards; (2) Prevention of Significant Deterioration in a Class I area; and (3) a special "adverse impact determination" for a Class I area.

The "adverse impact determination" is a site-specific test in which the federal land manager for an area (Assistant Secretary of the Interior for Fish and Wildlife and Parks) examines whether a proposed facility will, in fact, unacceptably affect the air quality values of a Class I area. If the Federal land manager determines and convinces the permitting authority that a proposed facility will adversely affect the Class I area, even though it will not cause a violation of the Class I increment, then the permitting authority may not authorize the facility to commence construction and operation.

The CAA also requires the federal land manager to exercise through the permit review process his or her "affirmative responsibility" to assure that the emissions from the proposed facility will not adversely affect the special air quality related values of the area in question. These "air quality related values" include visibility, odor, and the quality of natural and cultural resources. This "affirmative responsibility" is to be carried out through the "adverse impact determination" process described above. The Department of the Interior's procedures for determining adverse impacts under the CAA are provided in 47 F.R., No. 133, 30226-30227.

Section 169A of the Clean Air Act requires visibility protection for mandatory Class I federal areas. On December 2, 1980, the Environmental Protection Agency (EPA) promulgated regulations (40 CFR 51.300-51.307) that required those states with mandatory Class I areas to submit implementation plans that ensure progress is made toward the goal of the prevention of future and the remedying of existing visibility impairment in these areas. On July 12, 1985, the EPA promulgated federal regulations for visibility, new source review, and visibility monitoring for states that had failed to submit revised implementation plans (SIPs) (50 F.R. 28544).

The Clean Air Act requires the state of Alaska to establish a monitoring strategy for evaluating visibility conditions, baselines, and trends and develop a long-term strategy for making "reasonable progress" toward eliminating all man-made visibility impairment from mandatory Class I areas. Responsibility for this program is assigned to the Alaska Department of Environmental Conservation (ADEC), which has an implementation plan currently in a public review process.

Clean Water Act

The Federal Water Pollution Control Act (P.L. 92-500 and subsequent amendments), more commonly known as the Clean Water Act, was first promulgated in 1972 and has been amended numerous times since then (33 USC 1251 et seq.). This law was designed to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Goals set by the act were to maintain or upgrade waters to swimmable and fishable conditions by 1983 and to eliminate discharges of pollutants into the nation's waterways by 1985. As part of the act, Congress recognized the primary role of the states in managing and regulating the nation's water quality within the general framework developed by Congress. All federal agencies must comply with the requirements of state law for water quality management, regardless of other jurisdictional status or land ownership. States act to protect water quality under the authority granted by the Clean Water Act by establishing water quality standards and issuing point source discharge permits. Water quality standards are composed of designated use or uses made of a waterbody or segment, water quality criteria necessary to protect those uses, and an anti-degradation provision to protect existing water quality. Federal legislation and regulations are

generally implemented by the states, with the EPA serving in an oversight role. The Alaska Department of Environmental Conservation has delegated responsibility for water quality programs. A triennial review of the state's water quality regulatory program is conducted by each state's water quality agency to determine if its standards are adequate to meet federal requirements. These standards are then forwarded to the EPA for approval.

Section 404 of the Clean Water Act further requires that a permit be issued for the discharge of dredged or fill materials in the waters of the United States, including wetlands. The Army Corps of Engineers administers the Section 404 permit program, with oversight and veto powers held by the EPA.

The Safe Drinking Water Act of 1974 [42 U.S.C. 300 (f)-(j)] requires all federal agencies with jurisdiction over a federally owned or federally maintained public water system or injection wells to comply will all federal, state, and local primary drinking water regulations.

Cultural Resources Preservation Law

The National Park Service is required to manage its natural and cultural resources in accordance with prehistoric and historic preservation laws and presidential executive orders and departmental regulations. Major legislative constraints include; the Antiquities Act of 1906 (16 U.S.C 431-433), NPS Organic Act of 1916 (U.S.C. 1 et seq), Historic Sites Act of 1935 (16 U.S.C. 461-467), National Historic Preservation Act of 1966 (16 U.S.C 470), Executive Order 11593 (36 F.R. 8921), Archeological Resources Protection Act of 1979 (16 U.S.C. 470), Native American Graves Protection and Repatriation Act of 1990, and the National Historic Preservation Act of 1980 (94 Stat. 2997).

NPS Management Policies (1988) require park managers to locate, identify, evaluate, preserve, manage, and interpret qualified cultural resources in every park in such a way that they may be handed on to future generations unimpaired. Consistent with the requirements of law, resource managers and professionals at all levels shall take positive action to perpetuate unimpaired the cultural resources of the national park system; to prevent adverse effects on these resources by development, visitor use, or resource management activities; and to prohibit vandalism or unauthorized excavation, collection, or appropriation of cultural resources.

The NPS's Cultural Resource Management Guideline, NPS-28 (1985) expands, clarifies, and applies the legal hierarchy of laws, executive orders, and regulations that provide direction for cultural resource management in the Department of the Interior. This guideline serves as a reference and further source of direction for managers and others involved in the management

and preservation of cultural resources of the national park system. These standards also apply to researchers, consultants, and contractors working for or with the permission of the National Park Service.

National Environmental Policy Act

The National Environmental Policy Act of 1969 [42 U.S.C. 4321 et seq. (1988), 83 Stat. 852 PL 910190] declared a national environmental policy, created a formal, legal process for integrating environmental values into federal decision making, and provided an umbrella under which compliance with several environmental laws can be integrated. It specifically directs Federal agencies to "... include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement on the environmental impacts of the proposed action, any adverse environmental effects which cannot be avoided should the proposal be implemented, and alternatives to the proposed plan."

The act requires the federal government to use all practicable means to preserve important historic, cultural, and natural aspects of our national heritage and "... to maintain, whenever possible, an environment which supports diversity and variety of individual choice." It acknowledges the value of research and promotes efforts that will enrich the understanding of ecological systems.

Title II established the Council on Environmental Quality, which developed the legal procedures (40 CFR 1500-1508) that all federal agencies must follow in examining the environmental effects of proposed actions. These procedures involve three levels of documentation: (1) categorical exclusions; (2) environmental assessments; and (3) environmental impact statements. In the National Park Service, construction activities, natural or cultural resource management projects, actions on proposals such as mining plans of operation, and park plans trigger the majority of NEPA documents.

NEPA provides the National Park Service with many benefits. It enables the Park Service to integrate compliance with other legal mandates such as the Endangered Species Act, floodplain and wetland requirements, and Section 106 of the National Historic Preservation Act. It provides a format for public involvement and considering the viewpoints of outsiders. It enables the National Park Service to build a record in defense of park resources and policies and clear up confusion about policies in a public forum. NEPA also provides the National Park Service an opportunity to participate in the development and review of other agencies' NEPA documents when lands adjacent to parks are involved or when the National Park Service has review responsibilities as an agency with jurisdiction or expertise in recreation, land management, and

historic preservation.

Floodplain and Wetland Management

Executive Orders 11988 for floodplains and 11990 for wetlands (both signed by President Carter on May 24, 1977) and National Park Service floodplain management and wetland protection guidelines (USNPS 1993), which implement the Executive Orders, require that park managers recognize and preserve floodplain values, minimize hazardous conditions associated with flooding, and comply with federally mandated laws and regulations related to floodprone areas. These executive orders require proper consideration of the effects of dam safety and operation on floodplains in NPS administered areas.

The U.S. Army Corps of Engineers must approve any project that might affect the course, flow, cross-section, or sediment load of any navigable streams or protected waters in the park. Activities that are affected by these requirements include, but are not limited to, filling, excavation, structures, water level controls, bridges and culverts, intakes and outfalls, drainage, and alterations of protected waters for mining.

Miscellaneous Acts and Executive Orders

In 1973, President Richard Nixon issued Executive Order 1175 (38 F.R. 34793-34797) instructing the federal government to provide leadership in the effort to protect and enhance the quality of our air, water, and land resources through compliance with applicable standards for the prevention, control, and abatement of environmental pollution in cooperation with state and local governments.

The Resource Conservation and Recovery Act (RCRA) of 1976, an amendment to the Solid Waste Disposal Act, is the primary law that governs the management of solid and hazardous waste. RCRA's application to federal facilities was strengthened through the Federal Facility Compliance Act of 1992. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 contains significant provisions for reporting releases of hazardous substances and achieving site remediation. The National Park Service is required to meet certain standards established in each of these laws and can utilize their legal provisions in the protection of park resources.

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as Amended, and the Federal Environmental Pesticide Control Act of 1972 provide the broad framework for the manufacture and regulation of pesticides. Provisions of these acts that apply to the National Park Service include applicator certification, recordkeeping, storage and disposal, and so forth. Integrated

pest management operations are required to comply with those provisions and those set forth by the Alaska Department of Environmental Conservation under delegated authority from the Environmental Protection Agency.

Further direction on the handling of hazardous and toxic substances was received via Executive Order 12856 (August 3, 1993) titled Federal Compliance with Right-to-Know Laws and Pollution Prevention.

In 1977, President Jimmy Carter issued Executive Order 11987 Exotic Organisms, which directs Federal agencies to restrict the introduction of exotic organisms into the natural ecosystems on lands and waters of the United States.

Executive Order 12003 (July 20, 1977) and Secretary of the Interior Order 3007 direct the National Park Service to wisely use energy by applying sound ecological and management principles. However, natural ecosystems or cultural values are not to be degraded to provide energy for human enterprises.

Wilderness Designation and Recommendation

ANILCA (Section 701) designated most (2,124,783 acres) of the former Mount McKinley National Park as a wilderness under the Wilderness Act of 1964 (78 Stat. 892). This act defines wilderness:

> ... as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain...an area of undeveloped Federal land retaining its primeval character and influence...so as to preserve its natural conditions...generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable...

Section 1317(a) of ANILCA directed that a review be conducted of the suitability or nonsuitability for preservation as wilderness of all lands within the unit not so designated by the act. That study revealed that roughly 3.9 million additional acres were potentially suitable for designation at Denali. A Wilderness Recommendation and EIS were issued in 1988. Four alternatives for wilderness designation, ranging from no additional wilderness to near-total wilderness, were presented and their environmental impacts assessed. The National Park Service proposed the designation of 2,254,000 acres (60 percent of the park's wilderness suitable lands) as wilderness.

In 1988, the final wilderness recommendation was transmitted to the secretary of the interior by the director of the National Park Service. As of present (1998), a final wilderness recommendation has not been transmitted to Congress.

Both the wilderness designation and the wilderness proposal have direct bearing on resource management programs by helping to formulate limits of acceptable change and by limiting certain administrative activities.

ANILCA also authorized certain uses within the designated wilderness. Uses not normally allowed under the Wilderness Act include access via snowmachines, boats, and aircraft, maintenance and operation of public use cabins, and taking of wildlife. However, through ANILCA authorization these uses are permitted in the Denali Wilderness if they are traditional and as long as they do not cause resource damage. Such uses, including access and taking of wildlife, are not considered issues in the designated wilderness at Denali because the service does not consider them to be traditional.

Biosphere Reserve Designation

Denali National Park and Preserve is also a designated biosphere reserve under the United Nations Educational and Scientific and Cultural Organization (UNESCO) Man and the Biosphere Program. The purposes of biosphere reserves are to assure there are worldwide protected areas where long term ecological research will be possible on natural processes to compare with human altered areas and to assure protection of genetic diversity (UNESCO 1971).

Research conducted at Denali should be within the context of the biosphere reserve designation.

National Park Service Policy and Guidelines

Resources management activities within the National Park Service are also guided by management policies and a variety of guidelines on subjects such as natural and cultural resources, NEPA compliance, fire management, mining and minerals management, and so on.

Park Management Zones

Denali National Park and Preserve has been divided into four management zones to ensure that proposed developments, recreational uses, and resource management practices are mutually compatible and in keeping with optimal use capabilities of the area in question. They are the natural, historic, park development, and special use zones. The zones are described and mapped in the park's general management plan (USNPS 1986). Almost 98 percent of the park is

designated as falling within a natural zone. The Entrance Area and Road Corridor Development Concept Plan (USNPS 1997) resulted in further delineation of the "development zone" into numerous subzones and suggests the application of the Visitor Experience and Resource Protection Program (VERP) to protect park resources. The three remaining zones will not be modified.

Management zones are useful in determining the priority of consideration of various resource values when deciding the nature of resource management activities.

Adjacent Lands

Other federal, state, and borough agencies are responsible for natural resource management on lands adjacent to Denali National Park and Preserve. In many cases, these other land management agencies are mandated to allow a variety of uses that are not legally allowed on National Park Service lands. A substantial portion of the resource management program presented in this plan is devoted to cooperatively working with these agencies to maximize the benefits to the park from their management actions.

Private Land and Retained Use and Occupancy Rights

The park's land protection plan (USNPS 1986), affirms the intent to acquire surface rights to most categories of privately owned lands within the authorized boundaries of the park. Mineral properties will also be acquired when new mining activities may introduce development into previously undisturbed areas. Land acquisition is to be accomplished through willing buyer-willing seller relationships. Retained use and occupancy agreements may be negotiated. As of 1996, approximately 853 acres had been acquired.

Mining on valid existing claims is authorized in the park provided a mining plan of operations has been submitted, reviewed, and approved. The mineral rights themselves cannot be "taken" legislatively without compensation. Should holders of valid rights wish to dispose of those rights, they would have to be compensated for the fair market value of the right. Accordingly, the park's land protection plan (USNPS 1986) approves the acquisition of outstanding mineral rights. In 1997, legislation was passed by Congress that permits the taking of claims with claimant consent and subsequent negotiation for compensation. Actions under that legislation are so recent that results are not yet available.

D. Context and Themes

Natural Resource Context and Themes

Introduction

The legislative mandate and administrative history of Denali National Park and Preserve set the context for the management of natural resources and the development of the major themes that focus the activities of the Division of Research and Resource Preservation. The themes presented in this subsection describe Denali's importance to the nation's natural resource heritage and the reasons for its international significance. They reflect the significant resources and values for which Denali National Park and Preserve is consistently recognized as contributing to society.

These themes are also consistent with the direction for park management that is found in important planning documents such as the 1997 Park Strategic Plan, the 1986 General Management Plan (GMP), the Entrance Area and Road Corridor Development Concept Plan, and the South Side Development Concept Plan, which are derived from the park's legislative mandate and interaction with the public.

These themes provide insight into the vision for park resource conditions and justification for action. Project statements and the recommended actions contained in this resources management plan should be viewed in the context of these themes. Several statements or actions may be associated with one theme. The themes will also help to guide the prioritization of the many proposed actions.

Themes

Intact and Naturally Regulated Subarctic Ecosystem

Denali provides virtually the only intact and naturally regulated subarctic ecosystem in the world because of its long history of protection and substantial size. Developing an understanding of this system through research and long term monitoring as well as preserving its integrity by scientifically sound protection, mitigation, and interpretation actions make up the largest portion of the resource management activities outlined in this document.

Denali is important because the composition, structure, and functioning of the ecosystem is still in a natural condition. Present information indicates that significant species removal has not

taken place, and that populations still retain their natural structure and relationship to each other. Landscape scale processes such as fire, succession, and outbreaks of disease or insects are not thought to be significantly altered over large areas of the system. These components and processes of the system are still responding naturally to other primary processes such as weather or geologic events.

Special emphasis must be placed on wildlife components of this system, in particular the large mammal predator and prey relationships. The legislative mandate for the park clearly places added responsibilities on management to develop an understanding of and protection for this subset of the entire system. Research at Denali has contributed significantly to sound management of these large mammal species. Providing continued outstanding opportunities to view this intact system, especially wildlife in an overpowering wilderness landscape, is also an important aspect of this theme.

Vegetation and Wildlife

The vegetation of Denali is diverse because the park straddles the Alaska Range, which forms a major divide between the maritime climate on its southern flanks, and the shorter growing season with a drier, more continental climate to the north. Also, on the north side of the Alaska Range, major seismic faults and glacier systems both past and present have created a complex topography of ridges and valleys at the elevation of treeline. This extended subalpine zone with its mixed topography creates a mosaic of habitat types that brings together many plant species in one area.

A similar situation exists for the faunal composition of the park. The northern and southern regions of the park harbor different densities or even different species, creating different issues and management concerns.

Geologic Resources on a Grand Scale

Denali contains a major portion of the Alaska Range, which is one of the great mountain uplifts in the world. Towering 18,000 feet above the adjacent lowlands, Mt. McKinley, North America's highest peak, rivals the vertical relief of the worlds greatest mountains. The Denali Fault is North America's largest crustal break and is an area of significant seismic activity. The park encompasses a complex and diverse geology, which includes the Mt. McKinley massif and the Central Alaska Terrane Assemblage. A range of glacier types that includes some of North America's longest, also provide special opportunities for the study of global climate change. This spectacular landscape is world renown for its scenic qualities as well as providing significant information for studies of the earth's geologic

processes.

Pristine Air Quality and World Renown Scenic Vistas

Denali National Park and Preserve is the only class I air quality area of significant size in Alaska. On a clear day, Mt. McKinley can be easily seen from Anchorage, more than 130 air miles to the south. Outstanding views of natural features dominate the park landscape and are internationally known.

Because of its unique status in the continental portion of this 375 million acre state, ambient air quality monitoring is important in Denali to document baseline conditions and track long term trends. This is especially important because one of the most serious long term threats to air quality in interior Alaska originates outside the state, and even outside the North American continent. Air pollution transported primarily from Eurasia can form a visible haze in remote areas of arctic and subarctic Alaska. Its presence in Denali, a high profile visitor destination, could bring attention to this international environmental problem.

A Special Opportunity for Research and Long Term Monitoring

Denali presents special opportunities for research and long term monitoring due to its significant natural, cultural, and subsistence resources, and its ready accessibility. It is unusual when compared to other park areas in the subarctic because of its long research history and data sets, which span decades. As a result, there is a long term context for modern research that is impossible to obtain elsewhere.

The 1980 ANILCA park and preserve additions, the biosphere reserve designation, and the adjacent Denali State Park have all helped to create a land protection structure and mandate that is conducive to research. A protected core of the former Mt. McKinley National Park is now surrounded, for the most part, by a gradation of lands where varying degrees of human uses such as subsistence and sport harvest are allowed. This provides the potential for important comparative studies on the response of the ecosystem to a variety of human uses and use levels.

Denali has a substantial support infrastructure that is not present in other subarctic park areas. Road access, accommodations, administrative services, and aircraft support enhance the opportunity to conduct large scale, collaborative, interdisciplinary studies. Denali's participation in important national programs such as its designation as a prototype for the development of long term ecological monitoring also creates special situations that encourage research.

An Accessible Alaska Wilderness Recreation Opportunity

One of the special values of Denali is that an overpowering feeling of wilderness is still available to all types of users. Visitors of all physical abilities may travel the Park Road and pass through a rugged wilderness area that lacks the visual intrusion of extensive facilities. They can observe at close range both wildlife in its natural wilderness habitat and world class scenery. The premier vistas and opportunities for solitude in the park are consistent with the wilderness setting that visitors expect of our Alaska parks.

For the backcountry traveler, Denali is a very accessible wilderness by Alaska standards because of the road corridor and bus transportation; but its lack of maintained trails, signs, bridges, and designated camps creates a challenging, self-reliant, and exploratory wilderness experience. World class climbing opportunities are easily available as well. On a spectrum of opportunities in national park system wilderness areas, Denali lies midway between the backcountry areas of the contiguous 48 states' national parks, where multiple trails, signage, and visitor facilities exist, and the more remote Alaska parks, like Gates of the Arctic, that provide little or no road access. Denali also differs from Gates of the Arctic in that aircraft and snowmachine access are generally non-traditional and seldom used in the original Mt. McKinley parklands.

Protecting Denali's special balance of access and wilderness is a difficult management challenge that requires a strong focus in both routine park operations and long term planning.

Cultural Resource Context and Themes

Introduction

One need that transcends cultural resource categories is the identification and development of contexts (themes) that are illustrated by the park's cultural resources. Themes provide for meaningful and understandable interpretation of resources and facilitate the legally mandated process for evaluating cultural resources such as assessing eligibility for the National Register of Historic Places. They also provide insight into the vision for park cultural resource conditions and justify specific actions.

Past management reports have noted the usefulness of themes in determining and interpreting cultural resources, but have stopped short of actually identifying and describing them. The

NPS provides a framework of very broad themes to aid in addressing National Register significance. The current version of this framework (revised in 1993) offers some broad universal themes (some of which are referenced below), but a formal thematic framework relating these to Denali's unique resources and history has not been formulated.

Several sources of information touch on historical themes. One of the stated purposes of the Denali Historic Resource Study (HRS) was to develop historic themes. Volume I of the HRS, an historical narrative (Brown 1993), outlines major historical eras/events and Volume II, now being prepared by Alaska Support Office (AKSO) staff, will contain national register evaluations for historic resources. The resources documented in the Cultural Resource Mining Inventory and Monitoring program report (Saleeby in progress) will provide a basis for characterizing themes relating to historic mining sites. Cultural landscapes, once identified and developed for the park, will also illustrate some of the park's important cultural and historical themes.

For archeological resources, the lack of developed themes is due, in part, to the preliminary level of knowledge of the resource base. Since most known sites lack sufficient detail to characterize site function, age or cultural affiliation, themes are either hypothetical or tied to some very basic themes common to most prehistoric sites.

On a very limited level, based on existing reports and assessments, the following addresses some of the key themes in Denali's cultural history. The full exploration of themes will be facilitated by additional baseline data and an initiative to develop themes (Program Management Project Statement DENA-C-100).

Themes

Traditional Times

The oldest cultural theme in the park's human history is the close relationship between humans and the natural environment that characterizes prehistoric and later traditional Native lifeways. A number of subthemes grow out of this relationship. Cultural adaptation to the environment, whether in response to a major environmental change like the close of the Pleistocene, or regular seasonal change, can be seen in all aspects of life; technology, subsistence, settlement, and social organization. Cultural resources associated with this theme include the park's recorded prehistoric sites assumed, for lack of more detailed information, to be remnants of camps of seasonal mobile hunters, and other traditional Native cultural landscapes and subsistence sites.

Early Exploration

From the earliest recorded historical accounts, Denali has attracted explorers with different purposes. Their interaction with the mountain and surrounding region is illustrated in historical accounts and modifications of the landscape. As described in the historic resource study: "The Denali region beckoned to prospectors, mountaineers and engineers. Hunters, naturalists and artists would follow....despite their diverse callings, the second wave of pilgrims, like the first, would fall under the spell of this marvelous region. Purposefully or otherwise, they would all contribute to its dedication as a public treasure, a place of perpetual discovery" (Brown 1993:27). Cultural resources associated with this theme are as diverse as the explorers themselves. Well documented mining sites, mountaineering camps and trails, including the base camp of the Sourdough expedition.

The Mountain

The HRS identifies the "Challenge of the Mountain" as a major theme in the park's history. This theme includes the history of mountain climbing in the park from the early adventurers to modern day. Cultural resources associated with this theme include the base camp of the Sourdough expedition. The park's museum collection includes objects and archival materials that document early mountaineering.

Mining

As in other regions of Alaska, Denali's brief gold rushes (1903 - 1907) brought a sudden influx of people and changed the region. Mining operations, cabins and communities (Glacier, Roosevelt, Eureka) appeared and were quickly abandoned. Unlike other areas that could be accessed by major rivers, Denali's mining areas were remote and spotty, making them difficult to access and work. When the stampedes died down, a core of miners remained behind, living a lifestyle characterized by hard work, hope, and hospitality. Many prospectors and miners eventually turned to trapping. During World War II, Stampede was the nation's second largest supplier of antimony, an important mineral in military construction. Interest in mining continues up to the present day. A large proportion of the park's cultural resources are mining related sites and structures. These are documented as historical structures and as historical archeological sites.

Establishment of Denali National Park

Established in 1917, Denali is one of the nation's earliest national parks. As part of the national park system, Denali's growth and development illustrate the emergence of a

conservation ethic and the value that the American people put on wilderness. This theme is illustrated by the key figures and events in the park's creation and history, the Denali Headquarters Historic District and the patrol cabins, and many artifacts and archival material.

Access

Limited access, at first due to the park's remote location and later due to its management as a national park, has been key to the protection of significant resource values and park popularity with visitors, researchers, and residents. Related to the theme of access are various transportation themes. Traditional Native routes and trails, the railroad, the park road, dog mushing, air travel, mining development, the Alaska Road Commission and tourism all have potential to be developed as historical themes.

Subsistence Resource Context and Themes

Introduction

The harsh interior climate and the rugged terrain of the Alaska Range have influenced human activity in this region for many years. While some have chosen to live in this area, most have preferred to inhabit areas where the climate is less hostile, where the terrain is more conducive to travel, and where consumable resources are more abundant. These environmental factors have had a direct bearing on subsistence use of natural resources in and around the park. Denali's subsistence program is modest in size, but quite active. Neighboring communities engaged in subsistence activities within the park are few and none is particularly large. Individuals who live outside of those communities, but who qualify as subsistence users, are also few. The resources consumed by these people are also determined largely by the overriding environmental factors. For instance, fish resources are not a particularly important subsistence resource in Denali because their numbers are limited in and around the park.

Themes

Wildlife Harvest and Use

The main subsistence species hunted in the new sections of Denali National Park and Preserve are moose, caribou, ptarmigan, spruce grouse, and hare. In general, black and grizzly bears are not actively hunted, but are taken when they pose a threat to life or

property, incidental to other hunting, or when other meat is not available. Large mammals account for 70% of the resources used and are typically hunted in the fall or early winter.

Trapping and bartering of furbearing mammals, for subsistence purposes, has long been a customary and traditional activity for Native peoples and other park area residents. After Russian and American contact, trapping, trading and selling of furbearers became a significant socio-economic activity for both Native and non-Native subsistence users. In northern regions of Denali, traplines and winter travel in pursuit of furbearers can be extensive in distance and duration, which generally necessitates use of shelters, caches, and maintenance of winter trails. Traplines in the southern region tends to be more proximate to communities and operate without shelters.

Marten, mink, red fox, wolf, lynx, weasel, wolverine, land otter, beaver, muskrat, and coyote are important species that are trapped. Trapping seasons generally open in early November and continue through February.

Species harvested are used largely for food, as materials for clothing and other household items, and for sale or trade.

Timber Resources

Subsistence use of timber resources include construction of cabins, caches, smoke houses, dog houses, and as frames for tents. Timber resources are also used as a fuel for heating and to dry and smoke fish. Wood is also used in the construction of dog sleds, fish drying racks, fish wheels, and snowshoes.

These uses can be categorized as those that support other subsistence practices (hunting, trapping) or those that generally support a subsistence way of life (use of wood as a source of heat).

Other Subsistence Resources

Individuals who lead subsistence lifestyles make full use of natural resources to sustain themselves. Therefore, practices like gathering and consuming berries and mushrooms, use of vegetative material as chinking in cabins, and the use of stones in construction or as tools are common and generally regarded as customary and traditional.

E. References Cited

Bailey, R.G. 1996. Ecosystem geography. Springer-Verlag. New York, New York. 204pp.

CFR. 1992. Code of Federal Regulations. Office of the Federal Register National Archives and Records Administration. U.S. Government printing office, Washington, D.C.

Gallant, A.L. et al. 1995. Ecoregions of Alaska. Professional Paper 1567. U.S. Geological Survey. Denver, Colorado. 73pp.

General Accounting Office. 1994. Activities outside park borders have caused damage to resources and will likely cause more. GAO/RCED-94-59. Washington, DC. 34 pp.

Grant, Madison. 1925. The establishment of Mount McKinley National Park. In: Hunting and Conservation. The Boone and Crockett Club, 1925, Yale University Press. 548 pp.

Saleeby, B. In progress. Cultural resource mining inventory and monitoring program. U.S. Department of the Interior, NPS, Alaska Region. Anchorage, Alaska.

Shelton, N. and L. Fox. 1994. An introduction to selected laws important for resources management in the National Park Service. Natural Resources Report NPS/NRPO/NRR-94/15. National Park Service, Washington, D.C.

UNESCO. 1971. International coordinating council on the program on man and the biosphere (MAB) first session, Final Report. Paris, France. 65 pp.

USNPS. 1986. General management plan, land protection plan. U.S. Department of the Interior, NPS, Denali National Park and Preserve. Denali Park, Alaska. 231 pp.

USNPS. 1988. Management policies. Washington, DC.

USNPS. 1993. NPS floodplain management guidelines. Water Resources Division, National Park Service, Fort Collins, Colorado.

USNPS. 1995. Statement for management. U.S. Department of the Interior, NPS, Denali National Park and Preserve. Denali Park, Alaska. 63 pp.

USNPS. 1997a. Strategic Plan. U.S. Department of the Interior, NPS, Denali National Park and Preserve. Denali Park, Alaska. 54 pp.

USNPS. 1997b. Entrance area and road corridor development concept plan. U.S. Department of the Interior, NPS, Denali National Park. Denali Park, Alaska.

USNPS. 1997c. South side development concept plan. U.S. Department of the Interior, NPS, Denali National Park. Denali Park, Alaska.

PRESENT RESOURCE STATUS

Part Two: Present Resource Status

Introduction

In Part One of this document the legislative and administrative (including context and themes) information was provided in an effort to describe some aspects of driving forces behind proposals in this plan. Part Two builds on those aspects by providing a description of the level of understanding of park resources and an assessment of their condition. These are additional factors considered in preparing the proposals for action contained herein.

A. Natural Resource Baseline Information

In 1992, the service issued guidelines for resource inventories and monitoring (USNPS 1992). That guideline established a minimum level of resource information that should be available in all natural resource parks. This is referred to as Level I information and emphasizes gathering historical records or capturing synoptic information. Examples include natural history observation records and one time surveys. Level II information is derived from routine monitoring (ie. annual moose surveys, Christmas bird counts), while Level III is generated by intensive research or very sensitive monitoring (ie. predator/prey and nutrient cycling studies). Reference is made to these standards throughout this section.

Historical Database

A large body of extremely valuable resource data is available for Denali National Park and Preserve due to the long history of research and management activities in the area. Data is in the form of field notes, maps, photographs, reports, data sheets, and automated databases. Approximately 500 studies and monitoring programs are known to have been completed or are ongoing. Denali receives constant requests from researchers, Alaska Support Office staff, planners, and park managers for this information. Unfortunately, the extended time span of this record means that the information is poorly organized and exists in a variety of incompatible formats. As a result, it can only be accessed with great difficulty and limited thoroughness.

Much of that information focuses on relatively few species and is limited in geographic scope. Resources in major portions of the park remain undocumented, as do certain types of resources throughout the entire park. Inventory voids exist for invertebrates, fungi, soils, ground and surface waters, and geology. Additions to federal land holdings made in 1980 are woefully under-documented. Furthermore, what information is available is disorganized, prepared in different forms, mapped at different scales, and stored at different physical locations. Limited automated systems for information storage and retrieval exist, but manual methods are frequently used, resulting in handling that can be extremely cumbersome and time consuming. The quantity of information contained on maps often exceeds the ability to effectively manage and

analyze it.

These same deficiencies now prevent incorporation of information into Denali's resource management planning efforts and the Long Term Ecological Monitoring Program. An understanding of this historic information is urgently needed to help guide the direction of these programs and prevent duplication or omissions of it in planning and management.

Information management is becoming increasingly important for the protection and management of park resources. Quantities of new information are being generated at an overwhelming pace. The threat of loss of historical information increases with the passage of time. Park resource managers and scientists can greatly improve responses to management questions if information is well organized and current.

Under the auspices of the Servicewide Inventory Program, the park began participating in a bibliography development project in 1994. The bibliography was completed in 1997. While this project provides a foundation for information management activities, many tasks remain. Additional short term, project-oriented funding will be needed to:

1. Compile and synthesize historic resource information to facilitate its retrieval and use.
2. Organize existing automated data to facilitate its access and use.
3. Organize recently acquired technical library material to facilitate its use.
4. Take steps to communicate results of the project to scientists and other resource managers.

Species Information

Baseline information collection for biologic species is attempting to meet the objectives of a Level II level of effort as defined in the NPS Inventory and Monitoring Standards and Guidelines. The objectives of this level are to:

- Collect quantitative data necessary to develop long-term management plans.
- Study population dynamics.
- Begin to integrate data contributing to the understanding of community structures and dynamics.

Though this cannot be said to apply to all species, as a generalization the effort devoted to this area of collection exceeds the minimal effort described as a Level I.

Species Lists

A variety of park species lists are available as popular publications (bird and mammal checklists), technical lists (plants, birds, and mammals), and automated databases (Automated National Catalog System (ANCS), NPFAUNA, NPFLORA, NPLICHEN. While these may serve as a starting point for identifying the presence of species in the park, each source has associated confounding factors. For instance, some of the lists have no documentation to support inclusion on the list. In another case, a technical list of plants identifies the specimens in the park herbarium, but some of those specimens were collected beyond park boundaries.

Clearly the park plant list is incomplete; and other categories of species lists, such as invertebrates, are fragmentary due to insufficient survey work and synthesis from existing studies.

Biological Field Inventories

To date, the service has supported very few projects at Denali specifically aimed at documenting the presence of species or general resource conditions. Most service-sponsored investigations and documentation have focused on specific issues like predation, wildlife population declines, backcountry impacts, and human disturbance of wildlife or have been severely limited in geographic scope. Certainly partial inventories can be and have been byproducts of these studies. Where baseline information can be gleaned from existing sources, time is needed to accomplish that task and to organize that data in a systematic manner.

Investigations completed through cooperative efforts provide a much broader coverage of species inventory. For instance, about 20 individual studies of park invertebrates have been completed. Most of those appear to have been biological surveys; but no effort has been made to synthesize the information derived from the work to determine what study objectives were, to develop a species list, to identify under-represented taxonomic groups, or to assess the geographic or ecological completeness of the efforts.

Some baseline information can certainly be derived from studies with objectives that do not include inventories, but some cannot be. In those cases, funds need to be sought to allow contracting for inventories.

The park staff has supported inventory efforts on fungi of the park and anticipates significant inventory efforts stemming from the Servicewide Inventory Program. Park staff has also supported collection of natural history observations, and many years of data have been collected but not automated or analyzed.

Resource inventories can be conducted in a variety of ways. Species lists can be developed to indicate presence/absence, seasonality, and/or relative abundance. Voucher specimens,

photographs, or narrative descriptions of observations can be accumulated. Phenological descriptions and behavioral observations can be recorded. Beyond what is proposed in the Servicewide Inventory Program, it is unclear exactly how park staff will conduct baseline inventory projects. Strategic planning needs to be done. Given the vastness of the park/preserve, it is also imperative that rapid resource assessment techniques be established for the park. The park will develop inventory information that will meet the minimum recommendations as outlined in NPS-75, Natural Resources Inventory and Monitoring Guideline. As circumstances allow, more detailed inventory information will be accumulated. These various levels of intensity would be discussed in the strategic plan contemplated here.

Vegetation Maps

Efforts to map the vegetation communities at Denali have been ongoing for more than 10 years. Dean and Heebner (1982) used geographic information system (GIS) and remote sensing technology to map vegetation types in the Denali National Park region. Heebner's (1982) master's thesis was part of a study to develop baseline descriptive information on plant communities in the park, to provide reference data for interpreting Landsat spectral class information, and to assist in calibrating the resultant maps. Sample plots were chosen to represent a broad continuum of conditions from the complex terrain and vegetative cover types present on the study area. Both the north and south sides of the Alaska Range were represented, and cover types ranged from alpine scree to taiga. Fifty-nine community types were described in the study area, ranging from black spruce bogs to open mat and cushion tundra.

More recently, efforts have been directed at developing a landcover map for the entire park using remote sensing information. This effort is part of the Servicewide Inventory initiative to develop nominal base cartography layers for each park. Ground truthing data have been collected by crews that were supported by the Normal Fire Year Program (FIREPRO). Imagery is to be collected using orbital sensors. Completion of this effort will meet the Level II inventory standard. To date, these efforts have been stymied by the inability to collect cloud-free images of the park.

Fuels mapping should be completed once the landcover/vegetation map is completed.

Wildlife Habitat/Distribution Maps

Mapping of wildlife habitat and distribution has been going on within the park since its establishment. Most of these efforts have been confined to the larger mammals and very little information has been recorded for small mammals. The information that exists for large mammal populations within the park is spread among numerous reports, field notes, and the occasional paper map. Some digital telemetry location information is available, but a synthesis of this data does not exist in digital map format at the park. Because distribution information is scattered among numerous documents, it is difficult to analyze as a whole.

Geophysical Information

Geophysical Inventory primarily meets the objectives of a Level I effort which are to:

- Develop basic information necessary to characterize Park Service sites.
- Establish reference materials important to research and monitoring projects in other categories.

A Level II effort is reached in some areas, most notably meteorological and air quality monitoring.

Water Resources Inventory

Denali's surface and subsurface water systems are immense; however, existing inventory of water resources in the park is limited in scope and extent. Qunatifiable data regarding seasonal water quality and quantity relationships are also limited. A GIS layer of the park's hydrography exists, which is based on blue line representations of streams and rivers on USGS quad maps. Many of the maps from which the streams were digitized are out of date and inaccurate. For example, braided river channels shown in the hydrography often have no resemblance to current channel locations or conditions. The scale of the original maps (1:63,360) is too great to provide much accuracy.

Lakes larger than 100 acres are also included in the hydrographic layer. However, hundreds of smaller lakes and kettle ponds are found throughout the park, but are not inventoried in any database. These smaller lakes have numerous important functions, including areas for waterfowl nesting and rearing habitat.

Other related inventories include a database of all park glaciers, which was compiled in 1995. Descriptors, including the location and areal extent of each glacier, are included in the database. Due to lack of data, there is no inventory of subsurface aquifers within the park.

Water Chemistry/Quantity Stations and Data

Baseline water quality collection occurs at the Level I effort, and the large geographic extent of the park requires that the effort be expanded to present a more representative indication of park water quality. Only limited databases exist for water quality, stream discharges, or lake levels for most of the park. Occasional studies were made in the past 20 years, but most have focused on the Kantishna Hills district. The Water Resources Division (WRD) of the National Park Service conducted an inventory and analysis of the baseline water quality data for the park as of June 1995. The resulting document presents the results of surface-water-quality data retrievals for the park from five of the United States Environmental Protection Agency's (EPA)

national databases: (1) Storage and Retrieval (STORET) database management system; (2) River Reach File (RF3); (3) Industrial Facilities Discharge (IFD); (4) Drinking Water Supplies (DRINKS); and (5) Flow Gages (GAGES). The document provided: (1) a complete inventory of all retrieved water quality parameter data, water quality stations, and the entities responsible for the data collection; (2) descriptive statistics and appropriate graphical plots of water quality data characterizing annual and seasonal central tendencies and trends; (3) a comparison of the park's water quality data to relevant EPA and WRD water quality screening criteria; and (4) an Inventory Data Evaluation and Analysis (IDEA) to determine what Servicewide Inventory and Monitoring Program "Level I" water quality parameters have been measured in the study area.

Currently, one watershed (Rock Creek near headquarters) has an ongoing data collection study including water chemistry and discharge. The USGS operated a gauging station on the Teklanika River from 1965 through 1974, from which daily discharge data is available. Bedload studies were conducted on the Toklat River in 1988 and 1989. Bedload studies have also been conducted on the Teklanika and East Fork Rivers.

For the past several years the park has conducted a water quality monitoring effort on a number of selected water bodies throughout the park in order to develop a set of baseline data describing the physical and chemical conditions of surface waters. Analysis was done in both the field and in the laboratory. Field measurements included pH, electrical conductivity, total dissolved solids, dissolved oxygen (DO), temperature, and stream discharge. Laboratory analyses were performed for pH, electrical conductivity, chloride (Cl), nitrate nitrogen (NO_3-N), sulfate (SO_4), calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), ammonium (NH_4), dissolved organic carbon (DOC), alkalinity, turbidity, and suspended sediment.

Almost no information is known regarding the presence or quality of subsurface aquifers in the park. Groundwater availability is limited in northern and central Alaska by permafrost. Much of the park is underlain by discontinuous permafrost, the presence of which is determined by local drainage, topography, and surface insulation. Limited information on soil conditions and groundwater tables exists in the form of well logs from several wells drilled in the headquarters areas, as well as a few others located in campgrounds along the park road.

Hydrologic Maps

Hydrologic mapping that is available at this time is derived from the USGS 1:63,360 scale quadrangle sheets. That information has been provided in digital format as DLG files which are available on the park's GIS. There are several limitations with this data. The source data is more than 40 years old. In the intervening years beaver ponds have been created; braided and meandering streams have changed their course; in one instance as much as two miles. In addition, the resolution of much of the digital data is limited to ponds that are 50 acres or larger.

Geologic Resources Inventory

The service is mandated to preserve and protect those geologic resources in the same manner conventionally afforded to biological or cultural resources. For instance, some park geologic features and processes, especially fragile ones, specifically require inventory and protection (NPS Management Policies 4:19-20).

Geologic resources data for Denali is contained in various reports, bulletins, and other papers and is not compiled in a single location. The data has been developed with narrow purposes such as mineral potential and engineering characteristics in mind. The bulk of the data focuses on the 5 mining districts in the park. No comprehensive geologic database has been developed for the entire park.

Geologic Maps

Geologic mapping (bedrock and surficial materials) forms the basis for important resource themes and issues, and particularly so for water, soils, and vegetation conditions. The status of the geologic knowledge of two-thirds of the park meets Level I inventory requirements per the Inventory and Monitoring Guideline (NPS-75).

Three of the four 1:250,000 USGS quadrangles that make up the park were recently completed and brought in line, concerning the latest stratigraphic correlations and tectonic theory (Csejtey and others, 1992; Reed and Nelson, 1980). The fourth quadrangle, Mt. McKinley, which contains approximately one-third of the park area, including the summit area of Mt. McKinley, has only been reconnaissance mapped and does not meet Level I inventory requirements. This basic lack of information directly affects the agency's ability to protect physical resources. This preliminary work was done in the 1950s (Reed, 1961). The relatively superficial nature of this work and its age represent a significant information gap in the geologic knowledge and overall baseline information about the park. Efforts are currently underway to produce a new map of the McKinley Quadrangle bedrock geology, and a map exists in draft form. Surficial geology maps exist only for the Talkeetna quadrangle.

Baseline bedrock and surficial geologic mapping includes the inventory and identification of paleontological and archeological resources, geologic hazards, and glacier and water resource conditions. These resources, and their associated hazards and risks, would be identified and better understood by the initiation and completion of mapping efforts.

Soils Survey

Soils surveys within the park have only been undertaken on small, local scales as part of construction projects or small scientific investigations. Work on a parkwide soils survey began in 1997 as part of the soils mapping project mentioned below.

Soils Maps

A draft soils map presently exists for a small portion of the park. Soils maps in digital form have recently been acquired for the area immediately south of the park. Efforts are just now starting to develop a soils map for the park as part of the Servicewide Inventory initiative.

Paleontological Resource Inventories

Paleontological resources remain largely unknown.

The bulk of the known paleontological resources within Denali consists of marine macro and micro fossil invertebrates, which are found in Paleozoic and Mesozoic marine sedimentary units. Within the park, more than 60 marine invertebrate fossil localities have been identified in the 1:250,000 Healy Quadrangle (Csejtey et al, 1992); approximately 40 marine invertebrate localities in the 1:250,000 Talkeetna Quadrangle (Reed and Nelson, 1980); and an unknown number of sites reported in the 1:250,000 Mt. McKinley Quadrangle by various authors (Brooks, 1911; Capps, 1940); (Moxham and others, 1953); and (Reed, 1961). No doubt, numerous marine fossil localities in the park are reported in more obscure publications, and many additional park fossil sites have gone unpublished or unreported.

Although the above citations suggest some 150 or more fossil sites within the six million acres of the park, few of these sites have been systematically sampled; nor have attempts been made to maintain detailed stratigraphic control or to evaluate the depositional histories related to their burial or emplacement. Essentially these sites represent brief reconnaissance sampling that, at best, would give basic time signatures to large, undifferentiated rock units. In most cases, even relative time brackets for these undivided or undifferentiated units are missing.

Future additional fossil locality finds are always high probabilities in areas where only cursory reconnaissance level geologic mapping has occurred. The potential for Paleozoic and Mesozoic macro and micro fauna is excellent. Extensive marine sediments, of both deep and shallow water affinities, are largely unmapped and are often lumped with igneous or metamorphic rocks in undifferentiated units, requiring, as a next step, detailed stratigraphic description and age control. Known fossil bearing strata or lithologies are not precision mapped for their surface extent, where additional fossil localities are likely to be found. Geologic mapping and structural relationships at a regional scale (1:250,000) do not provide the detail to systematically expand a paleontological inventory in many locations of the park.

Paleontological Maps

As is indicated in the above paragraph, the information that exists for paleontological resources in the park is quite limited. The same is true for maps of these resources.

Air Resources Information

Meteorological Stations and Data

Meteorological data have been collected in the park since December 1922 when a weather station was established at the former Mt. McKinley National Park headquarters. This has resulted in one of the longest continuous weather records in Alaska. Weather data for other areas of the park are discontinuous with seasonal data collected only sporadically over the years in various locations (Wonder Lake Ranger Station, Eielson Visitor Center, and Stampede Mine). None of this information has been digitized or incorporated in a database and access is difficult and time consuming.

It wasn't until 1993, when the Remote Automated Weather Stations (RAWS) at McKinley River and Minchumina were winterized and six weather stations were installed as a part of the Long Term Ecological Monitoring (LTEM) program, that additional year-round data were collected. Geographic coverage of the park is restricted, however, with eight of the 10 existing year-round weather stations located within two miles of each other, all in the Rock Creek drainage. Very little is known about the weather at higher elevations in the Alaska Range or Kantishna Hills, especially during the winter months or on the south side of the park.

At present, meteorological data are gathered in the park under the following programs:

1. National Weather Service (NWS) Cooperative Network (Park Headquarters)
2. Alaska Fire Service (AFS) RAWS (Lake Minchumina, McKinley River/Slippery Slough, Wonder Lake, Tokositna River)
3. LTEM Program (Rock Creek drainage)
4. NPS Gaseous Pollutant (Ozone) Monitoring Network (Park Headquarters)
5. National Atmospheric Deposition Program (Park Headquarters)
6. Natural Resource Conservation Service (NRCS) Alaska Cooperative Snow Surveys Program (Five snow courses on the north side of the Alaska Range and five aerial snow depth markers on the south side)

Data are also collected as part of individual research projects, such as the Drunken Forest slump (mass movement) near mile five on the park road, and at Denali Pass near 18,000 feet on Mt. McKinley by the Japanese Alpine Club, and in concert with Denali Park Road studies.

Additional meteorological information is collected on lands adjacent to the park by the NWS (Cantwell, Healy, McGrath) and AFS (Telida and Wien Lake).

Designations and Air Quality Related Values

Denali is the only national park in Alaska listed as class I under the Clean Air Act. No air

quality related values have been enumerated for the park.

Alaska's Air Quality Control Regulations describe two integral vistas within Denali. These vistas are Primrose pullout, along the park road, looking east toward Mount Deborah, and the Mile 82 park road pullout looking south toward Mt. McKinley and the Alaska Range.

The state of Alaska also recognizes all class I areas as visibility special protection areas.

Air Quality Stations and Data

The park's air quality monitoring site is located a few hundred yards north of park headquarters.

Weekly precipitation samples are collected and measured for pH and specific conductance under the National Atmospheric Deposition Program (NADP) and sent to a network-operated laboratory to test for Ca, Mg, K, Na, NH_4, NO_3, Cl, SO_4, and PO_4. The site has been operating since June 1980.

As part of the Interagency Monitoring of Protected Visual Environments (IMPROVE) Network, particulate samplers collect two 24-hour samples each week. Samples are analyzed for mass, elemental and organic carbon, SO_2, NO_3, elements Na through Pb, H, N, and PM^{10} mass. Pre-IMPROVE stacked filter units were installed in August 1986, and the IMPROVE samplers have been operating since March 1988.

As part of the National Park Service Gaseous Pollutant Monitoring Network, continuous ozone monitoring was initiated at park headquarters in July 1987 and continues to today.

During summer months, between June 1988 and September 1994, a 35mm camera was used to photograph the view from Wonder Lake toward Mt. McKinley three times a day, qualitatively documenting visibility conditions. This camera will eventually be moved to the Lake Minchumina area to continue documenting visibility conditions.

A nephelometer was installed in November 1995 to test its operation in subarctic winter conditions, and if successful, measure the light scattering properties of air at ambient temperature.

Cartographic Information

With the development of an in-park GIS capability, the availability of digital cartographic coverages (DEM/DLGs, hydrography, roads, trails, etc.) has been greatly improved. In addition, detailed, site-specific maps, focused on areas of past and present mining activities, have been developed in AutoCad format. Efforts are ongoing to convert to digital, geo-referenced format, data that may exist in paper map or other forms. A list of needed layers has been

developed and existing analog information is being incorporated into the database.

Ecological Modeling and Process Understanding

With a few exceptions, minimal effort has been expended by park staff or cooperating investigators to identify ecosystem components, component interactions, and ecological processes that are occurring in and around Denali National Park and Preserve. Certainly rudimentary understanding of "system drivers" such as the influence on the Alaska Range, fire, and glacial dynamics are recognized; and extensive studies on large mammal predator/prey relations are ongoing. Despite this understanding and these studies, additional modeling efforts and process studies should be undertaken to fully understand the status of park resources.

Environmental gradients, such as elevation, aspect, slope, climatic conditions, lightning frequency, length of time since last disturbance, and type of disturbance are vital to understanding ecosystem processes. It is therefore imperative that monitoring and research studies are conducted that document these conditions as well as the more traditional resource inventory information.

Summary of Baseline Information

Table 1 provides a subjective analysis of the adequacy of baseline information for each of the aforementioned natural resource categories. In general, species, air quality, and cartographic information meet the Level I standard. Higher standards are not met and information available for geophysical resources does not meet Level I standards.

Table 1.

SUMMARY
NATURAL RESOURCE BASELINE INFORMATION

Inventory Components	Level I*	Level II*	Level III*
Historical Database	Adequate	Adequate	
Species Information	-------	--------	---------
Species List	Adequate	Inadequate	
Biological Field Inventories	Adequate	Inadequate	
Vegetation/Landcover Map	Adequate	Inadequate	
Wildlife Habitat Map	Inadequate		
Geophysical Information	-------	--------	--------
Water Resources Inventory	Inadequate		
Water Chemistry/Quantity	Inadequate		
Hydrologic Maps	Inadequate		
Geologic Resources Inventory	Inadequate		
Geologic Maps	Inadequate		
Soils Survey	Adequate	Inadequate	
Soils Maps	Adequate	Inadequate	
Paleontological Resources	Inadequate		
Paleontological Maps	Inadequate		
Air Resources Information	---------	--------	---------
Met Stations and Data	Adequate	Inadequate	
Air Quality Values	Inadequate		
Air Quality Stations	Adequate	Adequate	
Cartographic Information	---------	--------	--------
Topography	Adequate	Inadequate	
Boundaries/Land Uses	Adequate	Inadeqaute	
Ecological Model	Inadequate		

* Explanation of Standards:
Level I - historical records, synoptic information
Level II - continuous, general monitoring
Level III - intensive research, sensitive monitoring

B. Natural Resource Conditions

Current Conditions

Many basic resource inventories and ongoing condition assessments are lacking at Denali, so detailed resource condition trend analysis is premature. However, existing information does allow some conclusions about the condition of park resources. It is safe to say that, in general, the natural resources of Denali National Park and Preserve are still in excellent condition largely due to the long history of administrative protection and the remoteness of the area from the settlement and industrialization of the last two centuries. The habitat in and surrounding the park is still basically intact, the structure and composition of the ecosystem is still unaltered, and ecosystem processes are still functioning naturally.

There are also circumstances that will help protect these conditions in the future. The arrangement of administrative units with the most protected lands at the center provides some buffering against the inevitable future development at the edges, which has ecologically isolated so many other natural areas worldwide. Furthermore, our knowledge of managing natural systems is improved over the understanding that existed when so many other park areas were ill equipped to confront dramatic increases in use or external threats.

Despite these healthy conditions and many advantages for long term protection, there are, unfortunately, factors that threaten the ability of managers to protect this important natural area. The remoteness that prevented development also contributed to an incomplete knowledge of its resources. There is not a definitive list of the biological components of the ecosystem; basic maps of geology, soils, and vegetation are not available; inventories of streams and waterbodies are incomplete. There is only a rudimentary understanding of how subarctic systems function or respond to stress. These shortfalls will create a serious situation when stresses increase because there will be little understanding of what is at risk, the degree of risk a stressor presents to the system, and how to prescribe protection or mitigation. These pieces of information are lacking and are critical to both the day to day management of this natural area as well as its long term protection. These concerns for the future are compounded by the potential for rapid change that an increasingly technological society and an expanding population present. Technology has certainly improved our ability to understand and protect, but it has also increased the level of stress and the rate of change for a natural system like Denali's, which is facing a mounting wave of human activity.

A view of the overall natural system should also be tempered with a closer look at the details

of how this growing use is beginning to alter that natural system. A broad view can be deceptive and may miss significant events that occur and portend the future. Certain localized areas of the system appear to be under stress at this time. These local situations can be considered as warning signs. They are the first symptoms of greater stresses to come as the area surrounding Denali develops through settlement, service industry growth, and tourism. As each of these stresses increases, a synergy between them may also occur that could exponentially increase the impacts and their rate of change.

The great opportunity at Denali and one of its great values to society is that there is still the time to act, to head off many of the problems that are just beginning to appear, before they compromise the integrity of a truly important ecosystem in the subarctic. The challenge to current managers is to layout and prioritize the actions that are needed. The challenge to the public and future managers is to find ways to implement them before it is too late.

The following sections summarize the major stresses to the integrity of the Denali ecosystem. This information, combined with the concepts presented in the Natural Resources Context/Themes section, forms the basis for the development of the many individual project statements and the recommended actions contained later in this plan.

Significant Sources of Potential Adverse Impact

Three general mechanisms of stress occur in each one of the specific categories of threats listed below. In one situation the stressors are mobile. They are introduced directly to the Denali ecosystem, interact with natural resources *in situ*, and have the capability to move or be readily moved from site to site. People and their motorvehicles come to the park and interact with local resources and as a result change conditions. Contaminants or exotics are transported to the area and introduced directly into the system.

The second situation involves introduced stressors that are immobile or nearly so once introduced. Facilities to accommodate access and use are constructed that convert local habitat. These introductions occur both in and adjacent to the park.

In the final situation, park resources move outside the park boundary into areas where they encounter stresses. Golden Eagles or neotropical migrants encounter changes to their winter range. Merlins are subjected to pesticides in other countries that, if ever present, have long since been eliminated from the Denali ecosystem. Migratory animals may be hindered from interacting with populations or the environs outside the park due to service development along park boundaries. In each case, stress to an area outside the park or in another ecosystem may reflect stress back on the Denali system.

Development on a regional, national, hemispheric, or global scale can therefore profoundly influence the integrity of the Denali ecosystem. Consequently, prescriptions for managing park

resources must look beyond local or internal stress and consider the mobility of stressors in a modern technological world and the mobility of components of the natural system that is being managed. The action that must be taken will be very different in each case.

The following sections briefly describe the most important issues affecting the park's natural resources. The codes listed are used on a servicewide basis and are identified with each project statement elsewhere in this plan.

Access (Issue Codes: N05, N06, N15, N16, N18, N22)

The mission of the National Park Service is to provide for public enjoyment and preservation of natural and cultural resources. To achieve public enjoyment, access must be provided. Unfortunately, poorly planned access for human activities has high potential for impacts to the integrity of the Denali Ecosystem. Access corridors create edge effects. These boundaries are surfaces for alterations to ecosystem integrity. Every corridor that penetrates into the interior of a protected system also serves as a pathway that allows impacts from the edge into the center. At present, the area of impact for Denali is restricted to portions around its perimeter and only one primary extension, the Park Road, into its interior. While not "on the ground," a concentration of access occurs via aircraft particularly into the Kahiltna Base Camp on Mt. McKinley.

Three types of change in access could produce significant impacts to the Denali system. The first, and most significant, change could be to increase the level of penetration of the core area by a new primary access corridor. A second is the increased density of access corridors, primarily trails, off existing access created by the Park Road and its associated nodes of development. The third is the spill over of shorter distance access corridors from existing and emerging growth centers on the park's perimeter.

Recognizing the intense pressure that exists on the existing park road, the service developed the South Side Development Concept Plan with the intent of providing alternative avenues of access and visitor facilities. All parties engaged in this planning effort agreed that measures needed to be taken upfront to assure resource protection while accomodating the demand for access. This approach should diminish adverse resource impacts.

Substantial pressure exists for a new access corridor into the interior of the park. There have been repeated efforts in the 80-year history of the park to establish an additional public access road along the Stampede Trail. Park management will continue to respond to these proposals. This will require good resource information so the impacts of such an endeavor can be accurately communicated to the public.

Trail development is the primary way that the area influence of the current road corridor could be expanded to impact additional resources. Easier access would facilitate more use, different

types of use, and use over a larger area. It would change the area of high impacts from just a narrow band defined essentially by the road itself to a wide swath through the habitat in the park that supports important park opportunities such as wildlife viewing.

Growth centers at the perimeter are similar to the secondary impacts reaching out from a road corridor. They are more of a "bulge" that pushes into the protected zone from an adjacent, localized area. A gradation of disruption is created that ripples in toward the center of the protected area. The effects of this process are starting to be seen in areas like the settlements in the Stampede area, McKinley Village, and Cantwell. A similar pattern can be expected in the Tokositna area with its eventual growth.

These can work together from different directions to eventually reduce the integrity of an area. Some influencing from within, some influencing from the outside, and others cutting across whole regions and isolating one portion from another in the process. The potential for dramatic synergy is profound and often difficult to detect until dramatic shifts have occurred. At that point, the damaging changes are also extremely difficult, if not impossible, to repair. This phenomena of access intensification and its indirect effects is gaining more recognition.

There are two other aspects of access impacts that are important to consider when evaluating the threats to Denali. One involves the changes caused by the access facility itself such as a road or trail. Changes caused by the physical structure for access could be such things as habitat loss from the structure itself or gravel extraction activities, an impediment of migration, changes in hydrologic regimes, creation of an unnatural pathway for the movement of exotic species or contaminants, or a visual intrusion on a wilderness landscape. The other involves the activity of access such as walking, snowmachining, generation of fugitive dust, or driving a vehicle on a road. The structure could be intentionally created as in the case of a planned road or trails, or it could develop as a result of uncontrolled activity such as ATV or snowmachine use in an area.

At the present time, physical impacts are associated with use of the Park Road, roads in the Kantishna Hills, the remnant left from access development to the Stampede mine, and development near boundary communities or access roads such as the Petersville Road that come near the park. The effects from secondary access off these corridors in the form of trails are minor at this time, but could be substantial if management goals for the off road areas changed to encourage more trail development. The corridors of the George Parks Highway and the railroad are major physical alterations at the eastern edge of the park that also affect park resources.

The effects from the actual activity of access are more complicated to quantify. Management requires use controls, which are difficult to define and can be extremely controversial. Access activities are the concerns that are more commonly thought of when access is discussed as a threat or stress. For the purposes of the development of project statements and recommended

actions, access activities have been broken down in two general types of uses, motorized and non-motorized. Most of the concerns in either category focus primarily on user conflicts with wildlife , other users, or the creation of unplanned impact to resources such as vegetation and soils. The type, rate, and severity of these changes vary with the means of access employed. In general, motorized uses are more controversial and more of a threat to the values that are mandated for protection at Denali.

Important non-motorized uses considered in this plan include hiking, climbing, rafting, kayaking, canoeing, bicycling, and dog mushing. These uses tend to be focused intensively in only a few portions of the park, leaving large areas unaffected. An equilibrium of sorts has existed for many years for most of these uses. The one exception would be mountaineering, where use levels continue to increase. This generally balanced situation is likely to remain the case for some time unless a new primary access corridor such as a Stampede road is developed or commercial guiding increases.

Motorized use such as ATV, snowmachine, aircraft, watercraft, and road based vehicles is a very different scenario. All these uses have increased dramatically in recent years. Some are now spreading over large areas of park and preserve land at higher levels each year. Some regions are used intensively by many forms of access, which creates overlapping impacts. Additional concerns are developing because these areas of use also overlap with traditional areas of non-motorized use.

The implications of this impact to key values, such as wildlife, wildlife viewing, other public uses, and the conflicts between user groups, trigger many project statements and recommended actions in this document.

Animal Harvest (Issue Code: N19)

Overall, wildlife populations are still naturally regulated within the Denali Wilderness (generally the area of the former Mt. McKinley National Park) and the 1980 park additions. Subsistence harvest within the new additions is allowed, but is considered to be of minimal influence at this time. Brown bear are the most sought after species for sport hunters followed by moose and caribou, then sheep and black bear.

However, there are local areas of concern for both the Denali Wilderness and the 1980 additions. Of particular concern is the area along the eastern boundary where the Denali wilderness abuts state lands. Here, there is a sharp line created between harvest and no harvest. There are no 1980 park additions with a minimal level of harvest to buffer the harvest that is found on adjacent state lands. Controversy over the management of wolves in this area has already developed. The potential for influence on other species exists as a synergy of harvest, settlement, agriculture, transportation corridors, and industrial development along this boundary begins to work together to isolate park populations from adjacent areas to the northeast, east,

and southeast.

Areas of concern for the 1980 park additions are related to the subsistence harvests on park lands or activities adjacent to the park. The accessibility and presence of adjacent towns mean that the eastern end of the Stampede Trail and park lands near Cantwell see substantially higher harvest than other, more remote portions of the park. A new area of concern about which little is known is the Tokositna drainage on the south slope of the Alaska Range. Hunting occurs adjacent to the park and major recreational uses of the area are developing as well. Lack of knowledge about resources in this area and the potential for rapid change due to motorized access by snowmachine or motorized watercraft point to a need for close examination of the resources at risk and the levels of use in this area.

Current harvest levels are highest and the potential for impact from over-harvest is greatest on preserve lands because they are open to sport hunting and trapping as well as subsistence harvest. Regular information on harvest and populations is needed for these areas more than any other. The sheep population in the southern preserve unit is of particular concern.

Illegal harvest, particularly of wolves by aerial gunning, has been a problem in the past and may be a concern for the future. Ground-based poaching is likely around the boundaries at some of the more accessible locations.

Plant Harvest (Issue Codes: N06, N19)

Harvest on park and preserve lands is minimal and limited to firewood and house log gathering along traplines and adjacent to subsistence communities such as Cantwell. The effects could be locally significant if important habitat is eliminated or associated access corridors are developed as a result of removing the logs or firewood. These impacts can be managed within existing regulations, but resource condition information, which is not available, is needed first.

Mineral Extraction (Issue Code: N10)

Park lands are fairly secure from new mineral extraction by the public. The more significant problems are the effects of past activities, particularly in localized areas like the Kantishna Hills. The hydrology and vegetation has still not recovered in extensive areas of riparian habitat. Many access corridors and excavations remain in upland areas as well. The natural process of recovery will take substantial time. Reclamation in some areas will be required to regain proper stream bed alignments and grade as well as to encourage revegetation or control erosion.

Past gravel extraction for administrative use, such as the maintenance of the Park Road, has also created impacts to streams and upland sites. Demand for gravel will continue. Existing uses must be closely monitored and new sites carefully studied to control the potential for substantial impact to riparian or upland habitat as well as important wilderness viewsheds or recreation

opportunities.

Lands adjacent to the park in many areas are open to mineral extraction. Of particular concern are the three townships at the eastern end of the Stampede Trail. The 107,618 acre tract of state land, also known as the "Wolf Townships", was closed by the state to mineral entry under the Alaska mining law in 1975 to facilitate a land exchange between the NPS and the state that would have added the Wolf Townships to the park. Nineteen years later, the Governor initiated a statewide review of all mineral closures to determine if the original purpose was still valid. The park was contacted during this process and indicated that an exchange was still desirable. The NPS and state could not identify lands suitable for the exchange so the closure was opened. This area is currently open to staking for new state mining claims. Coal deposits nearby in the Otto Lake area could also be developed. The existing operation of the Usibelli Mine is a potential source of exotic plant species where they are used in reclamation efforts. There is also the potential for oil and gas extraction in the area immediately around the Muddy River in the preserve adjacent to Lake Minchumina.

Settlement (Issue Codes: N06, N16)

Impacts from settlement within the park are located along the Park Road with an intensification of activity at its eastern and westernmost reaches. It is associated with administrative functions of park operations, support services for park visitors, and tourist accommodations on private inholdings. A great deal of private land that could be developed for more tourist facilities still exists in Kantishna and may be a major concern for the future. Current policy is to purchase these lands, but development could easily take place before this goal is accomplished. In 1997, Congress passed legislation that should help facilitate land purchases.

Adjacent to the park, the primary areas of future increases in settlement are likely to coincide with transportation corridors in the northeast, eastern, and southeast flanks of the park. Steady growth is expected in the northeastern and eastern areas, but rapid growth could take place in the southeast due to recent planning decisions to increase visitor opportunities in the Tokositna area at the end of the Petersville Road. Small villages do exist at other locations along the boundary, but the remoteness of these areas will still contain growth for many more years.

Local, Regional, and Global Industrialization (Issue Codes: N11, N14)

Ironically, the most significant current effects from industrialization are from global activities. Industrialization in other areas, particularly Eurasia, has grown dramatically and has reached a level that is producing significant enough amounts of contaminants that long range transport of those products is now occurring. These air pollutants are probably more significant at this time then those from local or even regional sources.

Heavy industry is limited in Alaska. The economy is still resource extraction based with the

products transported intact from the region. The most significant contribution at the local or regional level is probably from power generation activities such as the coal fired power plant in Healy. The level of this stress will increase as population and settlement increase and as the economy shifts from extracting resources toward processing them within the state for a growing local market or to take advantage of local coal or oil reserves for power generation. Contaminants from these closer sources will then combine with the global inputs to produce a complex air pollution situation that could threaten the magnificent vistas and mountain scenery that are key resource values of Denali.

Summary of Conditions and Adverse Impacts

Table 2 provides a subjective summary of the general conditions of the park's natural resources. Resource conditions are generally good except for the Denali Caribou Herd and the degree of adverse impact is low to moderate.

Table 2.

NATURAL RESOURCE GENERALIZED CONDITIONS

Resource Category	**Resource Condition**	**Degree of Adverse Impact**
Atmospheric Resources	----------	----------
Air Quality	Good - Fair	Moderate
Visibility	Good - Fair	Moderate
Aquatic Resources	----------	----------
Surface Water Quality	Good - Fair	Low
Water Quantity	Good	Low
Groundwater Quality	Good	Low
Aquatic Vegetation	Unknown	Low
Aquatic Invertebrates	Unknown	Low
Fishery Resources	Good	Low
Geologic Resources	----------	----------
Geologic Features	Good	Low
Glaciers	Good	Low
Soil Resources	Good	Low
Terrestrial Biotic Resources	----------	----------

Terrestrial Vegetation	Good - Fair	Moderate
Terrestrial Invertebrates	Unknown	Low
Birds	Good	Moderate
Dall Sheep	Good - Fair	Moderate
Moose	Good	Moderate
Caribou	Poor	Moderate
Resource Category	**Resource Condition**	**Degree of Adverse Impact**
Wolves	Good	Low - Moderate
Bears	Good - Fair	Low - Moderate
Paleontological Resources	Good	Low
Ecosystem Processes	Good	Moderate

C. Cultural Resource Baseline Information

Denali National Park and Preserve contains significant cultural resources in each of the following subdisciplines; archeology, history, ethnography, cultural landscapes and history. The park area is known to have been inhabited for more than 11,000 years and contains some of interior Alaska's best-known prehistoric research sites. The park itself has experienced a rich cultural history, characterized by the interaction of traditional Native groups, explorers, miners, mountaineers, scientists and adventurers with the park's unique natural environment.

The Cultural Resource Documentation Checklist for Denali is included as Appendix E.

Archeological Resources

At the conclusion of the Park's Archeological Overview and Assessment (Griffin, 1990), 188 archeological sites representing several time periods and types of cultural material had been documented, consisting of 84 prehistoric sites and 104 historic sites. Since that time, an estimated 20 additional sites have been recorded. The park's collection also includes archeological materials collected during research and compliance projects. The 1995 Collection Management Report indicated that 2,586 archeological objects are in the collection.

Perhaps the most archeologically significant aspect of Denali is its proximity to some of interior Alaska's best known and most important prehistoric research areas (the North Alaska Range/Nenana Valley, Susitna drainage, Lake Minchumina, and Denali Highway/Tangle Lakes region). Projects in the area have documented 11,000 years of prehistoric activity from early

man occupations to the late prehistoric era. Their proximity to Denali strongly suggests that the park contains equally significant data.

Most prehistoric archeological sites in Denali are surface deposits of lithic tools or tool fragments, which are more vulnerable than buried deposits to impacts and also more difficult to classify and evaluate. Due to a lack of sufficient detail, these sites have not been formally evaluated for national register eligibility. One exception is the Teklanika archeological district, which has been evaluated and placed on the National Register of Historic Places. The Teklanika sites played an important role in defining the Denali complex, a very important early cultural type site in Alaska archeology that eventually was named for the park's defining feature (West 1965).

Sites with archeological value associated with the historic era account for more than half of the recorded archeological sites in the park (104 sites). These are divided among mining and other historic activities in Denali's past and range from nearly intact mining camps and operations to cabin ruins and scatters of isolated tools and equipment. Some of the types of historic sites with archeological potential recorded in the park are placer operations, lode operations, mining camps, placer and lode mining operations, mining communities or roadhouses, habitation sites, transportation sites, cairns, gravesites, community, and other resource extraction sites. Six sites have been found eligible for the national register and are anticipated to be included in a Kantishna Mining District Historic District.

Ethnographic Resources

Ethnography is concerned with the peoples associated with parks, with their cultural systems or ways of life, and with the related technology, sites, structures, other material features, and natural resources. Although formal identification or analysis of ethnographic groups has not been undertaken, use of Denali by different cultural groups and communities predates park development and is documented by past research. The best documented of these groups are the five different Athabaskan groups known to have used the park, subsistence users, and miners. It is possible that other occupational groups who have figured in Denali's history (mountaineers, pilots, park employees, etc.) may be defined as ethnographic groups as well.

Cultural Landscapes

Cultural Landscapes are cultural resource systems that reflect human land use and adaptation. The goal of a cultural landscape management program is the preservation of a cultural landscape's unique physical attributes, biotic systems, cultural associations and use, when that use contributes to its historical significance. Although no cultural landscapes have been formally identified or recorded in Denali, there is no question that qualified vernacular, archeological and ethnographic landscapes exist within the range of sites and time periods represented by the identified cultural resources and past land use in the park.

Historic Structures

Historic structures are the most apparent of Denali's cultural resources. They include the cabins, structures associated with the park headquarters, bridges, roads, and tailings piles. Although isolated cabin ruins are dealt with as archeological resources, cabin ruins associated with larger historic sites are managed as historic structures. The most recent List of Classified Structures (LCS) review for Denali (September 1997) included 143 structures.

National register evaluation and nomination of historic structures in the park is ongoing. Sites are evaluated, and if found eligible, are nominated. Additional structures have been categorized as potentially eligible, but presently lack formal national register nominations. Some of these will be prepared as part of Volume II of the Denali Historic Resource Study.

The Park Headquarters Historic District, which includes the Wonder Lake Ranger Station, consists of 18 historic structures and connecting roads. The structures house the park's administrative center.

A group of 14 cabins were added to the national register in a thematic nomination titled "Patrol Cabins, Mount McKinley National Park." The cabins share a similar rustic style; all are small, one story, buildings with horizontal log wall construction. All but one feature peeled logs. Some of the cabins are in use today.

The Savage River cabin, not included in the register nomination, is in use as an interpretive exhibit. Thoroughfare cabin, omitted from the nomination because it did not meet the 50-year age minimum for the national register at the time of the original nomination, should be considered for addition to the patrol cabin thematic nomination as should the Parker Cabin.

Summary of Baseline Information

See Appendices E and F.

D. Cultural Resource Conditions

Current Conditions

Appendix F contains a series of Cultural Resource Status Summary Charts that are to be used in concert with the following narrative descriptions.

Archeological Resources

A recent assessment suggests that 5% of the park has been surveyed for archeological resources (Schoenberg 1995). Archeological survey work in the park has been conducted at the reconnaissance level, and sites covered have been clustered in a limited number of areas (Griffin 1990, Schoenberg 1995). As a result, knowledge of prehistoric resources in particular should be viewed as preliminary and not taken as a reliable sample on which to characterize the resource.

The base documentation leads to two concerns about resource conditions. First, the lack of knowledge tends to result in less focus on protection of the resources. Second, archeological resources may be looted or damaged without the staff being aware of the site's existence. Fortunately most areas of the park are remote, and archeological remains are not an attraction to the public. The condition of these resources is difficult to assess.

Ethnographic Resources

Because no effort has been made to identify or assess ethnographic resources, comments on their condition would be speculative. In some cases, it is known that sites and material features are undergoing change through current use (mountaineering camps, land acquisition, and reclamation of disturbed mining districts). These changes usually have operational benefits but may also alter the integrity of ethnographic resources.

Cultural Landscapes

Cultural landscapes should be considered an unevaluated category of cultural resources in Denali. Despite this lack of evaluation, park landscapes are believed to be in excellent condition. The majority of the park is free from development and motorized access. Some concerns related to snowmachine and aircraft use exist.

Historic Structures

Both the headquarters structures and the patrol cabins are in fair to good condition. Current use has resulted in significant interior modifications, and the buildings have the potential for future alterations. Some structures are in poor condition and require major preservation treatment.

The Stampede lode mine, located in the northeast corner of the park, was at one time, the second largest producer of antimony in the United States. The site is eligible for the national register. Discovered in 1910, the mine was operated by Alaskan historical figure Earl Pilgrim between 1936 and 1970. The mine complex consists of shops, a bunkhouse, an assay lab, an office, a warehouse, a greenhouse, a few storage sheds and a four-story mill building. Management of the site is complicated by the fact that while the land and structures are owned by the NPS, the mineral rights and equipment were owned by the University of Alaska Fairbanks up until 1998. In 1987, while attempting to clear the site of explosives and hazardous

materials, a prescribed explosion inadvertently destroyed some structures and damaged others. Since that time the site has been cleaned up and damaged structures were stabilized. Theft of objects from the site could become a problem.

Significant Sources of Potential Adverse Impact

The discussion on the state of knowledge about and threats to natural resources applies equally to park cultural resources. Inventories and condition assessments are incomplete, so a condition assessment is not easily derived. Threats from access, industrialization, plant harvest, mineral extraction and settlement all have the potential to contribute to the degradation of cultural resources through outright destruction, loss of integrity, exposure to vandalism and theft, or deterioration by contaminants.

Concerns specific to cultural resources include the need for identification and evaluation studies (C02), site monitoring (C06), inventory and condition assessments (C12), overviews and assessments (C21), emergency stabilization (C54), routine and cyclic maintenance (C55) and adjacent land use (C73).

Summary of Conditions and Adverse Impacts

See Appendix F.

E. Subsistence Resource Baseline Information

Subsistence Resource Users

An ethnohistorc study of the Ingalik Athabaskan of the northern and western sides of Denali was conducted during the 1960s (Hosley 1961,1966,1968). Hosley examined the cultural changes brought on by acculturation, social organization, and the hunting, fishing, trapping and gathering activities of the Native residents of the area. Additional ethnohistoric research was conducted in the Upper Kuskokwim area for navigability determinations (Gudgel-Holmes 1979). Archeological studies in the area provide information on northern Athabaskan prehistory (Shinkwin 1975).

During the 1960s the U.S. Department of the Interior prepared two environmental impact statements for possible additions to National Park lands (USDOI 1974a, 1974b). These documents provide demographics of nearby communities as well as brief descriptions of hunting and fishing activities of local residents. The National Park Service funded research providing historical as well as contemporary information on subsistence activities by these communities (Bishop 1978, Schnieder 1981).

The Alaska Department of Fish and Game, Division of Subsistence conducted some research projects during the early 1980s, describing current demographics, socioeconomic conditions, and hunting and fishing activities for the Upper Kuskokwim communities (Stickney 1980, 1981; Stokes 1982, 1984; Andrews 1984).

Other documents are available that describe social and economic conditions of the Upper Kuskokwim region (Patterson 1973, Selkreg 1975, Tanana Chiefs Conference 1983, Toghotthele Corportation 1983). Information on the historical exploration and settlement of the Upper Kuskokwim River is available in Oswalt (1980).

Fewer studies are available describing subsistence activities by communities south of Denali. A decade ago, the Department of Fish and Game conducted research in Cantwell as a part of a larger study conducted among residents of the Copper River Basin (Stratton 1984, 1985). These studies provided data on estimates of harvests of fish and wildlife, resource distribution, wage/employment patterns and demographic characteristics. Maps depicting areas of use by Cantwell residents for hunting, fishing, trapping and gathering are included.

Ethnographic information on the Ahtna Athabaskan people who settled in Cantwell and their traditional patterns of use is available from studies of Copper River Basin people (Reckord 1983, de Laguna 1982, Kari 1983). Planning documents also provide some social and economic information (Selkregg 1977, USDI 1974).

Much of this information is 10 or more years old and probably does not represent current conditions.

In the 1990s the National Park Service initiated several ethnographic and subsistence related studies. A local ethnogeography was prepared for Athabaskans and their use of land in the Kantishna River drainage (Gudgel-Holmes 1991). The Kantishna oral history project initiated documentation of the Athabaskan oral traditions, native place names, associated stories and use areas. A report is being prepared on the Traditional Use of Cabins and Other Shelters Associated with Subsistence Uses in the North Additions to Denali to document the historical and contemporary use of cabins and other shelters associated with trapping by local residents in and around the Denali area (Johnson 1997).

Contemporary subsistence resource user information exists in a variety of forms ranging from annual harvest reports to specific community and geographic area subsistence use studies. The northern additions to Denali National Park and Preserve has been the focus for most subsistence use studies because of the areas long term, consistent pattern of subsistence use. Particularly noticeable is a lack of information regarding subsistence use for the southern additions to Denali National Park and Preserve.

The NPS determines eligible local rural subsistence users through the use of resident zone

communities and individual subsistence use permits. The communities of Cantwell, Lake Minchumina, Nikolai and Telida are identified as subsistence resident zones communities containing a significant concentration of residents who have customarily and traditionally used Denali National Park lands for subsistence purposes. In addition, there are fifteen other local rural families with subsistence use permits who do not live within one of these designated resident zone communities but have traditionally engaged in subsistence activities within the park.

Based upon 1990 U.S. Census Bureau data for the above subsistence use communities there are approximately 320 local rural residents eligible to engage in subsistence use activities within Denali National Park. A comparative review of 1980 and 1990 census data indicates that three of Denali's resident zone communities experienced a population growth and one showed a decrease. For social, political, economic, or regulatory reasons, not all members of these communities are active subsistence users. Since 1980 the overall populations for most communities surrounding Denali has increased, but the relative number of subsistence users actively involved in subsistence at Denali is decreasing. Effort and harvest levels for most subsistence species have remained about the same as in the past or have decreased. Overall the subsistence trapping effort, a significant component of subsistence for the northern regions, has declined relative to the decreasing price received for furs.

Resources Harvested

The previous section in this part (A. Natural Resource Baseline Information) should be referred to for general descriptions of what is known about those resources.

Community profile studies were conducted for most of Denali's subsistence communities in the early to mid 1980s. Studies indicate a dependence primarily upon moose, caribou, rock and willow ptarmigan, spruce grouse, hare, ducks and geese, salmon and a few species of freshwater fish. Less frequently used large mammals include black bear, brown bear and dall sheep. Large mammals account for 70% of the resources used, and fish account for 21%. Freshwater fish include burbot, dolly varden, grayling, lake trout, northern pike, rainbow trout and whitefish. Important fur animals include marten, mink, red fox, wolf, lynx, weasel, wolverine, land otter, beaver, muskrat, and coyote.

Reported harvest information for large animals, furbearers, waterfowl and fish can be found through the Alaska Department of Fish and Game harvest records, sealing documents, and registration permits. Most of this harvest information is lumped together for the entire Game Management Unit or subunits irrespective of park or preserve boundaries making review or use of the data very difficult. Harvest information is reported on a voluntary basis resulting in highly variable reliability of data. Much of the older data has not been digitized or entered into computer databases. Particularly noticeable, is a lack of information regarding subsistence

ROAD USE IMPACTS TO NATURAL RESOURCES

PROJECT CODE: DENA-I-670

SERVICEWIDE ISSUES:

N20	Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
N24	Other
S03	Visitor Impacts
S04	Visitor Use

STATEMENT OF PROBLEM

Present Condition

The frontcountry of Denali National Park and Preserve consists primarily of a corridor along a single road reaching approximately 90 miles into the heart of the park. The easternmost stretch of the road is paved (15 miles) and linked to the George Parks Highway (Alaska State Route 3). The remainder of the road is gravel, relatively narrow, and windy at spots. Associated with the road are a series of developed nodes which include facilities such as airstrips, visitor accommodations, employee housing, various maintenance shops, trails, campgrounds, administrative buildings, and utilities.

The history of the development and rise in use of the road is discussed in Brown (1991). Because of difficult access to the park, general visitation and park road use was very low for many years. With the opening of the George Parks Highway in late 1971, park managers predicted a sudden, significant increase in park visitation and felt that increased traffic on the park road might have adverse effects on wildlife which inhabited the road corridor. Thus, the Visitor Transportation System (VTS), a free shuttle bus system, was established to minimize disturbances to wildlife and scenery, to maximize wildlife and scenery viewing, and to minimize traffic hazards, with the least resource impact and energy consumption.

The precedent for bus operations on the park road actually predated the institution of the VTS with concession operated tour buses. Over the years new varieties of tours have developed and

tours are heavily used by park visitors.

Twenty-five years have passed since the establishment of the VTS. The current bus system operates near capacity, with all seats occupied on most buses. Today, the VTS and tour buses combine to form a comprehensive transportation system for the park. It is widely believed that the NPS policy of a mandatory transportation system has been highly successful in Denali relative to the original goals. However, park managers are continually faced with making difficult decisions on road use limits, but do not have sufficient information or tools to judge the consequences of the various alternatives that they may be asked to consider.

While the VTS has served to reduce the rate of increase of vehicle traffic that was demonstrated prior to it's implementation, numerous factors continue to contribute to concern regarding Park Road traffic. These include annual changes in shuttle bus scheduling, resurgence of private vehicle traffic to Kantishna, extension of road use into "shoulder seasons", and inauguration of a "short tour" in 1990 without limits on bus numbers.

There will be more questions about the scientific justifications for restrictions in the near future because the current traffic limits are beginning to impact the commercial tour industry. George Fleharty, former president of Outdoor World Ltd, summed up this situation in a 1988 letter to then Superintendent Robert Cunningham. He stated, "At any time that it becomes apparent that restrictions are imposing an adverse effect upon this industry, we can expect a close look at best, and unreasonable pressure at worst. We cannot expect to defend against this pressure if we are not on solid ground with the restrictions."

Furthermore, interest exists in finding products to improve the structural stability of the road and, consequently, in reducing the amount of gravel needed for road maintenance. Gravel is either purchased from sources outside of the park or mined within the park. Palliative products may be useful in reducing this concern. Extraction of gravel for road maintenance and repair from sources within the park has occurred historically and has potential for causing natural resource impacts. A detailed discussion of this issue is located in the Administrative Use of Resources project statement (DENA-I-800).

Finally, fugitive dust from the 72 miles of park road creates traffic safety problems, reduces visitor enjoyment, and may alter natural resources in the immediate vicinity of the road. Possible impacts include concentration of heavy metals in nearby soils, changes in soil pH, restriction of photosynthesis, gaseous diffusion and transpiration in vegetation, and inhalation by wildlife. Alterations in permafrost may also occur. Interest has been expressed in reducing road dust by applying dust palliatives to the road surface (USNPS 1991). Support is needed to assess both the environmental impacts of dust palliatives and the dust itself.

Current Management Actions and Results

Two studies on the effects of traffic on wildlife in Denali have been conducted (Tracy 1977, Singer and Beattie 1986). These studies met the needs of the era in which they were completed, but they are not adequate for the present situation. The 1986 general management plan for Denali acknowledged this need for continued research and directed management to establish a monitoring program as a guide before further modification to traffic levels or patterns is made. A commitment was made that the national park service would continue to develop a better understanding of the interaction between traffic and wildlife and determine its influences on visitor experience and the health of the biological systems.

An exploratory study was begun in 1989 by Wildlife Research Biologist Dr. Dale Taylor, then of the NPS Alaska Regional Office, Natural Resources Division. The objective of the study was to develop the techniques for a long term monitoring program that could eventually be taken over by the staff at Denali. While this effort may generate valuable information, it is currently unfinished and unassessed in relation to it's utility in resolving traffic management concerns.

In 1992, Dr. Bruce Hastings, of the U.S. Fish and Wildlife Service, was invited to the park to review the situation and consult with Research Wildlife Biologist Dr. Jeff Keay. His unpublished report (Hastings 1992) indicates that this issue is extremely complex both in the number of variables influencing the situation and in the nature of investigations which need to be undertaken. The report also outlines a number of avenues which the park staff can proceed along to develop a foundation for more detailed work in future years.

Between 1992 and 1993, an evaluation of alternative transportation systems was made. This effort focused primarily on the engineering and economic feasibility of alternatives to the extant system. Little emphasis was placed on biological feasibility. During 1993, the park road system evaluation (RSE) process was re-instituted (USNPS In Progress). The RSE Report places emphasis on known engineering and physical process concerns related to the road. Concurrently the state of Alaska proposed construction of a road from the Parks Highway to McGrath. Finally, in 1995, a serious proposal for additional rail or road access in the northern portion of the park came forward from the private sector. Park staff made the commitment and was later directed to prepare a feasibility report on this proposal. That report was completed in 1997. In each of these four evaluative and planning efforts, current biological information is/was sorely lacking.

Starting in 1994 and then more seriously in 1995, both park and National Biological Service funds were directed at resolving a number of concerns related to the park road. The following projects were initiated:

- Wildlife Monitoring Procedural Study (University of Idaho)

- Effect of Vehicle Traffic on Dall Sheep Migration (NBS)
- Visitor Satisfaction with the Road/Wildlife Experience (University of Idaho)
- Park Road Aerial Photography (Denali)
- Park Road Traffic Levels (Denali)
- Bus Patron Dispersal Patterns (Denali)
- Gravel Loss Study (Denali)
- Dust Monitoring (Denali)
- Palliative Impacts Study (Denali)
- Road Use/Wildlife Monitoring (Denali)
- Road Corridor Climatic Conditions (Denali)
- Road Corridor Impacted Areas Documentation (Denali)

Most of these projects are still underway but several publications have been prepared as a result of these efforts (Putera 1996, Putera 1997, Wright 1995, Yost 1996, Fortier and Olson 1996, Olson 1997 , Karle and Furbish 1997, Fortier and Burson 1996, Fortier et al. 1997, Fortier and Tomkiewicz 1995, Furbish 1996, Furbish 1997, Baxter 1997, Brease 1997). Accomplishments to date include obtaining current aerial photography of the road corridor, development of universally accepted road traffic figures and procedures for gathering that data, implementation of palliative, dust, sociological, and wildlife studies, establishment of weather stations in the road corridor, and improved documentation of human impacts in the road corridor. Dr. Dale Taylor made some further progress on analysis of his data.

In addition, during 1995, the Alaska Department of Fish and Game completed a pilot effort to assess the economic value of wildlife viewing in the park. Significant progress was made in refining project design but insufficient funding and higher priorities prevented followup efforts in 1996. The department worked quite closely with park staff on this project.

While these studies represent substantial progress in dealing with park road use issues, much work remains. Road corridor baseline information is still incomplete, corridor management planning is unaddressed, dust palliative studies are incomplete, and impact monitoring studies are unfinished. Unaddressed tasks are outlined below as recommended actions.

During 1996, NBS (now BRD) coordinated a review of park road study efforts. The findings of this review were made available in the fall of 1997 (Hammitt 1997). Those findings include recommendations for improving ongoing studies and proposals for new investigations.

RECOMMENDED ACTIONS

It is proposed that the park develop a comprehensive transportation system management program founded on scientific investigations, sound engineering, and ongoing monitoring programs.

Activities to be implemented follow:

A. Program Administration and Planning

I-670.001: Prepare a Comprehensive Transportation System Management Plan

This document would outline road management objectives and set forth procedures and standards which would govern road maintenance and traffic management. Use limits would be outlined based on modelling generated by research activities listed below. The document would also provide a central focus for documentation of information regarding the park road.

B. Research

I-670.011: Complete Taylor Study

This study was originally designed to determine (1) baseline numbers of animals observed by park visitors along the road corridor; (2) the locations of animals along the road corridor; (3) the distance of animals from the road; and (4) the relationship of the number of animals and distance from the road to number and type of vehicles on the road. Two summers of observations have been collected and entered into a data base. Some preliminary analysis of this information has been done, but the results have not been reported or published. There is now more information from subsequent summers of data collection that could be summarized to provide a more complete picture of the system.

I-670.012: Identify and Characterize Potential Environmental Impacts From Dust and Dust Palliatives

Conduct a literature review regarding the toxicological nature of dust palliatives. Complete field reconnaissance to determine vegetative cover and growth rate changes caused by dust/dust palliative, to determine impacts to wildlife and aquatics, to identify alterations in soil chemistry caused by dust palliative, and to ascertain the nature of palliative leachate movement into surface waters.

I-670.013: Conduct Wildlife Behavioral and Habituation Studies

More detailed studies on specific aspects of traffic and wildlife interactions must be conducted to answer questions regarding the nature and extent of wildlife disturbance and habituation.

I-670.014: Model Traffic Patterns

Traffic information would be gathered to allow modelling of traffic patterns on an hourly, daily, seasonal, and annual basis. This effort would help characterize wildlife behavior as it relates to traffic patterns.

I-670.015: Conduct Sociological Studies

As with the previously listed project, studies need to be conducted to determine visitor expectations and satisfaction with regard to wildlife viewing and the transportation reservation system, to analyze the visitor market, and to characterize park visitation and system users. Consideration should be given to a complete analysis of previously conducted studies.

I-670.016: Develop Simulation Model for Assessing Impacts from Various Road Use Levels

A study, which would potentially involve manipulation of road use, would be conducted to generate a model for forecasting impacts from variable road use levels. Information derived from application of this model would be the driving force behind use limits and would be incorporated in the transportation system management plan.

I-670.017: Prepare Administrative Histories

Administrative histories on key issues dealing with topics such as road management policies, road ownership, transportation system changes, road maintenance and repair would be prepared. These would include the basis for decisions and changes in policy and operations.

I-670.018: Develop Monitoring Procedures to Track Impacts to Wildlife and Vegetation, to Assess Visitor Use Levels and Satisfaction, and to Assess Impacts from Dust Palliatives

Development of a comprehensive monitoring program is contemplated. Monitoring would be a key element of the transportation system management plan. This program would provide feedback regarding the implementation of various maintenance practices and use levels. Emphasis is to be placed on assuring that adverse environmental impacts are not occurring. Information gathering methods utilized in the various NBS investigations would be examined for potential application as a monitoring tool.

I-670.019: Support Independently Funded Studies Related to the Issue

The service would support independently funded research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities when deemed appropriate by park management. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management I-410).

C. Mitigation

I-670.021: Develop Background Information

Twenty years of valuable data on road management needs to be assembled. This project calls for the generation of a suite of information which can be used in biological assessments and upon which future interdisciplinary research will be based, will establish a systematic method for collecting that information until such time that applied research dictates that alternate methods should be used, will contribute to preparation of a transportation system management plan, and will generate a strategy of conducting future investigations related to the issue. Specific baseline information needs include base cartographic mapping, road and facility mapping, vegetation, hydrology, and soils mapping, floodplain and wetland delineation.

I-670.022: Implement Road Maintenance Program Consistent with Management Plan

Fund and implement a road maintenance program which minimizes impacts to natural resources and visitor experiences. This program may include utilization of dust palliatives.

I-670.023: Implement Road Use Limits Based on Simulation Modelling and Management Plan

Establish and implement road use limits as a result of scientific investigations, modelling, and planning. Consider operational changes, such as "no stopping zones", to resolve conflicts with wildlife.

D. Monitoring

I-670.031: Implement Monitoring Procedures to Track Impacts to Wildlife and Vegetation, to Assess Visitor Use Levels and Satisfaction, and to Assess Impacts from Dust Palliatives

Implementation of a comprehensive monitoring program is contemplated. Monitoring would be a key element of the transportation system management plan. This program would provide feedback regarding the implementation of various maintenance practices and use levels. Emphasis is to be placed on assuring that adverse environmental impacts are not occurring. Information gathering methods utilized in the various NBS investigations would be examined for potential application as a monitoring tool.

This project statement is linked directly to DENA-I-610 Frontcountry Management and DENA-I-800 Administrative Use of Resources which should be consulted for additional information closely related to this project.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Transportation System Mgmt Plan	10.0	10.0	10.0	50.0	80.0
RESEARCH					
- Characterize Dust Impacts	25.5/0.3	25.0/0.3	25.0/0.3		30.0/0.9
- Model Traffic		25.5	25.0		50.0
- Wildlife Behavioral Studies				200.0	200.0
- Sociological Studies				200.0	200.0
- Simulation Model				200.0	200.0
- Administrative Hist.	20.0	20.0			40.0
- Monitoring Development	75.0	75.0	75.0		225.0
MITIGATION					
- Develop Background Information	85.0/1.5	85.0/1.5	85.0/1.5		255.0/4.5
- Maintenance Program				150.0	150.0
- Road Use Limits				50.0	50.0
MONITORING					

- Comprehensive Monitoring Program				100.0/1.0	100.0/1.0
TOTALS	215.0/1.8	260.0/1.8	225.0/1.8	970.0/1.0	1625.0/5.4

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Bailey, J. A. 1986. The increase and dieoff of Waterton Canyon bighorn sheep: biology, management, and mismanagement. Proceedings of the 5th Biennial Symposium of the Northern Wild Sheep and Goat Council.

Basile, J. V. and T. N. Lonner. 1979. Vehicle restrictions influence elk and hunter distribution in Montana. Journal of Forestry 77(3):155-159.

Baxter, V. A. 1997. Trails and nodes monitoring program, year end report, 1997. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Brease, P. 1997. Summary report, 1993-1996 Bear Cave slump surveys, mile post 45 Denali National Park road. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Brown, G. 1979. Alternative transportation system for reducing natural resources impact. In Recreational Impact on Wildlands, Conference Proceedings. U. S. Forest Service, Pacific Northwest Region.

Brown, W. 1991. A History of the Denali - Mount McKinley Region, Alaska. USNPS, Southwest Region.

Burson, S. and K. Fortier. 1996. Park road use/wildlife interactions: behavioral observations and monitoring - 1996. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Cameron, R. D. and K. R. Whitten. 1980. Influence of the Trans-Alaska pipeline corridor on the local distribution of caribou. Proceedings: Second International Reindeer/Caribou Symposium. Roros, Norway, 1979.

Dalle-Molle, J. 1980. Management of visitors feeding ground squirrels at Eielson visitor center. Unpublished Progress Report. Denali NP&P, Alaska.

Dean, F. C. and D. M. Tracy. 1979. McKinley's shuttle system and the management of traffic impact on wildlife. In Recreational Impact on Wildlands, Conference Proceedings. U. S. Forest Service, Pacific Northwest Region.

Fortier, K. and C. Tomkiewicz. 1995. Road use/wildlife interactions - procedures document - 1995. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Fortier, K. and S. Burson. 1996. Road use/wildlife interactions -procedures document - 1996. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Fortier, K. and S. Burson. 1996. Automated park road traffic counting - 1996. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Fortier, K. and S. Burson. 1996. Park road use/wildlife interactions: behavioral observations and monitoring - 1996. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Fortier, K. and G. Olson. 1996. Automated park road traffic counting - 1995 - a pilot effort. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Fortier, K. and G. Olson. 1996. Park road traffic - 1979 to 1995. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Fortier, K., C. Tomkiewicz, and G. Olson. 1996. Park road use/wildlife interaction monitoring - a pilot effort - 1995. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Furbish, C. E. 1996. Denali National Park - trail & nodes monitoring program - report on progress at end of 1995 season. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Furbish, C. E. 1997. Trails and nodes monitoring program, annual progress report, 1996. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Furbish, C. E. 1996. Effects of road dust and palliatives on vegetation and soils, 1994-1995. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Furbish, C. E. 1997. Effects of road dust and palliatives on vegetation and soils - third year progress report. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Hammitt, W.E. et al. 1997. Denali National Park road corridor studies review panel report. Biological Resources Division, USGS. Denali National Park, Alaska. 61+pp.

Harrison, G. 1975. The people and the park: reactions to a system of public transportation in Mt. McKinley National Park, Alaska. Journal of Leisure Research 7(1):6-15.

Hastings, B. C. 1992. Evaluation of research and management needs for managing people and wildlife along the Denali road. Unpublished report.

Johnson, D. R. and M. C. Todd. 1977. Summer use of a highway crossing by mountain caribou. Canadian Field Naturalist 91(3)312-314.

Karle, K. and C. E. Furbish. 1997. Dust palliative testing on the Denali Park road 1994-1995. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Klein, D. 1980. Reaction of caribou and reindeer to obstructions -- a re-assessment. Proceedings: Second International Reindeer/Caribou Symposium. Roros, Norway, 1979.

Lyon, L. J. 1979. Habitat effectiveness for elk as influenced by roads and cover. Journal of Forestry 77(10):658-660.

Marshall, S.C. 1997. Effectiveness of calcium chloride on road dust suppression and effects on roadside water and soil. Masters Thesis. University of Wyoming, Laramie, WY.

McLaughlin, P. 1991. A review of research on road dust effects and control measures. USNPS, Alaska Regional Office, Anchorage.

Miller, Pat. 1990. The Denali National Park visitor transportation system. Unpublished report. Denali NP&P, Alaska.

Olson, G.C. 1997. Park road traffic - 1996. Unpublished Report. Division of Research and Resource Preservation, Denali NP&P, Alaska.

Perry, C. and R. Overly. 1977. Impacts of roads on big game distribution in portions of the

Blue Mountains of Washington 1972-1973. Applied Research Bulletin No. 11. Washington Game Department, Olympia, Washington.

Putera, J. A. and J.A. Keay. 1996. Effect of vehicle traffic on Dall Sheep migration in Denali National Park - 1995. Unpublished Report. Denali Field Station, National Biological Service, Denali NP&P, Alaska.

Putera, J. A. and J.A. Keay. 1997. Effect of vehicle traffic on Dall Sheep migration in Denali National Park - 1996. Unpublished Report. Denali Field Station, National Biological Service, Denali NP&P, Alaska.

Schultz, R. D. and J. A. Bailey. 1978. Responses of national park elk to human activity. Journal of Wildlife Management 42(1):91-100.

Singer, F. J. 1975. Behavior of mountain goats, elk and other wildlife in relation to U.S. highway 2. Report for Federal Highways Administration and Glacier National Park. Glacier National Park, Montana.

Singer, F. J. and J. B. Beattie. 1984. The controlled traffic system and associated wildlife responses in Denali National Park. Arctic 39(3):195-203.

Taylor, D.L., K.D. Vogt, and J. Warburton. 1997. A system for monitoring impact of Denali National Park road traffic on wildlife. Biological Resources Division, USGS. Anchorage, Alaska. 259pp.

Tracy, D. 1977. Reactions of wildlife to human activity along Mount McKinley National Park road. Masters of Science Thesis, University of Alaska, Fairbanks. 260 pp.

Ward, A. L., J. J. Cupal, A. L. Lea, C. A. Oakley, and R. W. Weeks. 1973. Elk behavior in relation to cattle grazing, forest recreation, and traffic. In Proceedings of the 38th North American Wildlife and Natural Resources Conference.

Wright, R. G. 1995. 1995 Progress report - road use/wildlife interactions studies at Denali National Park. Unpublished Report. University of Idaho.

Yost, A. and G. Wright. 1996. Progress report - 1996 - road-wildlife studies in Denali National Park and Preserve. Unpublished Report. University of Idaho.

USNPS. 1983. Development concept plan - Denali Park road corridor. U. S. Department of the Interior.

USNPS. 1986. General management plan - Denali National Park and Preserve. Denali NP&P.

USNPS. 1991. Denali access task force report. Denali NP&P.

USNPS. 1993a. Visitor transportation system alternatives for National Park units - draft. Volume I. U. S. Department of the Interior.

USNPS. 1993b. Alternative transportation modes feasibility study -draft. Volume II. U. S. Department of the Interior.

USNPS. In progress. Road system evaluation. Denali NP&P.

USNPS. In progress. Gravel acquisition plan. Denali NP&P.

USNPS. 1997. Entrance area and road corridor development concept plan and environmental impact statement, Denali National Park and Preserve. U.S. Department of the Interior, NPS, Denver Service Center.

HAZARDOUS MATERIALS AND WASTE MANAGEMENT

PROJECT CODE: DENA-I-700

SERVICEWIDE ISSUES:

- N10 Disruption of Park Resources Due to Mineral Extraction Activities
- N11 Degradation of Park Water Quality Due to External Activities
- N20 Lack of Basic Data: Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Present Condition

Denali National Park and Preserve must properly dispose of hazardous materials found on disturbed lands, especially mining claims, and those generated during normal park operations. Abandoned property and debris need to be removed from disturbed areas in addition to regular garbage disposal from visitor use areas, park residences, and the headquarters/maintenance complex. Most routine hazardous materials and waste management concerns are dealt with by the Maintenance Division of park operations, but there are some unusual situations that require attention by Research and Resource Preservation Division personnel.

Hazardous materials requiring mitigation are generally located in the Kantishna Hills area. Park and systems support office staff have made significant progress in removing these materials, especially petroleum products. Remaining materials still pose a threat to backcountry visitors, aquatic systems and biotic organisms in the Kantishna area.

In addition to the hazardous substances on former mining claims, there are two sites on federal land which were believed to be contaminated with hazardous materials. One is near mile 5 on the main park road and the other is at mile 234 on the George Parks Highway. Both sites are former landfills and gravel pits. Preliminary site assessment work has been completed but remediation is still needed. In 1991, the sites were investigated and no evidence of contamination was found. The ground surface appears stable and there are no visual indications of seepage at either site.

Hazardous materials are regularly transported through the park on both the road system and the Alaska Railroad. Fuels hauled over the Park Road, the George Parks Highway, and the Alaska Railroad commonly include aviation fuel (AV-gas), Jet-B, both #1 and #2 diesel, and unleaded and regular gasoline. Volumes vary considerably from 50-gallon tanks in equipment operator pickups to railroad car tankers which may hold up to 22,000 gallons. Significant resource impacts could result from any fuel spill along these transportation corridors.

The park must also deal with routine generation of hazardous substances and solid waste. Procedures are well established for proper disposal of materials listed under the Resource Conservation and Recovery Act (RCRA). However, there is still a need to standardize procedures for recycling. Recycling appropriate materials should significantly reduce overall waste disposal needs when a standardized, park-wide program is effectively implemented.

Current Management Actions and Results

Standard Operating Procedures are in place for disposal of waste products generated through park operations and by concessioners and visitors. These procedures will need to be expanded and updated once long-term recycling methods are established in Alaska. Hazardous materials have been disposed of and records kept according to Resources Conservation and Recovery Act regulations. The Maintenance Division keeps an inventory, updated annually, of hazardous materials stored at the park. There is a facility at the headquarters auto shop for collection and temporary storage of hazardous materials such as lithium and alkaline batteries, wet cell batteries, mercury, paint products, miscellaneous cleaning supplies, sodium hydroxide, calcium hypochlorite, thinners and solvents, ethylene and polypropylene glycols, petroleum contaminated water, and used oil and absorbent materials. These substances are collected throughout the park and delivered to the designated storage area as part of maintenance operations.

After these substances are delivered to the storage facility, the disposal process is started. Where wastes can be recycled, they are. The park has a conditionally exempt small Quantity generator status and contracts for disposal of chemical and some petroleum-based waste. Wet cell batteries are recycled. Oil generated through NPS operations is collected, stored, and eventually burned on site as fuel for space heaters at park auto shops. The park has established a 6-month limit on storage of hazardous substances awaiting disposal. The storage area is inspected weekly to ensure integrity of the containers and overall safety.

The park has also disposed of hazardous materials resulting from mining operations. Alaska Support Office (AKSO) staff completed drum and barrel removal projects during the 1993 and 1994 field seasons. These operations have produced mainly waste petroleum products, automotive grease and solvents, used glycol, and adsorbents, and in a few cases abandoned explosives. The materials have been disposed of under the regional Environmenatl Protection Agency number and regional disposal contract.

Hazardous substances on mining claims scheduled for acquisition by the NPS have been surveyed in detail by a private contractor, Dames and Moore. Recertifications are completed each year to verify current condition. Land acquisition policy is to encourage the individual claim owners to mitigate hazardous substance problems prior to any purchase agreement. This has worked in some cases, while in others the NPS has acquired claims with hazardous substance problems through claim abandonment, land donation, and litigation. In these cases, the park, with Alaska Support Office (AKSO) assistance, is responsible for all mitigation. Hazardous substance mitigation is identified in the Draft Reclamation/Restoration Plan for Disturbed Lands as a precursor to implementing any reclamation or restoration site plan.

NPS reclamation and restoration of mined lands started with Glen Creek in 1988. Hazardous materials have been removed from other Kantishna watersheds such as Friday and Eureka Creeks. Large clean-up projects were completed during 1993 and 1994. Additional projects may be planned for future acquisition sites. Approximately 200 drums containing hazardous waste and other materials were removed during 1994 from the Stampede Mine and Crooked Creek areas. The park has disposed of abandoned explosives from 7 different sites since 1988.

The U.S. Bureau of Mines (USBOM) has assisted in identifying hazards to both human safety and the environment posed by abandoned mine lands. The Stampede and Red Top sites were investigated during 1994. Though this agency is no longer in existence, the NPS Geologic Resources Division is assuming some of the tasks of the USBOM, including abandoned mine hazards identification.

The park operated two contaminated soils remediation cells near the headquarters developed area (at 5-mile pit). Contaminated soils have resulted from removal of underground fuel storage tanks and the excavation of a spill site. Piping to the tanks created the contaminated soil in two cases while a leaking tank produced the spill requiring excavation. Each remediation cell contains soil from a separate site: Cell #1 contains approximately 250 cubic yards of soil and Cell #2 contains about 160 cubic yards. Remediation cells were not cost effective so soils in these cells need to be disposed of through alternate means. Approximately 650 cubic yards of soil from the spill site that was being stored awaiting remediation has been hauled to Fairbanks where it was burned.

Park staff members have identified several fuel oil spill sites (hotel powerhouse, headquarters steamplant, and C Camp fueling area) and work is ongoing with the Alaska Department of Environmental Conservation through the Voluntary Cleanup Program to improve the conditions of these sites.

The Alaska Federal/State Preparedness Plan ("Unified Plan") provides a framework for responding to oil and hazardous substance discharges and releases. Memoranda of understanding between the Department of Interior, the Environmental Protection Agency and the Alaska Department of Environmental Conservation define the roles of government agencies. The

Unified Plan outlines notification procedures, basic responsibilities of state and federal agencies, initial response procedures, administrative and funding requirements, and wildlife and cultural resources protection guidelines. It also summarizes area spill response resources and provides information on different categories of hazardous materials. In the event of a major spill, National Park Service personnel and resources would be incorporated into an interagency organizational structure based on the Incident Command System.

The park has a general emergency response plan which includes contact phone numbers for responding to hazardous materials spills; however, additional spill contingency planning is needed.

The Alaska Region, National Park Service oil and hazardous substances spill prevention planning process consists of elements or levels. These include a park spill prevention and emergency response plan, specific spill control plans for individual facilities, and pre-incident measures. Spill caches are available in the headquarters area but not at the Toklat Road Camp, Wonder Lake Ranger Station, or the Kantishna Airstrip. Some emergency response training is being provided to maintenance employees. A core group of employees maintain annual certifications to meet the requirements of 29 Code of Federal Regulations 1919.120 (Hazardous Waste Operations and Emergency Response).

Non-hazardous solid wastes are collected in the park by maintenance personnel, accumulated at an in-park transfer station, and hauled to local landfills by a contractor.

RECOMMENDED ACTIONS

The park will continue seeking methods to reduce hazardous materials generation and to recycle all appropriate substances. Facilities and equipment will be operated according to existing standards to reduce or eliminate the risk of improper storage and disposal of hazardous substances. The park will work with the Alaska Support Office's Physical Resources Team and Lands Division staff to seek funding for and to implement hazardous substances mitigation projects on former mining claims.

A. Program Administration and Planning

I-700.001: Complete Spill Prevention, Control and Countermeasure (SPCC) Plans for Large Fuel Storage Tanks

The park is required to complete an SPCC Plan for any single above-ground fuel tank that exceeds 660 gallons or any cluster of tanks that exceeds 1,320 gallons fuel capacity. A system of underground fuel tanks that exceeds 42,000 gallons capacity must also have

an SPCC Plan. Therefore the 2,000-gallon fuel tank at the Kantishna Airstrip, the 2,000-gallon tank at the McKinley Park Airstrip, and the 4,000-gallon above-ground fuel tank near the boiler plant each require an SPCC Plan.

I-700.002: Complete Standard Operating Procedures for Hazardous Materials and Waste Management

While standard operating procedures are in place for most hazardous materials and waste management, they need to be updated and expanded to include an effective recycling program. Options for additional recycling in the park need to be explored so that solid waste generation can be reduced. The park should continue to take a leading role in recycling and encourage concessioners and visitors to participate. An expanded program would provide mutual benefits to park operations and park residents throughout the year.

Standard operating procedures would continue to be updated to include standard techniques for mitigating hazardous substances problems. These updates will require integrating information from both research and monitoring projects. Training needs would also be identified.

I-700.003: Complete Park-wide Inventory of Hazardous Materials and Other Waste Management Problems

Considerable information on hazardous materials and waste management is available for the developed area that includes the visitor center and headquarters and also for the Kantishna Hills area. Additional inventory work needs to be completed to determine the extent of the problem park-wide. Former mining claims outside the Kantishna Hills and other human use areas may present hazardous materials or waste management problems not yet addressed. There are also former climbing caches on both the north and south slopes of the Alaska Range that present special logistical problems for clean-up.

Thorough field investigations would be necessary to complete the inventory. While field work would be conducted throughout the park and preserve, developments near headquarters such as the hotel and railroad corridor cannot be neglected. Once collected, all inventory data should be consolidated on the same data base to facilitate planning and decision-making. Planning for hazardous substance mitigation is one component of the Reclamation/Restoration Plan for Disturbed Areas (Project Statement DENA-N-530).

I-700.004: Develop Plan for Solid Waste Disposal, Mountaineering Operations

Because of the logistical problems encountered by climbers in the park, particularly weather problems on Mount McKinley, recommended procedures for packing out all solid waste have been difficult to enforce. The south district rangers will continue to

investigate new methods for dealing with this problem and will monitor both violations and complaints by climbers. A plan for long-term mitigation of solid waste disposal problems will be developed, beginning with the popular West Buttress route on Mount McKinley and expanding to other climbing routes as necessary. (Project Statement DENA-I-660)

I-700.005: Develop GIS for Hazardous Materials and Waste Management Inventory

As a park-wide GIS is developed, information from the hazardous materials and waste management inventory would be digitized and added as a separate layer. This information would then be readily available for management needs and would assist with decision-making, establishing priorities for funding, and continuing planning and research efforts.

I-700.006: Employee Training

Park staff needs training on topics such as proper use of hazardous materials in the workplace, hazardous materials disposal, and spill response. Training plans and records would be updated regularly.

I-700.007: Position Description Reviews

Position descriptions of employees routinely involved in management hazardous materials and wastes would be reviewed to assure that they contain a full description of assigned duties.

B. Research

N-700.011: Continue Working with NPS Geologic Resources Division to Characterize Mine Tailings and Acid Mine Drainage Problems

The NPS would continue to use personnel from the Geologic Resources Division (GRD) in conducting research on hazardous materials on mined lands within the park. The current emphasis of this research is to identify hazards on abandoned mine lands to both human safety and the environment. Recommendations for continued monitoring and mitigation of these hazards will also be made. Park and AKSO staff will continue to review project proposals and assist with field work logistics.

N-700.012: Develop Research Potential of Soil Remediation Cells in Park

The park would thoroughly document all experimentation and resulting improvements

associated with the soil remediation cells. Since this project is carefully monitored, it has the potential to provide considerable information on soil remediation techniques in a sub-arctic environment. Findings from this applied research could not only benefit the park but could contribute to overall knowledge in the field.

C. Mitigation

I-700.021: Continue Contaminated Soil Remediation

Small quantities of contaminated soils are present on most mining claims, and the NPS now owns some of the problem areas. The NPS will continue to encourage claim owners to mitigate contaminated soil problems before any title transfer occurs. However, the NPS will be required to mitigate soil contamination in some cases since claims are also being acquired through abandonment and legal action. The park will need to continue working with the AKSO to identify funding sources for contaminated soil remediation. Mitigation options include removal of contaminated soil from the park, establishing additional remediation cells, and establishing land farms. Some or all of these measures could be contracted.

The park operated two contaminated soils remediation cells near the headquarters area. Cell operation was not cost effective so soils are being hauled to Fairbanks for incineration.

I-700.022: Remove Hazardous Substances from Former Mining Claims

The Lands Division of the NPS (AKSO) encourages claim owners to mitigate hazardous materials problems on their claims before a purchase agreement can be negotiated. Complete clean-up by claimants may not occur when the NPS acquires former mining claims through abandonment or legal action. In these cases, the NPS will be responsible for disposing of hazardous substances. In the past the park has benefitted from AKSSO assistance in arranging for disposal of these wastes. These disposal needs will continue to be contracted so that park maintenance operations are not inundated by large quantities of waste products. Current facilities, budget constraints, and procedures would not allow for efficient disposal of these additional substances.

Additional work by the AKSO Drum Inventory and Removal Team may be necessary depending upon mining claim status. This program would be coordinated with projects initiated by park staff.

I-700.023: Remove Hazardous Substances from Other Disturbed Areas

Hazardous materials mitigation is identified as a precursor to reclamation and restoration

projects in the Draft Reclamation/Restoration Plan for Disturbed Lands of Denali National Park and Preserve. Once accurately inventoried, hazardous substances would be removed so that site-specific reclamation and restoration plans can be implemented.

I-700.024: Improve Fuel Spill Response Capability

Based on the planning efforts outlined above, spill caches would be available at all necessary locations throughout the park. Spill kits are currently available at all fuel handling locations, but the park needs to expand response capability so that "worst case" scenarios can be dealt with. A training program for all park staff involved in fuel spill emergency response would also be implemented.

I-700.025: Bring Underground Storage Tanks into Federal and State Compliance

The park would continue to periodically test and replace unregulated underground storage tanks pending available funding. Underground storage tanks will continue to be installed and used only where necessary and appropriate. All tanks would be brought into compliance with state regulations under 18 Alaska Administrative Code 78, which meet or exceed all federal regulations.

I-700.026: Implement Solid Waste Disposal Program (Other than Mountaineering Program)

Some planning is complete and additional planning needs are identified in the "Program Administration and Planning" section above. These planning efforts will outline a park-wide program that can be implemented to meet solid waste disposal needs.

I-700.027: Alternative Energy Sources

Park staff would explore alternative energy sources to operate park facilities in an effort to reduce consumption of petrochemicals and to diminish the threat of spills.

D. Monitoring

I-700.031: Complete Annual Recertifications of Hazardous Substances Surveys in Kantishna Hills

Dames and Moore, Inc. has operated under contract with the Alaska to re-survey hazardous materials problems on mining claims in the Kantishna Hills. These recertifications will be continued to provide the Lands Division with current information on hazardous substances problems on claims subject to acquisition. Some additional recertifications may be necessary on former claims now in NPS ownership so that

mitigation needs can be clearly identified. (DENA-N-313.033.)

I-700.032: Monitor Hazardous Materials Collection and Storage, Park Operations

Standard operating procedures include weekly inspections of the hazardous substance collection and storage facility in the headquarters area. In addition to continuing these inspections, park resource management and maintenance staff will monitor underground storage tanks, above ground storage tanks, operation of the contaminated soil remediation cells, and water, soil and vegetation status at the two CERCLA sites. Other potential sources of improper hazardous materials disposal and handling, such as concessions operations in the park, should also be investigated.

E. Protection

I-700.051: Establish Partnerships to Improve Hazmat Handling on Adjacent Lands

Park staff would seek opportunities to work with DEC, concession operators, inholders, and adjacent land owners to minimize resource and visitor exposure to hazardous materials.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- HAZ-MAT Inventory	20.0/0.3	20.0/0.3	0.0/0.0	0.0/0.0	40.0/0.6
- Plan for Mountaineering	20.0/0.3	20.0/0.3	20.0/0.3	20.0/0.3	80.0/1.2
- Develop GIS	5.0/0.1	5.0/0.1	5.0/0.1	0.0/0.0	15.0/0.3
RESEARCH					
- NPS GRD Studies	20.0/0.0	0.0/0.0	0.0/0.0	0.0/0.0	20.0/0.0
- Soil Remed. Research	20.0/0.3	5.0/0.1	5.0/0.1	5.0/0.1	35.0/0.6
MITIGATION					
- Contaminated Soils	30.0/0.3	30.0/0.3	0.0/0.0	0.0/0.0	60.0/0.6

- Haz. Substances - Mining Claims	60.0/1.0	50.0/0.5	50.0/0.5	50.0/0.4	210.0/2.4
- Haz. Substances - Other	60.0/1.0	50.0/0.5	50.0/0.5	50.0/0.4	210.0/2.4
- Response Capab.	40.0/0.5	20.0/0.2	10.0/0.1	5.0/0.1	75.0/0.9
- UST Replacement	60.0/1.0	60.0/1.0	30.0/0.5	30.0/0.5	180.0/3.0
- Solid Waste Disposal	50.0/1.0	40.0/0.8	30.0/0.5	30.0/0.5	150.0/2.8
MONITORING					
- Haz. Recert.	15.0/0.0	15.0/0.0	15.0/0.0	10.0/0.0	55.0/0.0
- Collection/Storage	11.0/0.3	11.0/0.3	11.0/0.3	11.0/0.3	44.0/1.2
TOTALS	411.0/6.1	326.0/4.4	226.0/2.9	196.0/2.3	1174.0/15.9

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

Applicable compliance documents already completed include the following:

1. Final Environmental Impact Statement, Cumulative Impacts of Mining, Denali National Park and Preserve, 1990: meets all National Environmental Policy Act, National Historic Preservation Act and Alaska National Interest Lands Conservation Act Section 810 requirements for implementation of a minerals management program.

2. Environmental Assessment: Mining Claim Acquisition Program, Denali National Park and Preserve, 1993: This document meets compliance requirements for most land acquisition, validity examination, cultural resources monitoring, and related activities in the Kantishna Hills. It does not cover unusual projects or those with special requirements.

REFERENCES

Alaska Department of Environmental Conservation, U.S. Coast Guard and U.S. Environmental Protection Agency. 1996. The Alaska Federal/State preparedness plan for response to oil & hazardous substance discharges/releases (Unified Plan-Volume 1-Change 1). Alaska DEC, Alaska.

Alaska Department of Environmental Conservation, U.S. Coast Guard and U.S. Environmental Protection Agency. 1996. Interior Alaska sub-area/regional contingency plan. Alaska DEC, Alaska.

Alaska Department of Environmental Conservation, U.S. Coast Guard and U.S. Environmental Protection Agency. 1996. Cook Inlet sub-area contingency plan, public review draft. Alaska DEC, Alaska.

Dames and Moore. 1992. Draft generic remedial action work plan, Volume I, Kantishna Hills, Denali National Park. Dames and Moore, Anchorage, Alaska.

U.S. Department of the Interior. 1996. Final report, bureau oil and hazardous substance spill response contingency pland and personnel qualification system, a pilot project. Bureau Contingency Planning and Coordination Work Group, Alaska Cooperative Planning Group, Office of the Secretary. Anchorage, Alaska.

U.S. Department of Labor. 1995. Code of federal regulations title 29--labor, parts 1900-1999, Occupational Safety and Health Administration. U.S. Government Printing Office, Washington DC.

USEPA and USCG. 199 . Memorandum of understanding concerning FOSC response boundaries for oil discharges and hazardous substance releases.

USNPS. 1988. Oil and hazardous substances spill prevention and emergency response plan. USNPS, Alaska.

USNPS. 1990. Final environmental impact statement, cumulative impacts of mining. Volume 1. Alaska.

USNPS. 1994a. Obtaining clearances for NPS sites having abandoned explosives, regional policy. USNPS, Alaska.

USNPS. 1994b. Status of the mineral examination program in Denali National Park and Preserve. USNPS, Alaska (unpublished memo).

ADMINISTRATIVE USE OF RESOURCES

PROJECT CODE: DENA-I-800

SERVICEWIDE ISSUES:
- N10 Disruption of Park Resources Due to Mineral Extratction
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Administrative use of resources is defined as the use or alteration of a natural resource in the administration of park operations (USNPS 1991). Administrative uses of natural resources cover a wide spectrum of activities that can, if not managed with sensitivity, lead to significant localized resource impact. Examples of administrative uses of resources include such actions as excavating gravel for road construction, cutting trees for firewood, and clearing natural areas for building sites. In some instances, these impacts can be long-lasting. All administrative uses of resources must be consistent with NPS policies and with park management objectives and should seek to minimize damage to the resource.

In all cases, administrative use of resources have impacts and have a high potential for perceived conflicts with other aspects of park operations and philosophical direction. Administrative uses should therefore demonstrate a clear public benefit and alternative sources of material should be thoroughly considered. Impacts are to be held to a minimum and standards similar to those for authorized private special uses (mining primarily) will be sustained.

Present Condition

Administrative uses of park natural resources result from activities in a number of different areas in Denali, including maintenance, resource management, and research. Resource use includes:

- gravel for park road and trail maintenance

- locally obtained seeds and plants for restoration of native ground cover in the Kantishna Hills and other areas

- site utilization for a variety of structures and utilities

- firewood for NPS backcountry patrol cabins

- groundwater and surface water systems for potable water supplies for human consumption

- log use for subsistence users cabin projects

- various natural history items for museum collection and visitor interpretation use

The management of administrative uses of resources takes place under a number of different policies, informal agreements, and regulations.

Current Management Actions and Results

Gravel and Other Substrate Materials - Gravel and sand are required in Denali National Park for road and trail maintenance and construction, and for other construction purposes. NPS Management Policies (1988) state the following: "Superintendents will only create or use new borrow pits or other sources or continue to use existing sources inside the park if it is determined, based on a written analysis, that economic factors make it totally impractical to import sand or gravel and if acceptable sources are identified in the park resource management plan". NPS Special Directive 91-6 provides guidance on how to comply with this policy. In some instances Denali acquires sand and gravel from external sources. For example, gravel was purchased from an outside source for construction of the Visitor Access Center near the park entrance in 1988 (USNPS 1987). Gravel was also purchased in 1992 for a major repair of the park road at Mile 22. However, most of the gravel used in the park has come from in-park sources. As such, it represents the largest category of administrative use of natural resources in the park, and one with potentially the most impact.

Caution needs to be exercised in endorsing and implementing gravel extraction activities in the park. Land acquisition is underway to extinquish private mining in the Kantishna Mining District. Administrative use of gravel must, therefore, be essential for the public good and done in an environmentally sensitive fashion.

The selection and development of gravel pits in a park or along a road can follow different strategies. Standard engineering and economic practices dictate that haul distances be short, which requires numerous gravel pits along a given stretch of road. This results in an obvious impact of more gravel mining sites. A second option is to reduce operational gravel pits and increase haul distances. Though this results in fewer excavation sites, fully loaded gravel trucks driving long distances create an added impact to resources along the road corridor. Additionally, the real cost of gravel becomes extremely expensive.

The use of gravel is currently guided by several park documents. The park completed a Borrow Source Inventory (USNPS 1988a), which identifies and describes 49 new and existing potential sources of borrow material in the park road corridor. In accordance with NPS Special Directive 91-6, park management has determined that it is economically infeasible to obtain gravel for road maintenance from outside Park sources. A document entitled "Gravel Acquisition Plan Environmental Assessment" (USNPS 1992) describes the process for selecting and assessing in-park gravel sources for long-term park road maintenance needs, and evaluates the impacts of the plan. The preferred alternative in the environmental assessment is to provide borrow material from two in-park sources. These include an upland source near Mile 26 on the park road, and a gravel floodplain source on the Toklat River. The plan and environmental assessment provide specific guidelines for gravel extraction limits, techniques, timelines and reclamation plans.

Though the gravel acquisition plan was the first attempt at a comprehensive planning document for gravel use in the park, several problems remain. With the selection of only two gravel sites, the west end of the park road remains without a viable gravel source for road maintenance. Additionally, this plan addresses the use of gravel only for long-term maintenance of the Park Road. This plan does not include individual road repair and rehabilitation projects, trail projects, or other construction or utility-related projects. Any such future projects will require additional planning efforts and environmental assessments. For example, a recent Road System Evaluation for Denali (USNPS 1994) recommends a number of road improvements or upgrades. Several alternatives with various levels of improvements are described in the report. If the recommendations in this report are adopted, additional sources of in-park gravel will have to be identified and assessed, or will have to be purchased from outside sources, estimated to cost at least $10,000,000.

Studies are currently underway to assess the possibility of using the Teklanika and East Fork Rivers as gravel sources, with techniques developed for gravel extraction on the Toklat River. If the technical studies determine that such projects are feasible and meet NPS constraints and requirements, the new sites will supplement in-park sources.

The Entrance Area and Road Corridor Development Concept Plan suggests that additional gravel sources also be located in Kantishna. Specifically, abandoned mine tailings may prove to be useful gravel sources.

In addition to gravel, the park requires other construction materials. Bedding sand and drainrock are required for various construction and utility projects, and sand is used for wintertime road sanding. At the present time, the park is unable to process such material, and must buy required quantities from outside park sources.

Building Sites - Current management actions concerning site utilization for a variety of structures and utilities are guided by several documents, including the 1983 development concept plan for the Denali Park entrance area (USNPS 1983). Recent actions in the past five years

have included site utilization for several permanent housing units in the park headquarters area, and a number of summer housing cabins for seasonal employees at the Toklat road camp. Site locations for structures and utilities are chosen in a fashion which will cluster such features around an established infrastructure, thereby minimizing overall disturbances to other areas. Other guidelines for locating structures include the placement of such structures to be away from areas of public use and public view.

In addition to park policies, several national directives guide site utilization for structures. Executive Order 11988 directs NPS to identify floodplain areas within the park, and inventory all existing and proposed structures and facilities within those floodplain areas. Planning and development activities should recognize and protect floodplains, and restrict construction and other development in such areas. Similarly, Executive Order 11990 specifically prevents construction activities in wetlands unless "there is no practicable alternative" and "all practicable measures to minimize harm to wetlands" are included.

Water Systems - The use of groundwater and surface water systems for potable water supplies for human consumption is guided by both park management concerns and Federal and state laws regarding such systems. Water supply systems, consisting mainly of deep wells, shallow wells, and three surface water systems, are located as to provide high quality water while being as close as possible to the infrastructure requiring the water. Deep wells serve the potable water needs of the park hotel (winter caretaker use), headquarters area, Visitor Access Center, and several campgrounds. This water is chlorinated. Shallow wells served both the Sanctuary and Igloo campgrounds, but they did not meet U.S. Public Health Service requirements. These were closed in 1993. A beaver pond serves as the water source for the Wonder Lake Ranger Station. Surface water is also used as a water source for the Eielson Visitor Center and the park hotel (summer use). Chlorination and filtration serve as the primary treatment for the park's fresh surface water needs.

At present, a monitoring and treatment program implemented by the service insures that drinking water available at park facilities meets established drinking water quality standards. Chlorination (and in three cases, filtration), kills or removes harmful bacteria from tap water, whether from surface or ground sources. The tap water is sampled twice monthly for total coliform. Sources of treated water that do not meet Alaska Department of Environmental Conservation and U.S. Public Health Service standards are closed to all use until the problem is identified and corrected.

In addition to potable water supplies, water is also drafted from surface sources for various maintenance operations. During construction projects, water is used for soil compaction purposes, and is also occasionally used to suppress dust on park roads. Contractors working in the park also use water for construction purposes.

Firewood and Cabin Logs - Firewood is collected in Denali for administrative use in

backcountry cabins during the winter months. Rangers on patrol utilize the cabins for overnight shelters, and therefore require firewood for heating and cooking purposes. A long-standing policy on firewood dictates that all wood gathered for such use will be down and dead. Firewood is generally gathered from the area where the cabin being restocked is located. For some of the remote cabins located in areas that don't have much wood nearby, firewood is hauled in during the winter by dogsled. This firewood is generally supplied by the Maintenance Division, which acquires and collects it during road maintenance and trail clearing operations.

Firewood may also be gathered and used by park visitors for campfire purposes, in campgrounds which specifically allow campfires. A long-standing park policy requires that the wood collected be down and dead, and be in the "nearby vicinity" of the campground.

In addition to firewood, trees may be harvested in the park by qualified subsistence users for domicile construction and other needs. For a complete description of this use, refer to Firewood and Cabin Log Use Project Statement, DENA N-344, (USNPS 1994b). For the reconstruction of historic park patrol cabins, logs are purchased from outside the park and transported into the site.

Incidental use of moss between cabin logs and on roofs also occurs.

Revegetation Materials - Locally obtained seeds are used for restoration of disturbed land, both in mining areas in Kantishna and other areas of the park. The direction for this use of park resources comes from NPS-77 (USNPS 1991b), which states that "...to the maximum extent possible, plantings in all zones will consist of species that are native to the park....Only native species will be allowed in natural zones." In the past several years, seasonal technicians have spent several days each summer gathering seeds for use in the Glen Creek restoration study, and for revegetation of areas along the road in the park entrance area which have undergone reconstruction. Seeds from more than 30 species of plants have been collected in the past to assist with park revegetation research. The most commonly collected seeds to be used for roadside revegetation efforts include legumes and grass species such as *Hedysarum alpinum*, *Oxytropis campestris*, and *Agropyron macrourum*. For revegetation of areas disturbed by mining, species collected include *Alnus crispa* and *Salix alaxensis*.

Museum Collections - The park museum is assigned the task of developing a research study collection of natural history and cultural objects. The research study collection has four primary functions (1) research, (2) baseline inventory, (3) continued monitoring of natural resources, and (4) preservation of voucher specimens from published studies. Items in this collection include biologic, geologic and paleontologic specimens. Cultural objects that pertain to the cultural history of the park including historical, ethnographic, and archeological objects are also collected by the museum. A park document entitled "Scope of Collection Statement and Collection Guidelines" (USNPS 1988b) provides guidelines for the administrative collection of specimens and objects within the park.

A collection of natural history items is also maintained for park visitor interpretation use. The collection is made up of items for which no accompanying scientific data exists, which exclude the items from the research study collection. No official policy for this collection exists, and no collection activities are currently being undertaken at this time.

RECOMMENDED ACTIONS

A. Program Administration and Planning

I-800.001: Develop an Administrative Use of Resources Management Program

An administrative use of resources management program incorporating standardized procedures to assess and use park resources and monitor changes in those resources over time would be developed and implemented. The program would assure that any required environmental assessments be conducted before such use occurs. It would also define criteria to determine if a use is appropriate and would establish standards for resource protection.

I-800.002: Develop GIS Applications

Implement a program to manage all resource utilization data in such a way that it is compatible and readily accessible for use in making sound planning and management decisions. A geographic information system (GIS) is a tool that will allow managers to store, manipulate and analyze data, and produce and display mapped information overlaying critical habitat with other management uses. Layers to be developed for this program include gravel pit locations, seed and plant collection locations, administrative site utilization locations, and others.

I-800.003: Develop a Parkwide Sand, Rock and Gravel Plan

Analyze existing and potential internal and external extraction sites to determine the most cost effective and environmentally sound way to provide sand, rock and gravel for long-term NPS needs and determine needs for maintenance and construction. Conduct a NEPA analysis of the proposed actions and prepare site specific plans to guide on-the-ground mining activities and restoration.

Final documentation should be sufficient to allow NPS implementation of the approved actions without additional NEPA documentation or site planning.

B. Monitoring

I-800.031: Initiate A Monitoring Program For Administrative Use of Resources

A program to systematically monitor all administrative uses of resources within the park would be initiated. Such a program would track different categories, and the quantities associated with each category. For example, the quantities of gravel extracted from in-park sources would be carefully tracked, as would the number of seeds and other plants collected for restoration projects.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Administrative Resources Use Mgmt Plan	13.0/0.25	13.0/0.25	13.0/0.25	13.0/0.25	52.0/1.0
MONITORING					
- Monitor Categories and Quantities	13.0/0.13	13.0/0.13	13.0/0.13	13.0/0.13	52.0/0.52
TOTALS	29.0/0.38	29.0/0.38	29.0/0.38	29.0/0.38	116.0/1.52

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

USNPS. 1983. Development Concept Plan, Denali Park Road Corridor. USNPS, Denali NP&P. 98 pp.

USNSP. 1987. Develop borrow source for visitor access center parking lot and road construction. Draft Environmental Assessment. On file at Denali NP&P, Division of Research and Resource Preservation.

USNPS. 1988a. Borrow source inventory. Unpublished report on file at Denali NP&P; Branch of Water, Air, Geology, and Soils; Division of Research and Resource Preservation.

USNPS. 1988b. Scope of collection and collection guidelines. Unpublished report on file at Denali NP&P.

USNPS. 1991a. Administrative use of in-park borrow materials. Directive, questionnaire, and response on file at Denali NP&P; Branch of Water, Air, Geology and Soils; Division of Research and Resource Preservation.

USNPS. 1991b. NPS-77, Natural resources management guideline. USNPS, Washington, D.C.

USNPS. 1992. Gravel acquisition plan/environmental assessment. Unpublished report on file at Denali NP&P; Branch of Water, Air, Geology and Soils; Division of Research and Resource Preservation.

USNPS. 1994. Road system evaluation, Denali National Park and Preserve, Alaska. USNPS, Denver Service Center.

AIR QUALITY MANAGEMENT

PROJECT CODE: DENA-N-110

SERVICEWIDE ISSUES: N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Present Condition

Denali National Park and Preserve is the only class I air quality area in Alaska, except for three island wildernesses in the Alaska Maritime National Wildlife Refuge. Because of its unique status in the continental portion of this 375 million acre state, ambient air quality monitoring is important in Denali to document baseline conditions and track long term trends.

Existing data have shown that air quality in Denali is excellent, although not always better than sites in the contiguous 48 states. One of the most serious long-term threats to air quality in interior Alaska originates outside the state, and even outside the North American continent. Air pollution transported primarily from Eurasia can form a visible haze in remote areas of arctic and subarctic Alaska (Barrie 1986). Its presence in Denali, a high profile visitor destination, can bring attention to this international environmental issue.

Local threats to air quality in Denali include increasing traffic on the George Parks Highway, which runs near the southern and eastern boundaries of the park, and increasing development in communities near the park, and generation of fugitive dust along the gravel Park Road. Summer visitation brings an influx of such emission sources as campfires, recreational generators, trains and busses. Wildfire smoke routinely causes degradation of air quality in the summertime, though it is not always detectable in areas accessible from the Park Road. Philosophically the NPS regards wildfire smoke as integral to the ecosystem but recognizes that it can create health and safety concerns. Occasionally, volcanic ash originating in the Alaska peninsula is thick enough to be detrimental to human health, electronic equipment, and aircraft engines.

A 25-megawatt coal-fired power plant located 6 kilometers from the park boundary in the town of Healy will expand in 1998 when a 50-megawatt addition begins operation. The new power

plant is a demonstration project for clean coal-burning technology. During the permitting phase of the project, a mitigation agreement was negotiated which lowered total allowable emissions, required retrofitting the existing plant to install low-NO_x burners, and will provide a framework for reducing plume impacts should they occur in the park.

Current Management Actions and Results

Air quality trend monitoring began in Denali in 1980 with the park's inclusion in the 200-site National Atmospheric Deposition Program (NADP) network. As the only network site in Alaska until 1992, Denali plays an important ongoing role in understanding long-term nationwide air quality trends. This role as a trend site has expanded to include two other air quality monitoring networks.

National Park Service Gaseous Pollutant Monitoring Network - Continuous ozone monitoring under the nationwide gaseous pollutant monitoring network was initiated at park headquarters in July 1987 and continues to the present. The following meteorological parameters are recorded hourly in conjunction with ozone monitoring: wind speed and direction, temperature, relative humidity, solar radiation and precipitation.

Interagency Monitoring of Protected Visual Environments (IMPROVE) Network - Particulate samplers collect two 24-hour samples each week. Samples are analyzed for mass, elemental and organic carbon, SO_2, NO_3, elements Na through Pb, H, N, and PM10 mass. Pre-IMPROVE stacked filter units were installed in August 1986, and the IMPROVE samplers have been operating since March 1988.

National Atmospheric Deposition Program (NADP) - Weekly precipitation samples are collected and measured for pH and specific conductance, then sent to a network-operated laboratory to test for the following chemical species: Ca, Mg, K, Na, NH_4, NO_3, Cl, SO_4, and PO_4. The site has been operating since June 1980.

Environmental Monitoring and Assessment Program (EMAP) - In 1997, the park was selected to participate in the EMAP program under the auspices of the DISPro initiative. A Brewer UV-B monitor was installed in late 1997.

Other Programs - A nephelometer was installed in November 1995 to test its operation in subarctic winter conditions, and if successful, measure the light scattering properties of air at ambient temperature.

Integral Vista Designation - The two integral vista sites within Denali are the only ones specifically described in the Alaska Air Quality Control Regulations. The state also designates the four class I areas, in Alaska, as visibility special protection areas. Denali's integral vistas

are (1) Primrose pullout, looking east toward Mount Deborah, and (2) Mile 82 pullout on the park road, looking south toward Mt. McKinley and the Alaska Range.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-110.001: Exercise Affirmative Responsibility to Protect Air Quality, Air Quality Related Values and Integral Vistas

Review environmental documents, plans, and reports on proposed developments inside and outside the park which may adversely affect Denali's air quality. Exercise affirmative responsibility if necessary.

N-110.002: Continue Cooperation with Agencies Responsible for Smoke Management During Naturally Occurring Fires and Prescribed Burns

Management planning and decisions about the use of prescribed fire in the park would comply with all Federal and state air quality regulations. Denali's fire management program would continue to be coordinated with the Alaska Fire Service (Fire Management N-520).

N-110.003: Assess and document Denali's Air Quality Related Values

A document would be produced describing the park's air quality related values, including visibility.

B. Research Actions

N-110.011: Analyze Existing Denali Air Quality Data

Existing air quality data would be synthesized to investigate trends and anomalies. Currently, data is quality checked and archived through each monitoring network, and summarized periodically. These summaries are produced from a national perspective, and provide limited interpretation of local and regional conditions. Analysis of ambient air quality data from the park's monitoring station would promote better understanding of monitoring results, and may be a critical first step toward developing research questions.

N-110.012: Analyze Available Regional Data From Other Alaska Parks and Preserves

Aerosol data from a five year study at six Alaska park units would be located, entered into a database, and analyzed. Comparison with regional background data is essential for interpreting local air quality data. Only a portion of the existing aerosol data, however, has been synthesized, and there are currently no other monitoring efforts in the state which are non-urban, long-term, and multi-site.

N-110.013: Assess Environmental Effects of Dust Control Measures for the Denali Park Road

Dust mitigation measures along the park road would be studied to determine effectiveness and assess environmental impacts (Road Use Impacts I-670).

N-110.014: Support Independently Funded Air Quality Research

The Service would support independently funded air quality research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management I-410).

C. Mitigation

N-110.021: Develop and Maintain an Implementation Plan for Visibility Mitigation in Conjunction with Golden Valley Electric Association

Park staff would meet with local representatives of Golden Valley Electric Association to develop an implementation plan for mitigating visibility impairment should it occur after the new Healy power plant comes on line in 1998. The 1993 memorandum of agreement signed by the United States Departments of Energy and the Interior, the Alaska Industrial Development and Export Authority, and Golden Valley Electric Association, Inc. requires that the power plant must temporarily reduce emissions if it causes visibility impairment in the park. Cooperative planning would promote better communication between park and power plant employees in the event that the mitigation measure must be implemented.

D. Monitoring

N-110.031: Continue Monitoring Atmospheric Deposition, Aerosols, Tropospheric Ozone, and Meteorological Parameters Through Existing Networks

Monitoring would continue, following protocols established by each network steering committee.

N-110.032: Analyze and Interpret Monitoring Data

Data from the park air quality monitoring site would be analyzed and interpreted at least every other year. In spite of its importance, this has not been done with the intent of reviewing the Denali air quality monitoring program or recommending design modifications. Data synthesis and interpretation to date have been accomplished through the national networks, providing only a national context for the park data. Periodic review of monitoring results would help guide the direction of the program and provide valuable information to park managers and interpreters.

N-110.033: Participate in the Design and Implementation of a Sustainable Regional Air Quality Monitoring Network

A small network of air quality monitoring sites would be set up throughout Alaska, to provide a regional background for understanding data from the Denali entrance area. One or two of the sites would be located in or near the southern or northwest areas of the park. Designing the network to be low cost would give it some independence from national competition for air quality network funding by making park and field area support of the sites feasible. This would provide valuable long term spatial and temporal trend data for Alaska.

N-110.034: Implement Air Quality Monitoring Recommended by the Environmental Protection Agency through the Demonstration Index Site Program

The Demonstration Index Site Program has recently been implemented at the park with the installation of a UV-B monitor. Full operation of the site will be evolving over the next several years. Air quality monitoring aspects of the program will be incorporated into the monitoring program at Denali.

E. Interpretation

N-110.041: Coordinate with the Interpretive Staff to Provide Accurate Public Information about Air Quality

Updated information would allow the interpretive staff to educate the public about the importance of Denali's class I airshed and the park's monitoring efforts. Denali's famous vistas and relatively pristine air may help raise public awareness of global air quality concerns such as arctic haze.

N-110.042: Install Air Quality Wayside Exhibit

A wayside exhibit that describes air quality issues in a broad way, will be installed in the proximity of the visitor center.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Protect air quality and related values	2.0/0.1	2.0/0.1	2.0/0.1	2.0/0.1	8.0/0.4
RESEARCH					
- Analyze Existing Data From Denali	25.0/0.5	15.0/0.3			40.0/0.8
- Analyze Existing Regional Data	25.0/0.5				25.0/0.5
MITIGATION					
- Develop and Implement Visibility Mitigation Plan	5.0/0.1	2.0/0.1	2.0/0.1	2.0/0.1	11.0/0.4
MONITORING					
- Continue Current Monitoring Program	35.0/1.0	35.0/1.0	35.0/1.0	35.0/1.0	140.0/4.0
- Analyze Data and Review Study Design		15.0/0.5		15.0/0.5	30.0/1.0
- Participate in Regional Monitoring Program	100.0/1.0	50.0/0.5	50.0/0.5	50.0/0.5	250.0/2.5
- Implement EPA Demonstration Index Site Program	100.0/0.5	25.0/0.5	25.0/0.5	25.0/0.5	175.0/2.0
TOTALS	292.0/3.7	144.0/3.0	114.0/2.2	129.0/2.7	679.0/12.1

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Barrie, L. A. 1986. Arctic air chemistry: an overview. In: Arctic air pollution. Stonehouse, B., ed. Cambridge University Press, pp. 5-23.

Copeland, S., K. Savig, J. Adlhoch, and J. Sisler. 1995. Integrated report of optical, aerosol, and scene monitoring data; Denali National Park - March 1993 through February 1994. Denali NP&P, Denali Park, AK.

Joseph, D. B., and M. I. Flores. 1993. Statistical summary of ozone measurements in the National Park System, 1981-1991, Volumes I and II. Technical Report NPS/NRAQD/NRTR-93/111.

Lynch, J. A., V. C. Bowersox, and C. Simmons. 1995. Precipitation Chemistry Trends in the United States: 1980-1993. Summary Report. National Atmospheric Deposition Program. Natural Resource Ecology Laboratory, Fort Collins, CO. 103 pp.

Sisler, J. F., and D. Huffman. 1993. Spatial and temporal patterns and the chemical composition of the haze in the United States: An analysis of data from the IMPROVE Network 1988-1992. ISSN No. 0737-5352-26.

U. S. Department of Energy. 1993. Final environmental impact statement for the proposed Healy clean coal project; Denali Borough, Alaska. U. S. Department of Energy.

USNPS. 1992a. Denali 1989 gaseous pollutant and meteorological monitoring annual data, NRAQD/NRTR-92/08. U.S. Department of the Interior, NPS, Air Quality Division. Denver, Colorado. 193pp.

USNPS. 1992b. Denali 1990 gaseous pollutant and meteorological monitoring annual data, NRAQD/NRTR-92/09. U.S. Department of the Interior, NPS, Air Quality Division. Denver, Colorado. 197pp.

USNPS. 1993a. Denali 1989 gaseous pollutant and meteorological monitoring annual data, NRAQD/NRTR-93/115. U.S. Department of the Interior, NPS, Air Quality Division. Denver, Colorado. 199pp.

USNPS. 1993b. Denali 1990 gaseous pollutant and meteorological monitoring annual data, NRAQD/NRTR-93/116. U.S. Department of the Interior, NPS, Air Quality Division. Denver, Colorado. 199pp.

USNPS. 1993c. Denali 1991 gaseous pollutant and meteorological monitoring annual data, NRAQD/NRTR-93/117. U.S. Department of the Interior, NPS, Air Quality Division. Denver, Colorado. 199pp.

USNPS. 1993d. Denali 1992 gaseous pollutant and meteorological monitoring annual data, NRAQD/NRTR-93/128. U.S. Department of the Interior, NPS, Air Quality Division. Denver, Colorado. 193pp.

USNPS. 1995. Annual data summary - 1995 - gaseous air pollutant monitoring network. NPSD-278. U.S. Department of the Interior, NPS, Air Quality Division. Denver, Colorado.

USNPS. 1996. Annual data summary - 1996 - gaseous air pollutant monitoring network. NPSD-281. U.S. Department of the Interior, NPS, Air Quality Division. Denver, Colorado.

METEOROLOGY

PROJECT CODE: DENA-N-120

SERVICEWIDE ISSUES: N20 Lack of Basic Data: Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Present Condition

Encompassing over six million acres of land in a subarctic biome, and spanning the Alaska Range with an elevational difference of almost 20,000 feet, Denali National Park and Preserve experiences a wide range of meteorological conditions. Mount McKinley, at 20,320 feet above mean sea level, is the highest point in North America and is widely acknowledged to have some of the most severe weather in the world. The north side of the Alaska Range, with a continental climatic regime, experiences extremely cold but dry winters, while the relatively milder and wetter conditions on the south side are more representative of a maritime/transitional climatic regime. Temperatures of minus 50 degrees Fahrenheit and lower are not unusual on the north side of the range during the winter, and although summer temperatures can climb above 90°F, they can also fall below the freezing mark. Significant amounts of snow have been recorded throughout the park, even during summer months. In August, 1981, for example, Eielson Visitor Center received twenty inches of snow.

While it may not be possible to monitor and document all weather variations within a park as large and diverse as Denali, good geographic and year-round coverage is vital. Meteorological monitoring is important to support studies of other park resources such predator-prey relationships, wildlife forage availability, and glacier mass balance, as well as global climate change. As such, it is a fundamental component of the park's Long-Term Ecological Monitoring (LTEM) program.

Real-time (or near real-time) meteorological data is also extremely important to the National Weather Service (NWS) for meteorologists to accurately forecast the weather. Accurate weather forecasts are particularly critical for mountaineering safety on Mt. McKinley, since severe storms are a significant factor in climber deaths and injuries.

Atmospheric resources of Denali National Park and Preserve are generally considered to be of extremely high quality. Specific threats to air quality conditions in the park are addressed in a separate project statement, Air Quality Management, N-110.

These threats to the park's atmospheric resources are compounded by a basic lack of data concerning atmospheric conditions and processes. Studies of meteorologic conditions on the park are non-existent, and no comprehensive climatological database exists. As a result, there is a basic lack of understanding of atmospheric systems in the park. Without a baseline inventory of the current conditions, understanding atmospheric processes and the influence of the processes on the park resources becomes a difficult task.

Current Management Actions and Results

Meteorological data has been collected in the park since December, 1922 when a weather station was established at the former Mt. McKinley National Park headquarters. This has resulted in one of the longest continuous weather records in Alaska. Weather data for other areas of the park is discontinuous, with seasonal data collected only sporadically in various locations (Wonder Lake Ranger Station, Eielson Visitor Center, and Stampede Mine). None of these data have been digitized or incorporated in a database, and access is difficult and time consuming.

Additional year-round data collection began in 1993, when the remote automated weather stations (RAWS) at McKinley River and Minchumina were winterized, and six weather stations were installed as a part of LTEM program. Geographic coverage of the park is still very poor; eight of the ten existing year-round weather stations are located within two miles of one another, all in the Rock Creek drainage. Very little is known about the weather at higher elevations in the Alaska Range or Kantishna Hills, especially during the winter season.

Many deficiencies exist in Denali's weather monitoring program. The park has no comprehensive network of weather stations gathering data that can be used to characterize regional meteorological conditions. Instrumentation and periods of operation are inconsistent, and in some cases, antiquated.

Meteorological data are currently gathered in the Park under the following programs:

1. NWS Cooperative Network (Park Headquarters)
2. AFS/NIFC RAWS (Lake Minchumina, McKinley River/Slippery Slough, Wonder Lake, Tokositna River)
3. LTEM Program (Rock Creek drainage)
4. NPS Gaseous Pollutant (Ozone) Monitoring Network (Park Headquarters)
5. National Atmospheric Deposition Program (Park Headquarters)
6. NRCS Alaska Cooperative Snow Surveys Program (Five snow courses on the north side

of the Alaska Range and five aerial snow depth markers on the south side)

7. Denali park road use and impact studies (Teklanika Flats and Wonder Lake RAWS)

Data are also collected as part of individual research projects, such as the Drunken Forest slump (mass movement) near mile 5 on the park road, and at Denali Pass near 18,000 feet on Mt. McKinley (by the Japanese Alpine Club).

Additional meteorological information is collected on lands adjacent to the park by the NWS (Cantwell, Healy, McGrath) and the Alaska Fire Service (Telida, Wien Lake).

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-120.001: Create Permanent, Full Time GS-7/9/11 Physical Science Position

This position would provide year-round support for meteorological monitoring functions in addition to other functions in the Water, Air, Geology, and Soils Branch (WAGS) of the Research and Resource Preservation Division (R&RP). A permanent, full-time physical scientist would provide continuity to the meteorological program, and would be responsible for maintaining weather stations, conducting winter snow surveys, organizing and analyzing data, and developing and implementing operational plans.

N-120.002: Create Seasonal GS-5/6 Physical Science Technician Positions

These positions would provide summer season support for meteorological monitoring functions in addition to other duties in the WAGS Branch for the R&RP Division. A seasonal technician would provide necessary assistance in the maintenance of weather stations, installation of new stations, retrieval of data, processing of data, and production of weather data summaries and reports.

N-120.003: Interagency Cooperation for Data Sharing

Park staff would develop close working relationships with other individuals, organizations, and agencies that are collecting meteorological data in interior Alaska with the intention of sharing data to improve regional understanding of climatic patterns and conditions.

N-120.004: GIS Applications

Develop GIS data layers that show locations of weather stations and develop relational

databases of meteorological data.

B. Research

N-120.011: Establish Data Collection, Analysis, and Reporting Protocols for All Weather Stations

Weather data collection at park weather stations would, to the extent possible, be standardized with written protocols. This would preserve comparability between years and between stations and also help protect data integrity.

N-120.012: Encourage Use of Denali Meteorological Data

Independent investigators would be encouraged to use the large body of existing meteorological data in concert with their research activities. Specific attention would be given to its use in statewide weather modelling and development of arctic climatic models.

C. Mitigation

N-120.021: Collect, Organize, and Archive Historic Weather Data

All historic weather data would be located and organized for safekeeping in the park archives. Data would be input to computer database files. NEWS computerized records for the McKinley Park weather station would also be organized, archived, and maintained.

N-120.022: Obtain Complete Records for NWS Weather Stations Near Denali National Park and Preserve

NWS computerized records for the Cantwell, Healy, and McGrath weather stations would be obtained from the National Climatological Data Center and National Weather Service. Records would be maintained and updated as necessary.

C. Monitoring

N-120.031: Replace Manually Operated Weather Station at Eielson Visitor Center with Automated Year-Round Stations

The station currently operated at Eielson Visitor Center would be converted to an automated system to provide year-round weather data. Real-time data from Eielson would allow the NEWS to provide more accurate forecasts for the western half of the

park road. This would be valuable to the Division of Protection and Visitor Services, which relies heavily on weather forecasts when dealing with road closures during storms.

N-120.032: Establish Additional Automated Weather Stations for Research and Safety Applications

Additional weather stations would be established to support research projects, and for safety considerations. Most areas in the park are remote and difficult to access. Because of the need for year-round real-time data, stations should be automated with the best possible communications and data transmission/retrieval hardware. The most desirable system would allow two-way communication between the weather stations and NPS personnel at park headquarters using cellular phone modems. This would allow remote data retrieval and maintenance/diagnosis of problems. It is expected that cellular phone coverage areas will increase and that, in the future, these systems will provide the best possible means of maintaining the integrity of Denali's weather station network. The next most useful alternative to cellular phone modem technology is a one way satellite telemetry link from the stations to a receiving/data archiving center in the conterminous 48 states.

Mt. McKinley: Meteorological data from the 14,000 to 17,000 foot level on Mt. McKinley would be valuable not only for research applications, but also for mountaineering safety. Access to real-time or near real-time weather data would assist the NEWS in weather forecasting for Mt. McKinley, would allow the NPS rangers to more accurately assess current conditions in emergency situations and would provide prospective climbers with accurate information on the conditions they can expect to encounter.

Benchmark Monitoring Glaciers: Mass Balance studies on selected benchmark glaciers in Denali National Park and Preserve require accurate data on local weather conditions (Glacial Resources Management, N-314). Automated weather stations should be established near glaciers which are being monitored for mass balance changes. Basic weather parameters should be monitored, including; wind speed and direction, total precipitation, snow depth, air temperature, relative humidity, and solar radiation.

N-120.033: Upgrade Existing Weather Monitoring Stations With Modern Communications Equipment

Existing automated weather monitoring stations in Denali National Park and Preserve should be upgraded with the best possible communications equipment. Wherever possible, hardware which would allow two-way communications between the station and staff at park headquarters should be employed. If two-way communications though cellular phone or radio frequency (RF) modem are not feasible, satellite telemetry

transmitters should be used.

N-120.034: Increase Meteorological Monitoring as Part of the Long Term Ecological Monitoring Program

A long-term, comprehensive program to monitor the park's climatic conditions would be developed and implemented as an element of the Long-Term Ecological Program (Project Statement I-210). To improve geographical coverage of the park, additional automated meteorological stations would be established in drainages that are representative of the park's different climatic regimes.

D. Interpretation

N-120.041: Develop Interpretive Displays at Visitor/Information Centers

Possibly develop displays at the Talkeetna Mountaineering Contact Station and Eielson Visitor Center that would provide the public with a better understanding of the environmental extremes on Mt. McKinley and would further climber awareness and safety. Displays could incorporate real-time weather data transmitted from a weather station on Mt. McKinley.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- PFT Phys. Sci. GS 7/9/11		40.0/1.0	40.0/1.0	40.0/1.0	120.0/1.0
- Seasonal Phys. Sci. Tech. GS 5/6	10.0/0.3	10.0/0.3	10.0/0.3	10.0/0.3	40.0/1.2
MITIGATION					
- Collect and Archive Data for Park and Adjacent Areas	1.0/0.1	1.0/0.1			2.0/0.2
- Data Collection Protocol	1.0/0.1	1.0/0.1	1.0/0.1		3.0/0..3

MONITORING					
- Automated Weather Station at EVC	10.0/0.0	0.5/0.0			10.5/0.0
- Additional Automated Weather Stations	30.0/0.0	30.0/0.0	10.0/0.0	10.0/0.0	80.0/0.0
- Weather Station Communications Equipment Upgrades	20.0/0.0	20.0/0.0	20.0/0.0	20.0/0.0	80.0/0.0
INTERPRETIVE ACTIONS					
- Interpretive Displays at Visitor Centers	5.0/0.0	5.0/0.0	5.0/0.0		15.0/0.0
TOTALS	57.0/0.5	97.5/1.5	66.0/1.4	60.0/1.3	360.5/2.7

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Searby, H.W. 1970. Climatic summaries of resort areas, Mount McKinley National Park. U.S. Department of Commerce, Environmental Science Services Administration, Environmental Data Service. Anchorage, Alaska.

WATER RESOURCES MANAGEMENT

PROJECT CODE: DENA-N-210

SERVICEWIDE ISSUES:

- N10 Disruption of Park Resources Due to Mineral Extraction Activities
- N11 Degradation of Park Water Quality Due to External Activities
- N20 Lack of Basic Data: Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Present Condition

The water bodies, including subsurface waters, of Denali National Park and Preserve are generally considered to be of high quality. However, localized impacts have led to serious degradation of park water resources in some areas. Mining activities, prior to 1985, in the Kantishna Hills region led to serious deterioration of many water quality parameters, including turbidity, suspended solids, and heavy metals contamination. Stream channels have been straightened, resulting in erosion of stream beds. Additionally, hundreds of acres of riparian habitat were destroyed or altered, upsetting the function of floodplains in the riparian ecosystem. Other, more recent threats to water quality in Denali include a sharp increase in recreational visitor use of rivers and streams on the East side of the park. As visitation and recreational development along the Nenana River and Moose Creek continue to increase, pressures from commercial rafting trips, powerboats, air boats, resorts, and concession facilities may result in additional impacts of litter, petroleum byproducts, noise pollution, and accelerated bank erosion from wave generation. Similar changes are likely to occur on the south side of the park as recreational use, development, and the tourism industry all expand.

Water quantity concerns relate to modification of instream flows that impact aquatic and riparian resources and habitat, navigation, water quality, and recreation/aesthetics. While this is not a significant concern for in-park waters, it is a concern for bordering or adjacent waters. In light of this concern, the Alaska Department of Fish and Game has an instream flow application on file to provide protection for a portion of the Nenana River.

These threats to the park's natural waters are compounded by a basic lack of data concerning

those waters. Studies of water quality in Denali have been sporadic in the past, and generally focused on the Kantishna Hills mining district. No comprehensive database exists for water quality, stream discharges, lake levels, or visitor use levels. As a result, there is a basic lack of understanding of the park water systems. Without a baseline inventory of current conditions, understanding water resource ecosystems, and the threats to those ecosystems, becomes an almost impossible task.

Current Management Actions and Results - Surface Waters

Surface Water Status - Denali's surface water system is immense. Over twenty major glaciers, some among the longest in the world, feed numerous silt-laden braided rivers. Upland spruce forests support small clear water streams, which are fed from snow-melt. In the northwest corner of the park, a vast, untracked expanse of flat boggy tundra features numerous lakes, ponds, and wetlands.

Limited databases exist for stream water quality and discharge; no databases exist for lake information or visitor use levels of lakes and streams. Occasional studies have occurred over the past twenty years, but most have focused on the Kantishna Hills district. Currently, one watershed (Rock Creek near headquarters) has an ongoing data collection study including water chemistry and discharge. The USGS operated a gaging station on the Teklanika River from 1965 through 1974, from which daily discharge data is available. Bedload studies were conducted on the Toklat River in 1988 and 1989. The NPS Water Resources Division has completed a database of all available water quality information from the EPA STORET database and others for Denali. GIS coverage is available for three layers, including USGS gaging stations, water quality sites, and municipal and industrial discharge sites. Additionally, the park has a GIS layer of the park's hydrography, based on photo-updated USGS quad maps (scale 1 inch to 1 mile).

Floodplain Identification and Management - Floodplains are areas of land that are susceptible to being periodically inundated by either river or lake waters, but are normally not submerged. A 100-year flood is a discharge of given magnitude with a 1 percent chance of being equalled or exceeded in any given year. The 500-year flood has a 0.2 percent probability of occurrence.

It is important to identify areas that may be subject to flooding and to determine the possibility of such flooding by establishing boundaries for the 100 and 500-year floodplains. A brief assessment of the status of development within floodplains in Denali follows:

-Some parts of the Toklat Road Camp, including the autoshop, leach field, propane storage tank, and refuse piles, are most likely within the Toklat River floodplain. Though these entities are located on a lightly vegetated bench and are not in danger of catastrophic failure, they could be subject to damage by long-term erosion. This same type of erosion destroyed the Toklat heliport and caused the relocation of an adjacent storage shed in 1992.

-The lower section of the Teklanika Campground may be located within the Teklanika River floodplain. Again, catastrophic failure is not likely, but damage to campground facilities could occur.

-Denali Backcountry Lodge (formerly Denali Mountain Lodge), a privately owned commercial lodge in Kantishna, is within the Moose Creek floodplain. Though on private land, attempts to install flood control structures could affect adjacent NPS lands.

The National Park Service is responsible for implementing the Executive Order on Floodplain Management (11988). In addition to this Executive Order, guidance for floodplain management is derived from NPS Special Directive 93-4 (Floodplain Management - Revised Guidelines). These guidelines, dated August 11, 1993, require identification of the floodplain areas within the park and an inventory of the existing and proposed structures and facilities (e.g. buildings, campsites and rest stops). Planning and development activities in the park should recognize and protect floodplains, and restrict construction and other development in such areas. This management policy would allow natural floods to occur without loss of lives or property.

Mining Activities and Impacts - Since 1905, the Kantishna Hills have been mined, both for placer and lode deposits of gold. Gold production dropped off several times over the years, but resumed in force in 1972, when the price of gold was de-controlled. In 1980, the Alaska National Interest Lands Conservation Act (ANILCA) was passed, which incorporated the Kantishna Hills mining district into Denali National Park and Preserve. Placer mining continued until the end of the 1985 season, when a lawsuit forced a moratorium on all mining until an Environmental Impact Statement (EIS) could be prepared to document and evaluate cumulative effects from such mining.

The documented effects from mining on the aquatic ecosystem in Kantishna were considerable. Impacts on water quality included decreased dissolved oxygen, depressed pH, increased concentrations of organic substances, increased turbidity, and increased water temperature. Impacts on channel morphometry included increased gradient, increased average width, increased floodplain icing, reduced stream length, and increased braiding. Other impacts included reduced instream cover material and shade, the reduction or elimination of some fish communities, and the loss of riparian habitat (USNPS 1990). Additionally, surface runoff from tailing piles associated with several ore-processing mills is contaminated with heavy metals.

In 1990, the EIS was completed and the moratorium on mining was lifted. Since that time, claimants have been required to submit mining Plans of Operation for evaluation prior to resuming operations. Concurrently a land acquisition program has been undertaken. Through acquisition and abandonment, the Service has inherited numerous claims with drums of hazardous materials and lead-acid batteries, which, if left on site, will corrode and enter surface waters, soils, and possibly ground waters.

Recreational Impacts - With the exception of the Nenana River, most of the park's water resources presently receive little, if any, recreational use. Several reasons contribute to this, including lack of access, difficult recreational boating conditions, flow fluctuation, and little or no fisheries. Wonder Lake and Moose Creek experience some recreational use from campground users and Kantishna-area lodge guests, including canoeing, swimming, fishing, and rafting. However, this use is very light, and specific impacts to water resources have not been noted to date.

The Nenana River corridor along the park's eastern boundary represents the greatest recreational opportunities for water resources. With close proximity to Fairbanks and Anchorage, outstanding scenery, and easy and plentiful access, the Nenana River represents one of the premier recreational rivers in Alaska. Thirty-six miles of upland frontage is owned and managed by the National Park Service. Recreational opportunities and uses in this area include rafting (commercial and private), canoeing, kayaking, powerboating, camping, and fishing. Though no public agency has been collecting use information on the Nenana River as a whole, the National Park Service estimates that 21,500 people floated the river along part or all of the park boundary in 1990 (Alaska Dept of Natural Resources 1991).

Several impacts by all types of river users may be noted, including litter and wildlife disturbance. Many people feel, however, that powerboat use provides the majority of impact to the resource, including increased erosion rates, fish mortality due to spawning bed disturbance, fish mortality due to physical contact with propellers or jet units, loss of fish habitat due to channel morphology changes, and deterioration of water quality due to gasoline and oil pollution of water. It is important to note that only anecdotal evidence exists to support these claims, as no studies or monitoring programs have occurred to investigate this situation.

Giardia lamblia is believed to exist natural in surface waters of the park but baseline conditions are not well established. The contamination of Denali's watersheds by *Giardia* cysts may also be a direct result of recreational use. Humans infected with Giardiasis may infect a water source by defecating nearby; surface storm runoff then carries the *Giardia* cysts from their location of deposit to the water source (Friedman 1983). Though the Service warns hikers of the potential of waterborne infection by *Giardia* in Denali, only limited studies have been conducted in the park to investigate the extent and methods of transmission of the *Giardia* cysts (Saltonstall 1988).

Impacts From Commercial Businesses - Commercial development in two areas of Denali have the potential for degradation to water quality. In the past twelve years, an extremely concentrated area of development has arisen between Mile 238 and Mile 239 of the Parks Highway, just to the North of the park's main entrance. This development is located in a narrow band along the highway, with much of it sandwiched between the highway and the Nenana River, and consists of a wide range of businesses, including hotels, restaurants, campgrounds, rafting companies, helicopter flightseeing, and bus parking and maintenance

facilities.

Domestic and industrial wastewaters generated by these businesses represent the most obvious threat to water quality in the Nenana River along the border of the park. The Alaska Department of Environmental Conservation regulates treatment and disposal of wastewater, and generally requires a permit of any system generating more than 500 gallons per day. Discharge after treatment from the two largest businesses along the Nenana River include both subsurface land and surface water discharge. Downstream cumulative effects from the discharge of wastewater effluent into the Nenana River could include such factors as an increased biochemical oxygen demand (and lower dissolved oxygen), increased suspended solids, fecal coliform bacteria, and an altered pH.

In addition to these point sources, the Nenana River may also be threatened by pollutants carried by surface runoff. Non-point pollution from such a developed area can include oil, gasoline and other organics; sediment; heavy metals; nutrients; and microbial agents. This non-point pollution is neither regulated nor monitored, and no information exists concerning the extent (if any) of downstream water quality degradation along this reach.

The second water body in the park subject to possible water quality threats from commercial businesses is Moose Creek in the Kantishna Hills. Four lodges and a campground are located along a 3-mile reach of Moose Creek. The park does not currently have any information on the types of wastewater treatment processes used by these businesses. Additionally, no sampling has been conducted in this area to determine if any water quality degradation is occurring along this reach due to wastewater effluent discharge.

Impacts from Transportation Corridors - Three primary transportation corridors bisect the park. One is the macadam George Parks Highway and another is the macadam and gravel park road. The third is the Alaska Railroad right-of-way. The railroad and both roads cross over streams and rivers or follow courses parallel and immediately adjacent to waterways. In some cases, stream courses have been physically modified to accommodate surface transportation. Surface runoff pollutants, as described above, may originate on the railroad and the roadways. Other substances which influence water quality include gravel dust, particle binders, and deicing agents. The extent of water quality degradation (if any) from this source has not been characterized (Road Use Impacts to Natural Resources, DENA-I-670).

Impacts from Hazardous Materials Utilization - Hazardous materials use is associated with numerous human activities in the park and poses threats to park waters. A detailed discussion of those uses and threats can be found in the project statement titled Hazardous Materials and Waste Management, DENA-I-700.

Current Management Actions and Results - Groundwater

Groundwater Status - Almost no information is known regarding the presence or quality of subsurface aquifers in the park. Groundwater availability is limited in northern and central Alaska by permafrost. Much of the park is underlain by discontinuous permafrost, the presence of which is determined by local drainage, topography, and surface insulation. Limited information on soil conditions and groundwater tables exist in the form of well logs from several wells drilled in the hotel and headquarters areas, as well as a few others located in campgrounds along the park road.

Wastewater Disposal - A variety of sewage disposal methods serve Denali's facilities and campgrounds. An open sewage lagoon treats wastewater from the Riley Creek campground, Visitor Access Center, and park hotel. This lagoon also treats waste pumped from seven campgrounds and reststops along the park road. Two campgrounds, as well as the Wonder Lake Ranger Station, Toklat Road Camp, Park Headquarters, Eielson Visitor Center, and C-Camp residential area, all support individual septic tank/leach field operations. Virtually all pit toilets in the park have been eliminated or replaced with chemical toilets within the past 10 years.

Though the sewage lagoon has adequately served the disposal needs of the park to date, it is currently operating at maximum capacity, and will not support any additional development demands in the park. Additionally, open sewage lagoons will not function in winter-time temperatures, and this may serve as a limiting factor when considering early spring and late fall operations of the park hotel and Visitor Access Center.

Potable Water - Deep wells serve the potable water needs of the park hotel during the winter, headquarters area, Visitor Access Center, and several campgrounds. Chlorination serves as the primary treatment for most of the park's fresh water needs. Shallow wells which served both the Sanctuary and Igloo campgrounds did not meet U.S. Public Health Service requirements, and have been shut down. A beaver pond serves as the water source for the Wonder Lake Ranger Station. This water is both filtered and chlorinated before use. Surface water is also used as a water source for the park hotel in the summer and the Eielson Visitor Center, and receives chlorination treatment.

Because of the perceived high quality of surface waters and the relative inaccessibility of readily available ground water, many backcountry users rely on the park's surface water for drinking and other domestic uses. Bacterial contamination may be present from naturally occurring soil and water microorganisms and from those associated with human and animal wastes (e.g., fecal coliform, fecal streptococci, pathogens including *Giardia lamblia* and the hepatitis virus). A comprehensive survey for microscopic contamination, including E. coli and giardia, has never been undertaken in DENA. Because of this, backcountry visitors to Denali are advised to boil or otherwise treat water for cooking and drinking that is drawn from lakes or streams.

At present a monitoring and treatment program implemented by the Service insures that drinking water available at park facilities meets established drinking water quality standards. Chlorination (and in one case, filtration), kills or removes harmful bacteria from tap water, whether from surface or ground sources. The tap water is sampled twice monthly for total coliform. Sources of treated water that do not meet Alaska Department of Environmental Conservation and U.S. Public Health Service standards are closed to all use until the problem is identified and corrected.

Landfill Leachates - In past years, the National Park Service has operated two modest landfills to dispose of park generated solid waste. One landfill is located at Mile 234 of the George Parks Highway; the other is located at Mile 5 of the park road. These sites are inactive and will not be reactivated. It is suspected that hazardous materials were probably disposed of in these sites in years past but no records exist documenting disposal. Likely products include paints, solvents, cleaning agents, and household chemicals. Both landfills are listed with the Environmental Protection Agency as CERCLA sites. Park staff frequent these sites in the course of routine operations but have not observed any outward evidence which leads them to believe that leachate problems exist. More rigorous monitoring may be warranted.

Solid waste disposal is currently handled through a contractor who hauls waste to area landfills outside of the park.

Underground Storage Tank Program - In recent years, problems with Underground Storage Tanks (UST) have gained prominence both nationally and locally. In response to this, NPS has developed an UST program to inventory and monitor the 25 underground storage tanks located within the park. The program includes precision tightness testing of tanks and piping, planning for in-tank monitoring, and upgrading regulated tanks according to EPA and state UST regulations. Additionally, old unregulated tanks will be removed and replaced as funding allows.

In addition to monitoring tanks, NPS has developed the capability to treat contaminated soils excavated in oil spill and tank cleanup situations. Depending on circumstances, the park may treat contaminated soils in the future by constructing on-site remediation cells, or by shipping soils to nearby treatment facilities. Fairly inexpensive treatment facilities currently exist in nearby Fairbanks, and the park may ship contaminated soils to such a facility for treatment in the future.

The park has several known problems related to fuel and underground storage tanks. During the winter of 1972, a rail car with 10,000 gallons of "oil" (presumably #1 diesel for park generators) was emptied onto the ground. In 1991, an unused well in the vicinity of the spill was found to have a column of fuel approximately 50 feet tall on the water. Analysis of water from other unused and active water wells in the area did not reveal any evidence of contamination. Approximately 120 gallons of fuel was subsequently pumped out of the well,

and no additional contamination has occurred to date.

Additional problems involving leaking underground tanks have been uncovered. An assessment at one site where two old heating oil tanks were removed in 1991 found evidence of leakage and soil contamination. The contaminated material was excavated and placed in remediation cells. Additional diesel petroleum contamination was also discovered underground in the vicinity of a leaking fuel oil transfer pump. The contamination is fairly localized and seems to be contained by an impervious clay layer about 12' below the pump. Approximately 100 cubic yards of material have been excavated and will be remediated to meet site cleanup goals. Other action the park has taken is the removal of two underground heating oil tanks at the Eielson Visitor Center, which were replaced by a single aboveground tank. The park is also planning removal and replacement of two 10,000 gallon, 34 year old heating oil tanks, which NPS feels represent a significant risk of leaking. Additionally, the park plans to replace single-wall fuel piping with double-wall piping.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-210.001: Develop Water Resources Management Plan

This plan would protect and preserve the high quality of surface and ground water resources in Denali and correct current water quality degradation problems. The major elements of the plan are described below. In 1985, preliminary information was gathered for plan preparation but the plan was never written.

N-210.002: Develop Hazardous Materials Spills Contingency Plan

The Service would develop and implement a hazardous spill contingency plan for the park. The plan would recommend actions to prevent hazardous materials spills and have an adequate response capability should one occur. Facilities in the park would be inspected for spill prevention features, and spill containment and cleanup materials would be available at NPS, concession and resort facilities. (Hazardous Materials and Waste Management, DENA-I-700)

N-210.003: Create Seasonal Physical Science Technician Positions

Seasonal technicians would be needed to implement the water resources management program. Technicians would conduct water quality monitoring, map water resources, assist in response to spills and in reclamation activities.

N-210.004: Coordinate Water Resources Program with Other Agencies

The Service would coordinate water resources programs in Denali with the Army Corps of Engineers, U.S. Geological Survey, Federal Energy Regulatory Commission, Alaska Department of Environmental Conservation, Alaska Department of Natural Resources, Alaska Department of Fish and Game, U.S. Public Health Service, Denali Borough, and local resort communities to assure clear communications and to foster joint efforts toward resolving concerns.

N-210.005: Consider Water Resources in All Land Use Planning

Adequate consideration for water resources and water quality values will be ensured in all land-use planning and decision making processes by mitigating impacts to the maximum extent possible and consistent with law or policy.

B. Research

N-210.011: Conduct Water Quality Research Parkwide

The National Park Service would conduct a comprehensive, problem oriented research program that would provide management with factual knowledge of water resources in Denali in order to protect, preserve, and in some areas, improve water quality. The physical, chemical, and biological quality of Denali's major lakes, clearwater streams, and major tributary streams would be intensively studied every five years to document status and trends.

N-210.012: Conduct Research on Methods to Enhance Riparian Zone Ecosystem Recovery in Watersheds Disturbed By Placer Mining

Research has been conducted since 1988 in the Glen Creek watershed. The Service would continue to conduct a comprehensive research program which would address the development of techniques for stabilization and rehabilitation of stream channels and floodplains disturbed by past and future placer mining activities. Physical, chemical, and biological parameters of the main study site and control site would continue to be monitored intensively each field season.

N-210.013: Conduct Research on the Effects of Hydrocarbons and Other Pollutants Released by Motorboats, Snowmobiles, and Motor Vehicles on Park Resources

The service would conduct a comprehensive, problem oriented research program that would provide management with factual knowledge of the water pollution problems

associated with the use of gasoline powered vehicles in the park. The research would identify aquatic environments that are sensitive to such pollutants and suggest measures to mitigate any impacts.

N-210.014: Identify and Manage Flood Hazard Zones in Denali

In cooperation with the U.S. Geological Survey and NPS Water Resources Division, the Service would conduct a comprehensive, problem oriented research program that would provide management with factual knowledge of the 100 and 500 year floodplains in Denali. These flood hazard zones would be mapped, incorporated into the geographic information system and recommendations for modifying activities and developed sites and facilities within these zones to reduce risk would be made and implemented. (Geologic Hazards Management, DENA-N-312)

N-210.015: Document Local Business Wastewater Systems

An inventory of the wastewater systems used by businesses along the Nenana and Moose Rivers, including such factors as type, capacity, and effluent discharge, will be conducted.

N-210.016: Assess the Condition of and Management Options for Channelized Streams

Stream courses have been altered in various locations along the park road corridor, particularly in Igloo Canyon. This alteration should be documented and options for maintenance or restoration should be examined.

N-210.017: Assess the Impacts of Dust Palliative Use

The service is currently testing various dust palliatives on the park road to improve air quality and aesthetic conditions. The impact of the proposed products on natural resources, including water resources is unclear. Those impacts would be assessed (Road Use Impacts to Natural Resources, DENA-I-670).

N-210.018: Support Independently Funded Water Resources Research Projects

The service would support independently funded water resources research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities when deemed appropriate by park management. The park would provide temporary housing and logistical support for field and laboratory work (Research Administration and Management, DENA-I-410 and Biosphere Reserve Management, DENA-I-420).

C. Mitigation

N-210.021: Continue Operation and Maintenance of Water and Wastewater Systems

The service would continue routine operation and maintenance of water and wastewater systems associated with administrative and visitor use facilities, including potable water testing.

N-210.022: Conduct Clean-up Operations of Contaminated Mine Sites

On abandoned and acquired mining claims, clean-up and of drums and lead-acid batteries will continue. In conjunction with the U.S. Bureau of Mines, the remediation of contaminated tailings piles at Red Top, Stampede, and Slate Creek mines will be conducted.

N-210.023: Conduct Reclamation of Placer-Mined Sites

As directed by numerous federal regulations and the 1990 EIS of the cumulative effects of mining, the service would continue to reclaim abandoned and acquired placer mines, including channel and floodplain reconstruction and upland recontouring and revegetation.

N-210.024: Replace Underground Storage Tanks

The service would continue the current program of testing and replacing older underground fuel storage tanks, both regulated and unregulated, throughout the park. Additionally, the service will continue to develop the capability for on-site contaminated soil bioremediation.

N-210.025: Eliminate Permanent Facilities from the 100 and 500-year Floodplains

After the boundaries of these floodplains are determined, construction of inappropriate permanent facilities in these areas would be prohibited.

N-210.026: Management of Hazardous Materials Spills

The Service would develop and implement a hazardous spill contingency plan for the park. The plan would recommend actions to prevent hazardous materials spills and have an adequate response capability should one occur. Facilities in the park would be inspected for spill prevention features, and spill containment and cleanup materials would be available at NPS, concession and resort facilities. (Hazardous Materials and Waste

Management, DENA-I-700)

D. Monitoring

N-210.031: Monitor Potable and Test Well Water Quality

The existing program to monitor drinking water supplies at administrative and visitor use facilities by the Maintenance Division would be continued. A program to monitor ground water supplies and quality in the park would be expanded, particularly in the vicinity of sewage treatment facilities.

N-210.032: Increase Water Quality Monitoring Parkwide

A long-term, comprehensive program to monitor the physical, chemical, and biological quality of Denali's major lakes, clearwater streams and major tributary streams would be developed and implemented as an element of the Long-Term Ecological Monitoring Program (Long-Term Ecological Monitoring, DENA-I-210).

N-210.033: Monitor External Threats to Park Water Quality

In conjunction with other federal, state, and local agencies, the service would evaluate the impacts of a variety of activities outside the park on Denali's' water quality and resources. Particular attention would be focused on recreational boating, road construction, railroad operations, and potential mining (i.e., gold and coal) activities adjacent to the park. Additionally, both point source and non-point sources of pollution from commercial businesses would be identified and monitored.

N-210.034: Continue Monitoring and Inventory of Underground Storage Tanks

The service would continue to monitor all underground tanks for leakage with in-tank monitoring devices. This program shall be conducted in compliance with the State of Alaska Department of Environmental Conservation and EPA regulations.

N-210.035: Conduct Periodic Monitoring Adjacent to Park Landfills

Surface and groundwater quality testing should be completed periodically adjacent to the park's inactive landfills.

E. Interpretation

N-210.041: Increase Public Information about Water Quality

Interpretive media would be used to explain to visitors the effects of poor sanitation practices and air pollutants in natural areas on public health and provide instruction on desirable minimum impact sanitation practices. Visitors would be informed of proper treatment of water for drinking or cooking.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Water Resources Mgmt Plan	12.0/0.1	0.0/0.0	0.0/0.0	0.0/0.0	12.0/0.1
- Spill Contingency Plan	0.0/0.0	12.0/0.1	0.0/0.0	0.0/0.0	12.0/0.1
RESEARCH					
- Parkwide Research	0.0/0.0	40.0/0.2	40.0/0.2	0.0/0.0	80.0/0.4
- Riparian Zone Ecosystem Recovery	0.0/0.0	40.0/0.2	40.0/0.2	40.0/0.2	120.0/0.6
- Hydrocarbon Impacts	0.0/0.0	0.0/0.0	25.0/0.0	25.0/0.0	50.0/0.0
- Flood Hazard Zone Delineation	0.0/0.0	15.0/0.2	15.0/0.2	0.0/0.0	30.0/0.4
- Document Wastewater Systems	0.0/0.0	10.0/0.1	10.0/0.1	0.0/0.0	20.0/0.2
- Channelization Study	0.0/0.0	0.0/0.0	20.0/0.1	20.0/0.1	40.0/0.2
- Dust Palliative Study	0.0/0.0	15.0/0.1	15.0/0.1	0.0/0.0	30.0/0.2
MONITORING					
- LTEM Program	0.0/0.0	40.0/0.5	40.0/0.5	40.0/0.5	120.0/1.5
- Monitor Threats	0.0/0.0	10.0/0.1	10.0/0.1	10.0/0.1	30.0/0.3
- Water Resources Database	0.0/0.0	15.0/0.2	15.0/0.2	15.0/0.2	45.0/0.6
INTERPRETATION					
- Public Information	0.0/0.0	5.0/0.0	5.0/0.0	5.0/0.0	15.0/0.0

TOTALS	12.0/0.1	202.0/1.7	235.0/1.7	155.0/1.1	604.0/5.2

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Alaska Dept. of Environmental Conservation. 1990. Alaska's groundwater protection strategy. Water Quality Management Section, DEC. 17 pp.

Alaska Dept. of Environmental Conservation. 1990. Alaska nonpoint source pollution control strategy. Water Quality Management Section, DEC. 93+ pp.

Alaska Dept. of Environmental Conservation. 1993. Alaska water watch, partners in environmental stewardship. Water Quality Management Section, DEC. 28 pp.

Alaska Dept. of Natural Resources. 1991. Nenana River corridor recreation study. Study conducted by USNPS. 125 pp.

Deschu, N. 1985. Water resources management plan: preliminary information - Denali National Park and Preserve. Alaska Regional Office, National Park Service. 14 pp.

Friedman, H. D., 1983. Effectiveness of water treatment for *Giardia*. Project paper for University of Alaska Fairbanks, Environmental Quality Science Department. 93 pp.

Saltonstall, W. L., 1988. *Giardia* in Denali National Park. A preliminary study. Unpublished report. On file in Division of Research and Resource Preservation, Denali NP&P.

USNPS. 1990. Cumulative impacts of mining final environmental impact statement, Denali National Park and Preserve. Denver Service Center, Denver, CO. Vol. I.

USNPS. 1995. Baseline water quality data inventory and analysis, Denali National Park and Preserve. NRTR-95/55. U.S. Department of the Interior, NPS, Water Resources Division. Ft. Collins, Colorado. 268+pp.

AQUATIC INVERTEBRATES

PROJECT CODE: DENA-N-240

SERVICEWIDE ISSUES: N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Present Condition

Aquatic macroinvertebrates are an important link in the aquatic food chain. These stream and lake dwellers feed on algal growth and detritus, and in turn are fed upon by both fish and birds.

Macroinvertebrates are widely used as biotic indicators of aquatic health. They reflect the health of a system over a period of time rather than at one point as displayed by chemical analyses. The presence of certain groups of macroinvertebrates is used as an indicator of water quality. The groups of particular significance are the Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), often referred to as EPT.

During short-term exposure to water of poor quality or adverse changes in habitat, organisms that cannot tolerate the stress are destroyed and the aquatic macroinvertebrate community structure changes. Since aquatic organisms respond to their total environment, they can become an effective tool for detection of environmental changes. Unimpaired streams typically support a wider diversity of taxa than do impaired streams.

Several factors make the collection and identification of benthic invertebrates difficult. There is a very clear sequence of events in the invertebrate benthos. Many species appear and disappear from collection sites at intervals throughout the year as one species after another completes its development. Additionally, because of the way that macroinvertebrates occupy space within stream environments, it generally takes at least three sample sites to represent the community accurately at a given station.

Identification of macroinvertebrates is an extremely difficult task. Because of the large number of species, the similarities between various types, and the various stages of development in which the organisms may be at the time of sampling, identification is necessarily a task left to a well-trained and experienced technician.

A paucity of data exists concerning the abundance and diversity of aquatic macroinvertebrates in Denali's rivers and streams. Due to the difficulty in identification, a species count of invertebrates in the park is impossible at this time, but is estimated to number in the hundreds. At least 20 different families have been identified in streams and rivers in the interior area of Alaska.

Several studies concerning the effects of mining on macroinvertebrates in the Kantishna Hills area were conducted in the 1980s. Mangum (1986) conducted an inventory of aquatic macroinvertebrates on thirteen streams in the Dunkle and Kantishna mining areas. Oswood et al. (1990) investigated the effects of heavy metals contamination from mining sites on macroinvertebrate abundance, taxonomic richness, and trophic structure. During that investigation, Oswood also found two stonefly nymphs near Wonder Lake which couldn't be identified from the nymphal stage. The nymphs were collected and reared from nymph to adult. As a result, one species was identified (*Isoperla katmaiensis*).

There are currently no known human health risks from mosquitos or other aquatic insects acting as disease-carriers in Alaska.

Current Management Actions and Results

Several long-term aquatic macroinvertebrate studies are currently being conducted in the park. Benthic invertebrate sampling has been conducted on Glen Creek and other streams in the Kantishna Hills since 1990 in support of a stream reclamation study (Karle and Densmore 1994). The goal of the study is to develop methods and techniques to restore natural functions to stream channels and floodplains disturbed by mining. Results from the benthic invertebrate sampling will be used to assess the success of various techniques employed, especially as compared to sampling from an undisturbed adjacent stream.

Sampling and analysis of macroinvertebrates are also being conducted as a component of a long-term ecological monitoring program being conducted in Denali (Milner and Gabrielson 1993). The LTEM program is an intensive multi-disciplinary research program, currently focused in Rock Creek near park headquarters. Macroinvertebrate sampling has occurred in Rock Creek, as well as a number of other streams located throughout the park. Information from this program will be used to address immediate management resource concerns at Denali, and to help address major scientific questions of ecological change in a regional and global context. Results from the Rock Creek sampling indicate that the stream system is not very productive. Further characterization of other park streams identified Rock Creek as one of several types of streams found throughout the park and that other types are more productive. Low productivity is not however, a function of contamination, but rather a result of a combination of substrate geochemical conditions, morphometric conditions, and rainfall events. When a stream tends to

flood quickly in response to precipitation events or snowmelt, the aquatic insects are often flushed out of the system. Though Rock Creek itself is 'flashy' in nature, the investigators feel that a lack of carbon sources, and an inability to retain detritus may result in low productivity rates.

RECOMMENDED ACTIONS

A. Research

N-240.011: Develop and Implement an Aquatic Invertebrate Research Program

1. An aquatic invertebrate management program incorporating standardized sampling procedures to inventory and assess the status of aquatic invertebrates parkwide would be developed and implemented.

2. Determine distribution, diversity, and abundance of aquatic invertebrates within Denali. Identify species sensitive to water quality changes and which may influence fish populations. Conduct surveys in watersheds where no data currently exists.

3. Investigate and implement methods to detect changes in invertebrate populations and diversity due to the effects of placer mining, road dust, social trails, natural fire, and fire suppression.

B. Monitoring

N-240.031: Implement Aquatic Invertebrate Monitoring Program

A program to systematically monitor aquatic invertebrates within the park would be initiated. Such a program would follow the protocol developed for the aquatic monitoring section of the LTEM program (Long-Term Ecological Monitoring I-210).

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
RESEARCH					
- Develop and Implement Research Program	40.0/0.0	40.0/0.0	40.0/0.0	40.0/0.0	160.0/0.0
MONITORING					
- Monitor Population	13.0/0.13	13.0/0.13	13.0/0.13	13.0/0.13	52.0/0.52
TOTALS	43.0/0.13	43.0/0.13	43.0/0.13	43.0/0.13	212.0/0.52

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Karle, K. F., and R. V. Densmore. 1994. Stream and floodplain restoration in Glen Creek, Denali National Park and Preserve. Technical report on file with USNPS Water Resources Division, Fort Collins, CO.

Magnum, F. A. 1986. Aquatic ecosystem inventory macroinvertebrate analysis. U. S. Department of Agriculture, Forest Service, Intermountain Region, Provo, UT. 86 pp.

Milner, A. M. and E. B. Gabrielson. 1993. Report on the bioassessment of Rock Creek in Denali National Park 1992. University of Alaska Anchorage, Anchorage, AK, 99501. 10 pp.

Oswood, M. W., K. Wedemeyer, and J. LaPerriere. 1990. Effects of mining disturbances on stream invertebrates and primary producers in Denali National Park, Alaska. Cooperative Agreement No. CA-9700-4-8013, U. S. Fish and Wildlife Service, Alaska Cooperative Fishery Research Unit, University of Alaska Fairbanks.

FISHERIES MANAGEMENT

PROJECT CODE: DENA-N-250

SERVICEWIDE ISSUES:
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
- N24 Human Impacts Within and Adjacent to Park

STATEMENT OF PROBLEM

Present Condition

Most of the rivers and streams in the Denali National Park and Preserve area are glacially fed and typically flow in braided channels in broad floodplains. Miller's (1981) baseline study of fish species shows that Denali has a relatively low species diversity and abundance compared to other regions of Alaska.

On the north side of the Alaska Range within the park, the Tanana River basin consists of the Kantishna and Nenana Rivers. The Kantishna River flows through the northwest section of Denali, while the Nenana River flows along the park's eastern boundary.

The Kantishna River basin is fed largely by glacial stream systems originating in the Alaska Range. These glacial streams carry high sediment loads and tend to have a lower biotic productivity than non-glacial streams. Two major glacial streams flowing into the Kantishna River basin include the McKinley and Toklat rivers. The Kantishna River basin also consists of Moose Creek and the Bearpaw River. These two streams, entering the system from the Kantishna Hills, are fed by clear waters derived from rain, snowmelt, and subsurface aquifers (USNPS 1988).

The Nenana River is fed by the Yanert River, another glacial stream system. Further downstream, clear water tributaries include Riley Creek and Healy Creek. Riley Creek flows from the Alaska range in the eastern portion of Denali.

On the south side of the Alaska Range, the Susitna River basin is made up of the Yentna and Chulitna rivers. The Yentna and Chulitna rivers drain high, mountainous areas and are largely glacial stream systems.

The Kuskokwim River drainage is made up of a series of clear water and glacial stream systems. Those originating in or flowing through the park include the Tonzona River and its tributaries and the Swift Fork River and its tributaries.

There are over 10,000 lakes within Denali with a combined surface area exceeding 23,000 hectares. The northwest portion of the park alone, measuring 1.25 million acres, is covered with many lakes making the ecology of this land dependent upon and driven by these waterbodies. Fish species, including northern pike (*Esox lucious*), broad whitefish (*Coregonus nasus*), blackfish (*Dallia pectoralis*), burbot (*Lota lota*), and sculpin (*Cottus cognatus*), have been reported in some of the larger lakes such as Wonder Lake, Chilchukabena Lake, Sprucefish Lake, and Blackfish Lake. However, no comprehensive inventory of this fishery, or evaluation of its importance to the local environment exists.

The Tanana, Kantishna, and Susitna River systems support anadromous fish populations which are important to sport, subsistence, and commercial fisheries (Selkregg 1974, USNPS 1988). Five species of fish identified in 22 of the 26 streams examined in Denali include the arctic grayling (*Thymallus arcticus*), Dolly Varden (*Salvelinus malma*), lake trout (*S. namaycush*), king salmon (*Oncoryhnchus tshawytscha*), and sculpin. Other species found in Denali include chum salmon (*O. keta*), coho salmon (*O. kisutch*), sockeye salmon (*O. nerka*), round whitefish (*Prosopium cylindraceum*), and sheefish (*Stenodus leucichthys*) (Miller 1981, USNPS 1988).

King, chum, coho, and sockeye salmon are anadromous species, primarily inhabiting salt water and migrating to fresh water to spawn. These species spawn in park streams including the Bearpaw, Toklat, McKinley, Foraker, and West Fork of the Yentna. Adult salmon produced from streams in the park are important to subsistence and commercial fisheries located downstream. The Kantishna, Nenana, Yentna, Tokositna, Chulitna, and Susitna are major drainages outside the park that receive park waters and support anadromous fish (USNPS 1988).

Arctic grayling is a cold-water species prevalent throughout the interior of Alaska. It is the predominant freshwater resident salmonid species in Alaska and is important for subsistence and sport fishing. The Arctic grayling is one of the few freshwater species that provides fly fishing in the state (Morrow 1980). The small populations of grayling in Denali may be vulnerable to even a moderate level of use by anglers. McPhail and Lindsey (1970) found that Arctic grayling are sensitively balanced to their environment, and cannot cope well with human encroachment. Their slow growth and ease of capture make them susceptible to local extirpation, especially in such exposed sites as streams bordering roads and highways.

Dolly Varden also tend to grow slowly, do not reach a large size, and mature at an early age. There are stream dwelling populations, isolated lake populations and anadromous populations from the Arctic regions of Alaska and Canada to southern British Columbia. Within the park, Dolly Varden are known to occupy streams of the Hines Creek drainage and certain tundra lakes near Wonder Lake but their total distribution is not known. Furthermore, it is not known

whether Dolly Varden present in Denali waters move further downstream and out of park boundaries. In general, Dolly Varden are most often found near the headwaters of freshwater streams. There is some evidence to suggest that during the summer they may spread out and occupy larger parts of the stream. They probably spend the winter in deep pools or move downstream toward the lower reaches to avoid low stream levels further upstream (Morrow 1980).

Round whitefish, uncommon in Denali waters, migrate up Moose Creek and North Fork Moose Creek to spawn. They may spend a majority of the year in lower Moose Creek, Bearpaw River or the Kantishna River (Meyer and Kavanagh 1983).

Lake trout occupy Wonder Lake and its outlet, Lake Creek (Miller 1981). The lake trout is likely an isolated population and, as a popular sport fish species in Denali, may also be susceptible to overfishing.

Slimy sculpin was located in four streams along the park road and three additional streams in the Kantishna area. This bottom-dwelling species is important to larger fish, since young sculpin as well as sculpin eggs are consumed by larger fish such as lake trout (Morrow 1980, Miller 1981).

Current Management Actions and Results

Fisheries studies within the park and preserve have been minimal. Most of the fisheries resource studies within Denali have occurred along the park road corridor and in the Kantishna Hills area and are a result of post-mining research on environmental impacts. Eight of these studies are related to water quality, one to hydrology, three related to aquatic invertebrates and four studies directly related to fish resources (Deschu 1986). Areas represented in these fisheries related studies encompass only a small portion of lands within Denali. Denali does not have a fisheries management plan or a fisheries monitoring program. A primary element in managing fisheries in Denali should be to document the current status of the fisheries resources.

Mining Impacts - Placer mining in the Kantishna Hills area began in the early 1900's with mining activity occurring in the 1920's and 30's, and later in the 70's. Increased turbidity and decreased light penetration associated with mining disturbances of freshwater streams in the Kantishna Hills mining district has ultimately reduced the primary production of benthic algae and larger plants attached to the stream bottom (Lloyd 1985, Wangaard 1981). The reduction of this food source results in reduced fish production (Lloyd 1985).

As a result of studies conducted in the early 1980's, Kantishna streams were found to have naturally high levels of heavy metals upstream of any mining disturbance, many of which exceeded state and federal water quality criteria (West and Deschu 1984). Data is not available

to indicate levels of metals in study area streams downstream of mining disturbance during seasons when no mining occurred. However, areas disturbed by past mining activities probably contribute metals to streams at a higher level than undisturbed streams through precipitation runoff as sediment loads increase (USNPS 1988).

Rainfall influences the concentration of heavy metals in Kantishna Hills streams. In some cases, an increase in metals was observed due to increased dissolution of metals, whereas in other cases metal concentrations decreased due to the dilution from increased flow. Concentrations varied due to the size of the area of surface runoff for a particular stream, and to the intensity (not just the absolute volume) of the rainfall (Deschu 1985).

Major stream systems that drain mining claim areas in the park include the Kantishna, Toklat, and Nenana rivers, which flow north and contribute to the Yukon River basin, and the Chulitna River, which flows south and contributes to the Susitna River basin (NPS 1988). Streams along the east side of the Kantishna Hills mining district flow into the Toklat River.

Recreational Impacts - Under 36 CFR 13.63(a), Denali's fishing regulations for certain species are quite liberal compared to those of the Alaska Department of Fish and Game (ADF&G). Lake trout and grayling limits under ADF&G (1994) regulations are 2/day, 2 in possession and 5/day, 5 in possession respectively. Denali's lake trout limit is the same but the grayling limit is 10 fish but not to exceed 10 pounds and one fish (USNPS 1991).

Anecdotal information indicates that sport fisheries use in the Moose Creek drainage and Wonder Lake by Kantishna lodge guests and park visitors is suspected to be increasing. Lake trout found in low productivity, high altitude, Alaskan lakes, such as Wonder Lake, are generally very slow growing and prone to overharvest from even limited fishing pressure. Another stream that receives use is Caribou Creek, a tributary of the Savage River. All of these areas are within easy access to visitors as they are located along the Denali Park Road corridor. Recreational fishing pressure on other new park and preserve areas is not well known.

No formal study has been done to determine fisheries use and no monitoring program exists.

Administrative Impacts - The primary impacts, resulting from administrative uses, are those associated with stream crossing and proposed water drafting from in-park water bodies. In the Kantishna Hills area, vegetative cover estimates showed that about one quarter of the streamside areas crossed by access routes have exposed soil, compared to no exposed soil in undisturbed sites. Plant diversity is also reduced on disturbed sites. Changes in species composition have been observed on disturbed areas where the more complex tundra mat has been removed and grasses and sedges have invaded (Bliss and Wein 1972, Chapin and Shaver 1981). Arctic ecosystems are slow to recover from disturbances. Access disturbance and reduced plant cover may alter the soil and water temperatures, pH, moisture, and chemical regimes (Challinor and Gersper 1975, Gersper and Challinor 1975).

The Denali Park Road also impacts fisheries resources by hindering movements of fish. Of the 26 streams surveyed by Miller in 1981, culverts were used to channel seven with confirmed or potential fish populations across the Park Road. Improperly designed culverts can produce water velocities that exceed fish swimming abilities. Furthermore, poor design can create plunge pools and situations where the mouth of a culvert is raised above the surface level of the stream, resulting in significant obstacles to fish movement. A highway culvert study (MacPhee and Watts 1976) found that bigger, more mature grayling had a higher success rate moving upstream through culverts than smaller, less mature grayling. Grayling's motivation to spawn may increase their passage through culverts, hence the higher rate of movements of more mature grayling. Successful passages through culverts were also directly proportional to the length of the culvert, given similar stream velocities. A longer (30.5 m.) culvert resulted in a lower passage rate than a shorter culvert (18.3 m.).

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-250.001: Develop Fisheries Management Plan

A fisheries management plan would be developed and implemented to document the current status of fisheries population, distribution and abundance within Denali's boundaries. Necessary contacts and agreements will be pursued to encourage interagency participation in the implementation of the fisheries management plan. This plan will provide current research needs and objectives for resource managers.

Recreational and subsistence harvest data will be collected and a fisheries use strategy developed for each species identified. Documentation of fisheries utilization of streams in the park will promote more informed management decisions regarding fisheries resources.

N-250.002: Establish Appropriate Fishing Regulations

Denali has two different sets of fisheries regulations. The park and preserve sections comply with Alaska Department of Fish and Game regulations, and the wilderness area of the park has its own catch limits. The wilderness area is exempt from ADF&G regulations since the former Mt. McKinley National Monument boundaries were established in 1917, 42 years before Alaska gained statehood in 1959. An analysis by Denali management staff would determine if the park should adopt ADF&G fisheries catch limits, continue with its own regulations, or devise additional regulations (DENA-N-250.017).

N-250.003: Create a Fisheries Biologist Position

A fisheries biologist would work on programmatic objectives and oversee the fisheries management operations. This position would be responsible for the research and administrative duties of Denali's fisheries management program. The fisheries biologist would coordinate with adjacent land management agencies on fisheries related projects within and adjacent to Denali.

N-250.004: Update NPFAUNA with Fish Species

Fish species would be added to the NPFAUNA database.

N-250.006: Cooperative Working Relationships

Park staff would develop closer working relationships with Alaska Department of Fish and Game fisheries biologists.

B. Research

N-250.011 Research Fisheries Habitat

The park would conduct a comprehensive fisheries habitat survey in the 1980 park additions and update the surveys in the wilderness area. The survey of fisheries habitat would include measurements of year-round discharge of stream systems, turbidity, sedimentation, water quality, heavy metals presence and identification of benthic and aquatic organisms. The presence or absence of fish species in various rivers and streams, on a year round basis, would be documented to verify fish habitat use. An inventory of anadromous fish spawning grounds would be completed.

N-250.012 Document Fish Health

Fish species utilizing previously mined and unmined streams would be analyzed to determine their health. The impacts of increased heavy metal concentrations, increased sediment flow and water quality related impacts of mined streams (Water Resources N-210) would be documented.

N-250.013 Recover Historic Data

Recent and historic fisheries-related studies would be summarized to better assess and manage current research needs in Denali. The summary would outline private and interagency research projects within park boundaries and adjacent lands. Other fisheries related information such as technical reports and fisheries survey data from ADF&G

would be collected.

N-250.014 Investigate Road Impacts to Fish Movements

A study of Denali Park Road impacts to fish movements would be conducted to determine the effects of culverts on fish migrations. The study would evaluate culvert design criteria to ensure adequate fish movements and the maintenance of fish populations.

N-250.015 Follow-Up Research on Heavy Metals Presence in Arctic Grayling in the Kantishna Hills

As recommended by West and Deschu (1984), further investigations of heavy metals impacts to grayling in the Kantishna Hills area would be done. Additional work would involve a look at invertebrates as indicators of heavy metal toxicities, the potential of magnification of some metals through the food chain, and the levels of metals bound in stream sediments.

N-250.016 Research Habitat Restoration Designs

Research of reclamation techniques for streams with mining impacts in the Kantishna Hills area will continue. Research efforts will be expanded to include restoration of aquatic biota. Stream and floodplain restoration projects such as the Glen Creek project (Karle and Densmore 1994) will continue in order to provide innovative and experimental reclamation designs for further work in other mined stream systems of the subarctic environment.

N-250.017 Research Lake Trout Status in Wonder Lake

Research would be conducted to determine a sustainable harvest level for the lake trout population in Wonder Lake. Parameters measured would include population size, fish condition, length, weight, age, growth, food habits, fecundity, maturity, and annual catch and harvest. Existing sport fishing regulations for Wonder Lake would be revised, as necessary, as a result of this research (DENA-N-250.002).

N-250.018: Develop Fish Census Techniques

A parkwide fish census techniques manual specifically related to the Denali region would provide methodologies for collecting fisheries data. Efficient and effective sampling techniques would provide meaningful results when implementing various fisheries-related projects throughout the park.

C. Mitigation

N-250.021: Implement Analysis of Administrative Impacts to Fisheries Habitat

An analysis of administrative impacts to fisheries habitat will help determine the amount of fisheries habitat damage from park managers. Of special interest will be; the use of Moose Creek as an access route to the Glen Creek research camp; access points for drafting water from park waterbodies; and Denali Park Road impacts to fisheries movements. Recommendations on minimizing these administrative impacts will aid in the recovery of fisheries and riparian habitat, as well as other park resources.

N-250.022: Continue Operation of Riparian Habitat Restoration

Current ecological restoration/reclamation projects will continue in the Kantishna Hills mining district. This program will monitor and document ongoing restoration to improve and reestablish fisheries and riparian habitat.

N-250.023: Modify Road Crossings to Allow Fish Movements

Based on the findings and recommendations of the investigations of the Denali Park Road impacts to fish movements (DENA-N-250.014), necessary actions will be taken to accommodate adequate fish movements and the maintenance of fish populations.

D. Monitoring

N-250.031: Implement Fish Census Program

In concert with the park's long term ecological monitoring program, a fish census program would be implemented to provide information regarding population size, distribution, and health.

N-250.032: Implement Fisheries Use Monitoring

Detailed documentation of high use areas is essential in monitoring the status of impacts to fish species. Currently, only an estimate of fisheries use data is available for both sport and subsistence purposes. The economic and social values of fisheries to private businesses, concessionaires, NPS employees and the visiting public also need to be addressed. The level of use by Kantishna area lodge clients of grayling in the Moose Creek drainage is not known. Nor is the level of visitor use of road corridor stream systems.

The park will monitor sport and subsistence harvest and continue monitoring fish habitat

in both mined and unmined streams on a parkwide basis. Field mapping of anadromous fish spawning grounds and fish species stream utilization, including overwintering areas will be documented. The fisheries biologist will provide program oversight for planning and implementing the fisheries monitoring program.

E. Interpretation

N-250.041: Maintain Adequate Public Information about Fisheries

Interpretive and other park staff would be informed of the status of fisheries and habitat conditions within the park. This would result in improved communications with the public as well as other state, local and government agencies. Interpretive staff would encourage catch and release by the public.

F. Protection

N-240.051: Enforcement of Fisheries Protection Regulations

An analysis of Denali's fisheries regulations should be done to determine if the regulations adequately protect fish from potential overharvest. Denali's sport fish catch limits in the wilderness area are liberal compared to ADF&G catch limits in the park and preserve additions. Sport and subsistence fish harvest data, on a parkwide basis, will need to support any changes to the fisheries regulations.

Enforcement of fisheries regulations would protect fish habitat and maintain adequate fish populations. Patrols of suspected high use areas such as the Moose Creek drainage, Wonder Lake, and streams along the Denali Park Road corridor such as Caribou Creek would provide fisheries protection.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Fisheries Mgmt Plan		20.0/0.1	40.0/0.1	20.0/0.1	80.0/0.3
- Fisheries Biologist	40.0/1.0	40.0/1.0	40.0/1.0	40.0/1.0	160.0/1.0
RESEARCH					
- Research Fisheries Habitat	40.0/0.2	40.0/0.2			80.0/0.4

- Research Fish Health			40.0/0.2	40.0/0.2	80.0/0.4
- Investigate Road Impacts to Fish Movements			40.0/0.2	40.0/0.2	80.0/0.4
- Heavy Metals Presence in Grayling, Kantishna Hills		30.0/0.4	30.0/0.4		60.0/0.8
- Research Restoration Designs	10.0/0.2	10.0/0.2	10.0/0.2	10.0/0.2	40.0/0.8
- Research Lake Trout in Wonder Lake		30.0/0.1	30.0/0.1		60.0/0.2
- Develop Census Techniques	30.0	30.0			60.0
MITIGATION					
- Riparian Habitat Restoration	12.0/0.1				12.0/0.1
- Implement a Fisheries Use Survey	20.0/0.3	10.0/0.3	10.0/0.3	10.0/0.3	50.0/1.2
- Administrative Impacts Survey	10.0/0.1	10.0/0.1			20.0/0.2
- Modify Road Crossing to Allow Fish Movements			100.0/2.0	100.0/2.0	200.0/4.0
MONITORING					
- Fisheries Monitoring Program	25.0/0.3	25.0/0.3	25.0/0.3	25.0/0.3	100.0/1.2
INTERPRETATION					
- Public Information		10.0/0.2	10.0/0.2	10.0/0.2	30.0/0.6
PROTECTION					
- Enforcement of Fisheries Protection Regulations		20.0/0.3	20.0/0.3	20.0/0.3	60.0/0.9
TOTALS	175.0/2.1	235.0/2.3	375.0/4.4	295.0/3.9	1080.0/13.1

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Alaska Department of Fish & Game. 1992. Alaska sport fishing regulations summary. ADF&G, Juneau, AK.

Bliss, L. C., and R. W. Wein. 1972. Plant community responses to disturbances in western Canadian arctic. Canadian Journal Of Botany 50:1097-1109.

Challinor, J. L. and P. L. Gersper. 1975. Vehicle perturbation effects upon a tundra soil-plant system: II. Effects on the chemical regime. Soil Science Society, American Proceedings 39:689-695.

Chapin, G. S. III, and G. R. Shaver. 1981. Changes in soil properties and vegetation following disturbance of Alaskan arctic tundra. Journal of Applied Ecology 18:605-617.

Deschu, N. 1985. Arsenic sediments, water, and benthic fish in placer-mined and unmined streams, Denali National Park and Preserve, Alaska. Master of Science thesis, University of Washington.

Deschu, N. 1986. Water-related research and monitoring in the Kantishna Hills Mining District, Denali National Park and Preserve, Alaska. NPS-Alaska Regional Office, Anchorage, Alaska.

Gersper, P. L., and J. L. Challinor. 1975. Vehicle perturbation effects upon a tundra soil-plant system: I. Effects on morphological and physical environmental properties of the soils. Soil Science Society, American Proceedings 39:737-744.

Karle, K. F. and Densmore, R. V. 1994. Stream and floodplain restoration in Glen Creek, Denali National Park and Preserve. Water Resources Division-National Park Service. Fort Collins, CO. 1994.

LaPerriere, J. and L. Casper. 1976. Biogeochemistry of deep lakes in the Central Alaska Range. Institute of Water Resources Report No. IWR-68, University of Alaska, Fairbanks. 1976

Lloyd, S. D. 1985. Turbidity in freshwater habits of Alaska. ADF&G. Juneau, AK.

Loftus, K. H. 1958. Studies on river-spawning populations of lake trout in eastern Lake Superior. Transaction of the American Fisheries Society 87:259-277.

MacPhee, C. and F. J. Watts. 1976. Swimming performance of arctic grayling in highway culverts. U. S. Fish and Wildlife Service. Anchorage, AK.

McPhail, J. D. and C. C. Lindsey. 1970. Freshwater fishes of Northwestern Canada and Alaska. Bulletin 173, Fisheries Research board of Canada. pp.123-128.

Meyer, S. C. and Kavanagh R. C. 1983. Fish resources and the effects of mining activities in the Kantishna Hills, Denali National Park & Preserve. USNPS, Alaska Regional Office, Anchorage, AK.

Miller, P. 1981. Fisheries resources of streams along the park road and in Kantishna Hills, Denali National Park and Preserve. USNPS, Denali NP&P, Unpublished Report.

Miller, R. B. 1946. Notes on the arctic grayling, Thymallus signifer Richardson, from Great Bear Lake. Copeia 1946: pp. 227-236.

Morrow, J. E. 1980. Freshwater fishes of Alaska. Alaska Northwest Publishing Co., Anchorage, 248pp.

Schneider, W., D. Gudgel-Holmes, and J. Dalle-Molle. 1984. Land use in the north additions of Denali National Park and Preserve: An historic perspective. USNPS Research/Resources Management Report AR-9.

Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Ottawa, Fisheries Research Board of Canada. Bulletin 184.

Selkregg, L. L. 1974. Alaska regional profiles. Vol IV: Southeast Region. University of Alaska, Anchorage, AK.

U. S. National Archives and Records Administration. 1991. Code of Federal Regulations, 36 CFR. U. S. Government Printing Office, Washington D.C.

USNPS. 1988. Final environmental impact statement, cumulative impacts of mining, Volume 1, Denali National Park. USNPS, Alaska Regional Office, Anchorage, AK.

Wangaard, D. 1981. Kantishna Hills fishery resource study proposal. U. S. Fish & Wildlife Service, Anchorage, AK.

West, R. L. and N. A. Deschu. 1984. Kantishna Hills heavy metals investigations, Denali National Park. Alaska Regional Office, Anchorage, AK.

GEOLOGY

PROJECT CODE: DENA-N-311

SERVICEWIDE ISSUES:
- N20 Lack of Basic Data: Insufficient Understanding of Park Ecosystems and Threats to Them
- N24 Other Issues: Threats to Public Health and Safety by Geological Processes

STATEMENT OF PROBLEM

Introduction

Denali National Park and Preserve consists of three primary geomorphic provinces which are closely associated with bedrock types and geochronology. The northern third of the park is underlain by the oldest rock, which consists primarily of metamorphosed Precambrian and Early Paleozoic marine sediments and volcanics. The surface of this area can be described as interior lowlands, interspersed with rounded hilltops, which are blanketed with glacial, fluvial and eolian deposits. The northern foothills of the Alaska Range are mainly Tertiary fresh water sediments, overlain and intruded by volcanic and plutonic rocks. The southern half of the park, consisting of the crest of the Alaska Range and most of the highest elevations of the park, is dominated by Late Paleozoic to Mesozoic marine sediments and plutonic rocks. This rugged terrain has undergone extensive glacial modification, with major surface areas still occupied by large glacier systems.

Most of the geologic data or information on Denali National Park and Preserve is either of a cursory reconnaissance level, is limited to small site-specific areas, or is entirely lacking. As such, little information is available for assessing park physical resources, geologic hazards, or even the rudiments of ecosystem conditions. Key resource relationships and resource protection concerns, such as bedrock/soil and vegetation interactions, surface and ground water quality, and other relationships get little attention or go unnoticed due to this basic lack of information. The condition or well-being of all park biological resources are first and foremost dependent upon the earth's surface and subsurface conditions.

This basic lack of information also directly affects or threatens physical resources that are protected by specific laws. The Service is mandated to preserve and protect those resources in the same manner conventionally afforded to cultural or biological resources. For instance, some park geologic features and processes, especially fragile ones, specifically require inventory and protection (NPS Management Policies 4:19-20).

Geologic mapping in Denali National Park is outdated and incomplete at the most basic level of conventional baseline resource mapping. The current geologic mapping status of the park does not meet Level-I inventory and monitoring requirements as identified in the Inventory and Monitoring Guidelines (NPS 75).

Up-to-date geologic mapping is essential to understanding a myriad of resource relationships, understanding and evaluating geologic hazards, and to scientific research. Accurate knowledge of bedrock geology is necessary for all subsequent research or inventory of all biotic and abiotic resources such as soils, hydrology, water quality, and aquatic biota.

In addition, the stratigraphy and tectonic history of the park are poorly understood. Key geologic information exists within the park boundaries that is essential to solving the Denali Fault problem (conflicting field interpretation of the nature of movement of the fault system) and essential to the understanding of other portions of the regional tectonic history. Denali represents a significant information gap in the quest for an understanding of the geologic history of Central Alaska.

Furthermore, complete and consistent geologic information in a single source is not available for Denali National Park. Assimilating the geology of the park requires the use of numerous and often non-corresponding maps, U.S. Geological Survey (USGS) and Alaska state publications, and various university theses. The park geologic guide offers only an introductory view of park geology. It emphasizes only the road accessible northern portion of the park, and does not include a park-wide geologic map. Consequently, the park staff is unable to respond to frequent requests for a geologic map of the park, or other concise park-wide geologic information, from both the casual geoscience enthusiast and the research oriented physical scientist.

Geologic mapping and associated physical science data collection is also an important element in the protection of the park's geo-resources. Erosion or flood damage potentials are some of the obvious risks to park resources that are generically understood by most park managers. However, the preservation of many fragile or highly delicate resource features or phenomenon, such as formation type sections, volcanic or glacial geomorphic features, and cave potentials, often gets overlooked, especially when the baseline inventory of such resources is nearly non-existent. Even more obscure geo-resource and bio-resource relationships, such as bedrock influences on surface and ground water conditions must be understood by undertaking systematic

bedrock geologic mapping.

Additional benefits gained by baseline bedrock and surficial geologic mapping include the inventory and identification of paleontological and archeological resources, geologic hazards, and glacier and water resource conditions. These themes are covered in separate resource management plan project statements, but the cross-over relationships and many of the inventory and research methodologies are inseparable, and require synergistic planning.

Present Condition

Baseline geologic mapping of the park consists of four 1:250,000 USGS geologic maps which variously contain mapped bedrock units, unit descriptions, stratigraphic columns, cross-sections, structural interpretations, absolute and relative age locations, and tectonic and/or terrane descriptions (Reed and Nelson 1980, Csejtey et al. 1978, Csejtey et al. 1992, Reed 1961). The Mt. McKinley Quadrangle (Reed 1961) has been produced chiefly by 1950's photo interpretation, and as such, lacks the complete and up-to-date information available in the other quadrangles. Some specialized maps of gravity and geochemical anomalies also exist at scales of 1:500,000 or less. Additionally, several topical or specific areal geologic maps exist at various scales for areas primarily along the park road.

Three geologic guides are known to exist for the park, all of which concentrate on the north side of the park along the park road. All three guides offer descriptive text, maps, diagrams and/or figures to describe the geology. One of those guides is out of print (Gilbert 1979) and another (Brease and Till 1995) is a limited in-house production.

There are hundreds of journal articles, bulletins, and other documents available concerning park, or central Alaska Range geology, and/or mining and economic mineral conditions within the park.

Current Management Actions and Results

Program Administration - Current cooperation with other agencies, institutions, and individuals regarding geologic data acquisition is generally conducted under research or collection permit conditions. Efforts are ongoing to establish formal relationships, particularly when large or long-term projects are anticipated. Potential cooperating partners may include the USGS, Alaska State Division of Geophysical and Geological Survey (ADGGS), Natural Resources Conservation Service (NRCS), US Forest Service (USFS), University of Alaska Fairbanks (UAF), UAF Geophysical Institute, and many others. A memorandum of understanding with the USGS for the purposes of updating the McKinley Quadrangle and production of a park-wide geologic map is currently in preparation.

Research - Geoscience research efforts in Denali consists of a few USGS or academic investigators working on site specific interest or problem areas. Current national and NPS interest in resource inventories and ecological monitoring has recently prodded the need to know more about the abiotic baseline database, including surficial and bedrock geology.

Leading this combination of research, inventory and baseline monitoring is the USGS. Proposals are in place, and joint NPS-USGS efforts have occurred, regarding the mapping of the McKinley 1:250,000 Quadrangle. Several 10-day field efforts have resulted in progress refining some locations within the Mt. McKinley quadrangle (Till and Harris 1995, Csejtey et al. 1995). Though these modest efforts are only a small part of the entire Mt. McKinley mapping project, they can have potentially significant implications for the geology of central Alaska, and the tectonic history of the state.

Recent geologic mapping efforts by investigators from Purdue University and Allegheny College on the Cantwell sediments and volcanics have provided new evidence of age, depositional style and providence of the Cantwell unit (Ridgeway 1993, Ridgeway and Troup 1996, Troup and Ridgeway 1996). Additionally, refinements in the understanding of the metamorphic complexes of the Kantishna Hills and Chitsia mountain area were recently accomplished (Cooper 1995, Till and Harris 1995).

Several NPS geologic investigations are in progress. The Drunken Forest, a slump-earthflow type mass movement, has been the site of surface and subsurface investigations since 1987. Accomplishments include the establishment of twenty-two survey monitoring stations to characterize the nature of the movement, mapping of the surface geology, and other efforts to determine subsurface conditions and permafrost potentials (Brease 1993). Another effort has been initiated regarding delineation of meltwater channels in the Wonder Lake area.

Monitoring Efforts - The park has, in cooperation with the UAF Geophysical Institute, permitted two seismic monitoring stations within the park. A 1986 memorandum of understanding between the NPS and the institute provides for the establishment and upkeep of these stations, and also calls for the institute to "assist the NPS in interpreting the geologic phenomena of the Alaska Range, by cooperating in the design of an interpretive exhibit at the Eielson Visitor Center." The seismic monitoring stations have been operating since 1987, providing constant event data to the state-wide seismic monitoring network. Additionally, the institute has provided a drum seismograph and posters for interpretive display at the visitor center.

Interpretation - The park resource management staff supplies geologic information to both the park interpretive staff, university and agency groups, and the general public. This consists primarily of lectures and field trips. Recent efforts include the establishment of a seismic demonstration program at Eielson Visitor Center.

Current popular guides to park geology include "The Geology of Denali, by "Michael Collier and "A Geologic Guide to Mt. McKinley National Park," by Wyatt Gilbert. The first of these pamphlets is currently in press and available to the general public, while the second is out of print. Both publications cater to the reader who is new to geology, and discuss only the geology along the park road.

In progress is an effort to provide a comprehensive geologic guide to the park that addresses the geology and glacial features park-wide, provides an extensive summary of the geologic literature, and gives a complete geologic history of the evolution of Denali National Park and Preserve. Other geologic summaries and topical papers or "monograms" exist to inform or assist for both professional and popular dispersal.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-311.001: Coordinate Geo-Resource Programs with Other Agencies and Institutions

Establish contacts, memoranda of understanding, and cooperative agreements regarding research, monitoring and other projects as necessary to gain first-hand knowledge of physical resource issues and to disseminate that information to the public. Encourage and enhance park personnel participation in outside research and other data collection endeavors.

N-311.002: Create PFT GS-7/9/11 Geologist or Physical Scientist Position

Workloads in geology, mass movements, glaciology, soils and climate monitoring, and other geological and physical sciences branch tasks have increased in recent years. The geologist/physical scientist would provide professional-level program oversight for soils, glaciers and/or geology operations. Depending upon the specialty, this individual would be the primary soils, glacier or other earth science lead, including the task of primary investigator regarding research or monitoring efforts and developing and implementing physical science activities. A geologist/physical scientist would provide direction and perspective on many branch management operations.

N-311.005: Create Temporary Seasonal Physical Science Positions

Physical science technicians would provide program assistance, field support, and data manipulation for many branch operations. Nearly all physical science field programs

require additional help regarding transportation, logistics, data collection and data reduction. Additionally, many of these programs also require significant data input time for various reports, papers and other accomplishment products.

B. Research

N-311.011: Geologic Mapping - McKinley Quad

Initiate a level one geologic mapping project of the McKinley 1:250,000 Quadrangle as a joint effort between NPS and other federal and state agencies and/or academic institutions. Specialists in various disciplines would be involved intermittently for geochemistry, geophysics, paleontology, absolute dating, isotopic chemistry, and perhaps other areas.

The project would require two 30-day field efforts, one each field season for two years, and two additional years for compilation of data and report/map preparations.

The anticipated products from this proposal would be published in a folio series (and available in GIS format) and would include:

1. Geologic map and cross-sections of McKinley Quad.
2. Geochemical and geophysical data sets for unit & regional interpretation.
3. Park wide geologic map and interpretations for the public.
4. Assistance in preparing exhibits for the public.
5. Special projects or detailed studies as deemed desirable and appropriate.

N-311.012: Geologic Mapping-Major Unit Refinement

Work cooperatively with agencies and academia to initiate geologic mapping of major units which are poorly understood or not well refined within the park. These units vary from large major reconnaissance mapped sequences with significant time unit and/or lateral extents, to smaller, more confined units that are often lumped into rough, time unit/lithologic categories. Study approaches vary from mapping small areas (detailed lithology, controlled stratigraphic descriptions, obtaining age controls, etc.) to larger mapping projects on units or sequences that are extensive throughout the park and sometimes extend outside park boundaries. The following is a partial list of such units:

Depositional-Structural units:

Lower Paleozoic Undiv. Marine Margin (Oc,Sl,Dl, Pzus)
Lower Paleozoic Undiv. Marine Margin (Dos, Dls)

Permian/Ordovician Mt. Dall Conglomerate -
Triassic Sedimentary/Volcanic Units (McKinley terrane)
Triassic Calcarious Sedimentry Unit (Pingston terrane)
Jurassic-Triassic Seds & Volcanics (Chulitna terrane)
Jurassic-Cretaceous Flysch (Kjs, KJb, KJfl, KJf)
Cretaceous melange (Windy/Broad Pass Kms,Kmn,Mnl)
Cretaceous-Paleocene Cantwell Sedimentary Unit
Miocene-Eocene Kenai & Coal Bearing Group
Pliocene-Miocene Nenana Gravel

Metamorphic Units:

Precambrian-Early Paleozoic Yukon-Tanana Crystalline
Early Paleozoic Totatlanika Schist
Early Paleozoic "Wyoming Hills Fm"
Lower Paleozoic Undiv. Marine Margin (Pzus)

Volcanic:

Cretaceous-Paleocene Cantwell Volcanic Unit
Eocene Mt Galen Volcanics

Plutons:

McKinley Intrusive Sequence
Eocene Foraker-McGonagall Plutons
Undivided Intrusives (Tki, MzPzi, MzPzd)

N-311.012: Parkwide Geologic Map

Initiate efforts to compile known mapped geologic data into a single sheet 1:250,000 map depicting (in order of preference) bedrock geology, cross-sections, structural interpretations, tectonostratigraphic terranes, fossil locations, surficial and/or glacial geology, and an interpretive pamphlet. This proposal would include an update of some areas of the park (project proposal N-311.011) but could be accomplished with existing mapped information.

N-311.013: Investigation of "Drunken Forest" Mass Movement

Continue investigation of a slump-mudflow informally called the "Drunken Forest," located near headquarters. Current studies have revealed periods of punctuated "surging" movement related to long-term freeze-thaw storage, or short-term, high intensity rainfall, rather than slow deformational movement associated with permafrost, as commonly interpreted. Twenty-two stations have been established on the flow to characterize and

monitor the movement. Flow rates and mass transfer will be calculated over a ten year period and associations with precipitation and temperature will be determined.

N-311-014: Initiate NPS and Cooperative Special Studies.

The NPS would address special topics, features or problem areas by initiating research projects independently or cooperatively with other agencies. Projects could include type section refinements, structural studies, data improvement on stratigraphic relationships, or any of many unanswered tectonic dilemmas within the park. Coordination and cooperation with specialists in other agencies or institutes would be encouraged. Some of these projects are suitable for student theses. Listed below are potential special study areas and/or topics:

Shellabarger Pass-Refine mapping (controlled stratigraphy, lithology, structure and paleontology) of units Pzus, Dl, Sl, or Oc.
Chulitna Terrane-Identify unique stratigraphy in park.
Bent Creek - Detail mapping of Denali Fault and associated units in areas Dos and Kjf.
South Anderson Pass-Map extent of new fault sliver and confirm related boundaries with Dos, Kjf and other potential units.
Dillinger/Tatina River-Map, describe and photodocument Ordovician (Pzd) units.

N-311.015: Support Independently Funded Geologic Projects.

The Service would support independently funded geologic research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities when deemed appropriate by park management. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management DENA-I-410).

C. Mitigation and D. Monitoring

N-311.021: Support Park Engineering Needs

Continue physical science contributions to park engineering and park facility design in attempts to avoid facility failure or poor performance. Park Road designs relating to geologic conditions (slope stability, soils suitability, water retention) will be reviewed by the physical science branch for feasibility. Design suggestions will be bolstered by monitoring and research projects dealing with such issues as natural ground moments, surface gravel retention, and general permafrost conditions as necessary (Geologic

Hazards DENA-N-312).

E. Interpretation

N-311.041: Encourage Public Awareness of Geo-Resources

Develop public displays, provide books, monograms, brochures, slides and or videos, and encourage interpretive programs regarding the geologic wonders of Denali.

Geologic Guide-Continue to develop a comprehensive geologic guide to the park that addresses the geology and glacial features park-wide, provides an extensive summary of the geologic literature, and gives a complete geologic history of the evolution of Denali National Park and Preserve.

Geologic Monographs-Develop short and medium length papers on specific geologic topics of popular interest.

Geologic Video-Produce a geologic video that highlights the important geologic features of the park, and provides the complete geologic history.

Geologic Slides-Provide quality slides of geologic features within the park for in-house use, and provide geo-slide collections to be offered for general public sale.

Denali Rock Catalogue-Develop visual and descriptive source book for park rock units and formations. Provide photographs of rock types, formations, type sections, and other particulars for each mapped unit in the park. Additionally, the museum geologic sample collection will become the final repository for this information along with actual samples as appropriate.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Geologic Resources Mgmt Plan	0.5/0.0	1.0/0.0	0.5/0.0		6.5/0.0

- PFT Geol/Phys. Scient.		15.0/0.5	15.5/0.5	17.5/0.5	48.5/1.5
- Seasonal Temp.	6.0/0.3	6.0/0.3	6.0/0.3	6.0/0.3	24.0/1.2
RESEARCH					
- Geo Map (McK. & Park) (helicopter)	75.0/0.0	75.0/0.0	0.0/0.0	0.0/0.0	150.0/0.0
- Special Studies (heli)	2.5/0.0	2.5/0.0	2.5/0.0	2.5/0.0	10.0/0.0
MITIGATION AND MONITORING					
- Engineering Assist.	1.0/0.0	1.0/0.0	1.0/0.0	1.0/0.0	4.0/0.0
INTERPRETATION					
- Geologic Guide	1.5/0.0	3.5/0.0	1.5/0.0	0.0/0.0	6.5/0.0
- Geologic Monographs	1.0/0.0	1.0/0.0	1.0/0.0	1.0/0.0	4.0/0.0
- Geologic Video		5.0/0.0	20.0/0.0	20.0/0.0	45.0/0.0
- Geologic Slides	0.5/0.0	0.5/0.0	0.5/0.0	0.5/0.0	2.0/0.0
- Rock Catalogue	0.5/0.0	0.5/0.0	0.5/0.0	0.5/0.0	2.0/0.0
TOTALS	88.5/0.5	111.5/1.5	54.5/1.5	44.0/1.5	296.0/2.7

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Brease, P. B. and A. Till. 1995. The geology and glacial history of Denali National Park and vicinity. Geologic Society of America Trip #9 Guidebook and Roadlog, Cordilleran Section

Meeting - Fairbanks, Alaska.

Collier, M. 1989. The geology of Denali National Park. Alaska Natural History Association.

Cooper, K. M. 1995. Structural and metamorphic history of the southwestern Kantishna Hills, Denali National Park, Alaska. Geologic Society of America Cordilleran Meeting - Program with Abstracts, Fairbanks, Alaska.

Csejtey, B. Jr. et al. 1978. Preliminary aeromagnetic interpretive map of the Talkeetna Mountains quadrangle, Alaska: USGS Open-File Report 78-558-C, 14p., scale 1:250,000.

Csejtey, B. Jr. et al. 1982. The cenozoic Denali fault system and the cretaceous accretionary development of Southern Alaska. Jrnl of Geophys Rsrch, vol. 87, no. B5, pp 3741-3754.

Csejtey, B. Jr. et al. 1992. Geology and geochronology of the Healy quadrangle, Alaska, USGS Misc. Invest. Series.

Csejtey, B. Jr. et al. 1995. Correlation of rock sequences across the Denali fault in south-central Alaska, in Geologic Studies in Alaska by the U.S Geological Survey, 1994. USGS Bulletin 2152, Moore, T.E., and Dumoulin, J.A. editors.

Gilbert, W. 1979. A geologic guide to Mt. McKinley National Park. Alaska Natural History Association.

Jones, D. L. et al. 1982. Character, distribution, and tectonic significance of accretionary terranes in the central Alaska range. Jrnl of Geophys Rsch, Vol. 87, No. B5, pp 3709-3717.

Reed, B. L. and S. W. Nelson. 1980. Geologic map of the Talkeetna quadrangle, Alaska. USGS Misc. Invest. Series Map I-1174.

Reed, J. C. 1961. Geology of the Mt. McKinley quadrangle, Alaska. USGS Bulletin 1108A.

Ridgeway, K. D. 1993. Tectono-stratigraphic analysis of the Cantwell basin, Alaska range, Alaska. Project proposal to USNPS Denali NP&P.

Ridgeway, K. D. and J. M. Trop. 1996. Late cretaceous basin formation along a suture zone, Cantwell Basin, Alaska Range: implications for development of the Denali fault system. In press, Geologic Society of America Bulletin.

Till, A. B. and A. G. Harris. 1995. Evidence for post-triassic emplacement of metamorphic rocks of the Yukon-Tanana terrane above triassic marine sedimentary rocks in the Kantishna

Hills, Central Alaska range, Alaska. Geologic Society of America Cordilleran Meeting - Program with Abstracts, Fairbanks, Alaska.

Troup, J. M. and K. D. Ridgeway. 1996. Petrofacies and provenance of a late cretaceous thrust-top basin, Cantwell basin, central Alaska range. In press, Journal of Sedimentary Research.

GEOLOGIC HAZARDS

PROJECT CODE: DENA-N-312

SERVICEWIDE ISSUES:
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
- N24 Other Issues: Threats to Public Health and Safety by Geological Processes

STATEMENT OF PROBLEM

Introduction

Geologic hazards can be defined as naturally occurring or human-influenced geologic conditions that are a potential danger to life and property. In Denali National Park and Preserve, some of these conditions can result in catastrophic events such as those associated with seismic activity, flooding, ground subsidence, landslides, icefalls and erosion. Other geohazard conditions are more subtle, such as high concentrations of certain elements (e.g., heavy metals or radioactive materials).

The National Park Service Management Policies (USNPS 1988) address various geohazard issues including the requirements to:

- Inventory wetlands and floodplains...identify high-hazard flood areas (Management Policies, 4:16).
- Identify recognizable threats to the safety and health of persons and to the protection of property (Management Policies, 8:5).
- Facilities will not be located where natural processes pose a persistent threat... Hazardous areas include sites with unstable soils and geologic conditions, fault zones, thermal areas, floodplains, flash-flood zones, and coastal high-hazard areas (Management Policies, 9:2).

NPS-77, the Natural Resource Guidelines for the National Park Service (USNPS 1991), only cursorily address geologic hazards within the section on Geologic Resources Management. In that section of NPS-77, it is recommended that the NPS identify, inventory and manage geologic features and processes. Specifically, NPS-77 suggests:

- Identification and inventory...to make management decisions to avoid geologic hazards such as faults, rockfall areas, landslides and unstable substrata to protect park structures, roads, and visitors.
- manage glacier processes for the safety and well being of visitors and employees.

Geohazards are directly or indirectly addressed in many other sections of NPS-77 including Freshwater Resources Management, Soil Resources Management, Public Health and Safety, and Planning.

Other sources of NPS guidance or requirements on detection and/or management of geohazards include NPS-50 "Loss Control Management Guideline," which addresses radiation and general public health and safety, NPS-83 "Public Health Management Guideline," which is concerned with drinking water standards (chemical or heavy metal content and radionuclides), the Executive Order on Floodplain Management (11988), which provides for identifying floodplain areas and the inventory of existing or proposed structures in those floodplains, as well as Executive Order 12699 and Staff Directive 93-1 (March 30, 1993) which implement seismic safety standards for new building construction.

Present Condition

The park contains several physiographic provinces, numerous bedrock types and countless soil/landscape types that present many categories of geologic hazards. The core area, or wilderness portion of the park, is dominated by bedrock and ice exposures, with inherent rock and icefall hazards that can threaten climbers, backpackers, park staff, and researchers. Major glacial outflow rivers provide additional risks to backcountry users when crossings of highly fluctuating flows impede their travel. Other threats to persons or facilities are more likely to take place in the road corridor or other developed locations.

Flooding & Erosion - Glacial rivers present flooding threats to park facilities or other facilities downstream, both near and within the perceived floodplain. Annual, seasonal and daily flow fluctuations always pose the potential for high water events, but most NPS, and probably private facilities, are not built within the high risk areas of the floodplains. Of particular concern is the possibility of glacial outburst flooding (or jökulhaup), where a glacier-dammed lake can be formed then released suddenly, causing catastrophic flood damage to facilities many miles down stream. Most of the major glaciers on the south side of the park (Eldridge, Buckskin, Ruth, Tokositna, Kahiltna, and Yentna-Dall) pose some threat of jökulhaup development, and some perhaps on the north (Toklat, Muldrow) as well.

Additionally, both glacier and clearwater rivers cause flooding and stream bank erosion problems at numerous areas in the park where NPS or private facilities are located. High energy waterflows and slow to rapid meandering conditions on the Toklat River threaten the park road on the east side of the bridge and at the Toklat Camp, where bank erosion has made it necessary to relocate a helipad and fuel cache facility. Flooding and bank erosion also threaten two of the

privately owned lodges within the Kantishna Hills vicinity.

Mass Movements, Permafrost & Subsidence - The park and preserve lie entirely within the zone of discontinuous permafrost. Over half of the park is comprised of foothills and interior lowlands, frequently veneered with fine-grained glacial and/or eolian materials, which tend to be areas of ice-rich ground. These materials are highly absorptive, which ensures their permafrost condition, but enhances erosion when the permafrost soils are disturbed. A delicate thermal balance exists between the insulating vegetative mat and the underlying frozen ground. Even the slightest impact to the vegetation in this extremely sensitive relationship can initiate thermokarsting and extensive soil erosion.

These fine grained materials also are highly susceptible to mass movement (landslides, slumps, mud & debris flows, soil creep or solifluction) which affect park road maintenance attention and costs. Periods of high precipitation often mobilize these surface materials releasing mass movements (liquefaction) at numerous locations simultaneously along the park road. These mass movements are further assisted by permafrost or seasonally frozen conditions where the frozen layer acts as an aquiclude that enhances overburden saturation, provides containment pressure, and supplies a relatively flat slip plane.

Rockfalls and icefalls, although infrequently reported, occur within the steeper rock and ice environment. Known unstable areas, particularly avalanche and icefall danger zones, are well known on familiar routes and climbing or trekking parties are usually warned about these areas when they check in or otherwise communicate with the climbing rangers in the Talkeetna Ranger district.

Earthquakes & Seismic Activity - The park is wholly within a level three seismic risk zone, receiving greater than 500 events per year at a magnitude of 4.00, and at depths varying from near surface to 150 km or slightly greater. Seismic frequency within the park is primarily concentrated around Mt. McKinley itself, although events are dispersed throughout the park in any given year.

Although no known seismic damage has occurred to human-made structures in the park, seismic events may have triggered avalanches, landslides and other mass-movements are known to have occurred in both remote and well-traveled portions of the park. Several significant seismic events are reported in mountaineering and other exploration or backcountry literature in the Denali area. Perhaps the most famous account, is that of the Parker-Brown expedition of 1912, where the eruption of Mt. Katmai on June 6 propagated major tremors in the Denali area significantly changing snow and ice walls on the Muldrow-Karstens Ridge climbing route. A more recent seismic event, magnitude 6.1 at a depth of 112 Km right under Mt. McKinley, occurred on May 21, 1991, and resulted in numerous massive snow and ice avalanches as reported by several climbing teams on Mts. McKinley and Foraker.

Geochemical & Radioactive Hazards - Natural concentrations of oxides, sulfides, heavy

metals or radioactive compounds occur in the park in numerous locations, often associated with mining or mineralized areas. In Denali National Park and Preserve, as is the case in most mineralized areas, the mineral concentrations are not particularly threatening in their natural "in-place" condition. Only after human disturbance and concentration of these substances does any threat occur. Known geochemical hazards related to mining within the park are well documented and evaluated for remediation in various documents including the park's draft reclamation plan (Tranel and Spencer 1994) and the Hazardous Materials and Waste Management Project Statement, DENA-I-700.

Naturally occurring sites of oxidation (unmined and undisturbed) are located in a few areas in the park, and contribute to minor changes to local stream chemistry. Since these sites are not in locations of frequent human habitation, threats to human life are considered minimal.

The only known natural radioactive mineral concentrations within the park occur in the park headquarters area, where the presence of radon gas has been detected. Radon 220 is often present as a daughter product of radium 224, and exists usually in very low concentrations in many types of rocks. Locally, the Pre-Cambrian to Lower Paleozoic Yukon-Tanana rocks (formerly known as the Birch Creek Schist) which underlie headquarters and many other park facilities, are the host to the radon occurrence. Uranium mineralization has also been reported within the Tertiary Coal Bearing Group (Dickson 1982), which is sparsely located in portions of the park. Additional possibilities for uranium occurrence (and subsequent radon presence) may be associated with other rock units within the park.

Current Management Actions and Results

Efforts to recognize, understand and monitor geologic hazards that are perceived as an immediate threat to park facilities occur as time allows, or, more often, when potential crises are recognized.

Flooding and Erosion - With the exception of a few facilities, NPS structures and areas of concentrated activity are not within ordinary floodplain locations and therefore not susceptible to 100-500 year flood events. The planning of new facilities and the possibility of siting on active floodplains is significantly diminished due to environmental review requirements such as the Executive Order on Floodplain Management (11988). Additionally, park flood hazard identification and floodplain delineation are recommended actions within the park Water Resource Management Project Statement, DENA-N-210.

The possibility of glacial outburst flooding affecting park facilities in Denali National Park is generally considered minimal. Additionally, anticipating locations for potential outburst flooding can be a complex and risky wager. Also, outburst water volumes are difficult to estimate, and are frequently in remote locations where effects to human made facilities located many miles downstream are difficult to perceive. Some privately owned properties or cabins on the south side of the park may be at some risk to jökulhaups.

Mass Movements, Permafrost & Ground Subsidence - Numerous large to small mass movements are known to occur throughout the park, and there are topographic indicators of historic or prehistoric mass movements in various locations as well. Some of these phenomena not only directly threaten existing facilities, such as the park road or park buildings, but less obvious potential mass movements may threaten land use areas indirectly by altering stream courses and creating erosion or flooding hazards.

Identified historic or prehistoric slides on the north side of the park include large block slides or debris flows at Quake/Berg Lake, Drunken Forest, and along the Parks Highway south of the park entrance. Numerous smaller slumps and debris flows occur in various drainages in the northern foothills of the Alaska Range, and many are noticeable along the park road. Active slopes have been identified along Hines Creek, Teklanika River, Igloo Creek, the Wyoming Hills vicinity, and the Toklat and Thoroughfare Rivers.

Historic or prehistoric mass movements on the south side of the park include block glides and debris flows at Hidden River, Coffee Creek, Slide Creek. In the southwest corner of the park movements have occurred at Shellabarger Pass, the headwaters of Dillinger River, and a large slump block complex near the terminus of Shadows Glacier (Reed and Nelson 1978).

Several potentially large scale movements currently threaten the park road or have already caused significant damage. The 20 mile slope failure, which occurred in 1992, was caused by the liquefaction of fine grained sediments beneath the road, resulting in fracturing and subsidence at the road surface. Repairs included minor road relocation and a "digout" of the culprit soils. The 43 mile failure concerns an outer shoulder fracture due, at least partially, to unloading of a buttress slope by the East Fork River. This failure was first detected in 1988, has been drilled and monitoring continues while the movement appears to have slowed or ceased.

The 45 mile failure (or Bear Cave Slump), which consists of a multiple slump terrace surface of nearly an acre in size, was first noticed to be active (or reactivated) in the summer of 1990. Four or five scarps, approximately 7 to 10 feet high, were identified on the primary terrace surface, along with numerous fractures in a pressure ridge that is forming at the bluff edge which overlooks the East Fork River. The uppermost scarp is within 35 feet of the park road where in 1990, a relief culvert outlet was feeding water to the movement almost directly. Although this culvert was relocated shortly after discovery of the problem, the headwall of this scarp continues to erode toward the park road. In 1993, a survey net of more than thirty stations was established to characterize the movement and monitor the encroachment upon the park road. Subsequent drilling and seismic investigations have refined our knowledge of the subsurface in this area.

Numerous smaller slumps and debris flows threaten the park road on an intermittent basis, particularly during periods of heavy or concentrated rainfall. On August 28, 1990, during such a period of continued rainfall, several mass movements at or near the park road were activated,

resulting in rockslides and earthflows that partially or completely blocked the road. These sites at mile 34, 36 and 37 in Igloo Canyon, and at mile 46 on Polychrome Pass, as well as several sites at Stony Dome, Thorofare Pass, and Eielson Bluffs, require continued maintenance and monitoring.

Although only one NPS structure has been damaged by subsidence, several problem areas on the park road (areas of subsidence, grade sags, and other movement) are known or suspected to be at least partially caused by permafrost degradation or fine grained soil compression. Slow deformational subsidence has been identified at mile 4, 49, and 74, with occasional subsidence symptoms noticeable in other sections of the park road. Additionally, the Wonder Lake Ranger Station, built in the 1930's, has continued to subside on the outer perimeter walls of the foundation due to fine grained soils compression or possibly permafrost conditions.

The primary method of inventorying and understanding geologic hazards within the park, whether mass movements or other hazards, is by bedrock and surficial geologic mapping. Fault zones, landslides, slumps, avalanches and areas susceptible to subsidence are most frequently identified by geo-surficial mapping. Numerous locations within the park demonstrate obvious slope stability problem areas, and additional geo-surficial information would expand our knowledge of these principal and potential risk areas. No systematic evaluation of slope stability or landslide risk potential has been attempted in the park. Additionally, no known formal risk assessment has been made of rock and icefall areas on any travel routes (roads, trails, backcountry or climbing routes) within the park.

Earthquake/Seismic Monitoring - In cooperation with the Alaska Earthquake Information Center (AEIC), the park has permitted two seismic monitoring stations within the park at Rock Creek Ridge and Thorofare Mountain. A memorandum of understanding (MOU) signed by the University of Alaska - Geophysical Institute and the park superintendent in October, 1986, calls for the Institute to establish, monitor and maintain seismic monitoring equipment in agreeable locations in the park, and for the institute to assist the NPS in geologic interpretations with an exhibit at Eielson Visitor Center. The seismic monitoring stations have been operating since 1987 providing constant event data to the statewide seismic monitoring network.

Additional seismic monitoring stations and computer displays of seismic activity have been discussed with the Institute. At least two or three locations, in addition to the existing two seismic monitoring sites would be preferable to refine the location of in-park and other seismic events, and would also help to refine fault geometry and other geophysical mechanisms. Portable seismic monitoring units placed in strategic locations for short periods (one or two field seasons) would further refine some of this data and would further resolve seismic anomalies (unusual clusters of seismic activity) that exist in the park.

Earthquake danger or seismic risk can also be better understood and managed by geo-surficial mapping and associated geophysical data collection methods. Better understanding of seismic phenomena within the park could contribute to future transportation route planning or building

sites, as well as being an important contribution to the understanding of the park and its natural history.

Geochemical & Radioactive Hazards - As mentioned above, geochemical hazards related to mining within the park are well documented and evaluated for remediation in various documents including the park's draft reclamation plan (Tranel and Spencer 1994) and the Hazardous Materials and Waste Management Project Statement, DENA-I-700.

Natural sites of oxidation are only casually known and efforts should be made to document the sites and evaluate their effects on the local environment. Known or unknown mineral licks may also provide information on associated metallic or other substance concentrations.

Low to moderately high concentrations of radon were discovered in some basements and crawl spaces under living quarters and offices in the headquarters area. Remediation of the conditions consists of vapor sealing walls and floors to prevent gas intrusion, and to provide passive and active ventilation in those areas of higher readings. A park-wide resource based evaluation of all radioactive sources or potential sources might be in order.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-312.001: Coordinate Geohazard Evaluation with Other Agencies and Institutions

Establish contacts, memoranda of understanding, and cooperative agreements regarding inventory, research, and monitoring of geologic hazards and to disseminate information on areas of concern and risk potentials to the public. Also encourage and enhance park personnel participation in outside research and other data collection endeavors.

N-312.003: Involve PFT Geologist or Physical Scientist in Geohazard Recognition and Evaluation

(see DENA-N-311.005, DENA-N-314.006, and DENA-N-320.104)

N-312.004: Create Temporary Seasonal Physical Science Positions

A physical science technician would provide program assistance, field support, and data manipulation for many branch operations. Geohazard and other physical science field programs require additional help regarding transportation, logistics, data collection and data reduction. Additionally, many of these programs also require significant data input time for various reports, papers and other accomplishment products. (see DENA-N-

311.006, DENA-N-314.007, and DENA-N-320.105)

B. Research

N-312.011: Evaluate Geologic (Slope Stability) Hazards

Inventory, investigate and monitor mass movements and suspected potential slope stability problem areas throughout the park. The priority for this project should focus on known problem areas that impact the park road and other structures, both NPS owned and privately owned. Understanding the bedrock, soil, aspect, and the many other variables that contribute to slope failure in the park could head-off damage to structures and provide insight to surface erosion & water transport conditions in the park.

N-312.012: Evaluate Seismic Risks

Initiate efforts to gather, quantify and map seismic events within the park and evaluate risks to structures, and visitors as well as impacts to park resources.

N-312.013: Identify Rock, Icefall and Avalanche Hazard Locations and Provide Risk Assessment

Determine rock, icefall, and avalanche hazards for all travel routes (roads, trails, backcountry and climbing routes) and prepare maps and other information to inform park users of the locations and associated risks.

N-312.014: Identify and Evaluate Glacial Outburst Threat (jökulhaup) Potentials

N-312.015: Investigate Seismic Anomalies

Establish temporary seismographs or other surface motion monitoring equipment to characterize the seismic swarms near the Foraker River and Birch Creek.

N-312.016: Continue Shallow Seismic Refraction Surveys

Collect and catalogue seismic velocities of particular strata and surface materials for park-wide and rock unit-wide comparison. Establish environmental or regional variabilities in shallow seismic response of materials, and provide subsurface data for mining, engineering or other potential needs.

N-312.017: Inventory and Document Geochemical/Geophysical Conditions

Inventory and characterize park-wide mineralized zones and other geo-chemical/physical conditions (oxidized surface localities, warm or hot springs, mineral licks, etc.) to

determine the effects of the condition, and to evaluate hazards or risks to park personnel, visitors, or other resources.

N-312.018: Inventory and Document Radioactive Source Areas within the Park

Identify locations, rock units and other surface materials that have or may emit radioactivity (radon or other radioactive products). Determine the need for mapping radioactivity (isorad map) at target locations in the park.

N-312.019: Support Independently Funded Geologic Hazard Research

The service would support independently funded geohazard research projects in Denali National Park and Preserve by public and private organizations, agencies and universities. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management DENA-I-410).

C. Mitigation

N-312.021: Closures of High Hazard Areas

A public use closure system would be put in place to protect the public from risks associated with high hazard areas.

N-312.022: Site/Structure "Hazard Proofing"

Park staff will undertaken efforts to design and construct facilities to reduce or eliminate damages that may result from hazards. Factors such as soil/permafrost conditions, presence of a floodplain, and unstable slopes will all be considered.

N-312.023: Facility Removal

Park facilities will be inventoried and assessed for hazards. Where risks are considered unreasonable, facilities will be removed and relocated.

D. Monitoring

N-312.031: Continue and Expand Seismic Monitoring

Continue in-park seismic monitoring in cooperation with the USGS and UAF/Geophysical Institute. Existing seismic stations at Rock Creek and Wickersham Dome will be maintained to provide seismic event information to the state-wide net. Investigate additional instrumentation needs and localities to refine the local and state net seismic

interpretations.

N-312.132: Monitor Geo-hazards & Geo-engineering Conditions

Continue monitoring known hazards and conditions (i.e. Bear Cave and other earthflows and slumps, Wonder Lake Ranger Station subsidence) that threaten park facilities and park resources. Continue physical science contributions to park engineering and park facility design in attempts to avoid facility failure or poor performance due to geotechnical reasons. Park Road designs relating to geologic conditions (slope stability, soils suitability, water retention) will be reviewed by the Physical Science Branch for feasibility. Design suggestions will be bolstered by monitoring and research projects dealing with such issues as natural ground movements, surface gravel retention, and general permafrost conditions as necessary.

E. Interpretation

N-312.041: Maintain Seismic Display at Eielson

Support, enhance and encourage the seismic display, and similar or better displays, at Eielson Visitor Center.

N-311.042: Increase Public Awareness of Geologic Hazards

Develop public displays, provide brochures, encourage interpretive programs regarding earthquake/seismic risk, landslide potentials, flooding risks, glacier dangers and others.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- PFT Geol/Phys. Scient.	(funding covered under other RMP statements)				
- Seasonal Temp.	10.0/0.5	10.0/0.5	10.0/0.5	10.0/0.5	40.0/1.0
RESEARCH					
- Evaluate Slope Stability	75.0/0.0	75.0/0.0	75.0/0.0	75.0/0.0	300.0/0.0
- Seismic Risk	1.0/0.0	1.0/0.0	1.0/0.0	5.0/0.0	8.0/0.0
- Rock, Ice, Avalanches	10.5/0.0	5.0/0.0	5.0/0.0	5.0/0.0	25.0/0.0

- Jökulhaup Inv.	5.0/0.0	5.0/0.0	2.5/0.0	2.5/0.0	15.0/0.0
- AEIC Seismic Mon.	0.5/0.0	0.5/0.0	0.5/0.0	0.5/0.0	2.0/0.0
- Seismic Anomales	1.0/0.0	1.0/0.0	0.5/0.0	0.5/0.0	3.0/0.0
- Refraction Surveys	0.5/0.0	0.5/0.0.	40.0/0.0	0.5/0.0	41.5/0.0
- Geochem/Geophys Inv.	1.0/0.0	3.0/00	3.0/0.0	3.0/0.0	10.0/0.0
- Radioactive Inv.	0.5/0.0	1.0/0.0	1.0/0.0	1.0/0.0	3.5/0.0
MITIGATION					
- Closure System	1.0/0.0	1.0/0.0	1.0/0.0	1.0/0.0	4.0/0.0
MONITORING					
- Geo-engineering	3.5/0.0	3.5/0.0	1.5/0.0	1.5/0.0	10.0/0.0
INTERPRETATION					
- Seismic Display	0.0/0.0	1.5/0.0	1.0/0.0	1.0/0.0	3.5/0.0
- Public Awareness	1.0/0.0	2.5/0.0	2.5/0.0	5.0/0.0	11.0/0.0
TOTALS	112.9/0.5	113.0/0.5	145.5/0.5	102.5/0.5	483.9/1.0

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Collier, M. 1989. The Geology of Denali National Park. Alaska Natural History Association.

Csejtey, B. Jr., et al. 1992. Geology and Geochronology of the Healy Quadrangle, Alaska. USGS Misc. Invest. Series.

Dickson, R. K. 1982. Uranium Mineralization in the Nenana Coal Field, Alaska. in Short Notes on Alaskan Geology, 1981. Alaska State Division of Geological and Geophysical Surveys, Geologic Report 73.

Gilbert, W. 1979. A Geologic Guide to Mt. McKinley National Park. Alaska Natural History Association (out of print).

Reed, B. L., and S. W. Nelson. 1980a. Geologic Map of the Talkeetna Quadrangle, Alaska. USGS Misc. Field Invest. Map MF-870-J.

Reed, B. L., and S. W. Nelson. 1980b. Surficial Geologic Map of the Talkeetna Quadrangle, Alaska. USGS Misc. Invest. Series Map I-1174.

Reed, J. C. 1961. Geology of the Mt. McKinley Quadrangle, Alaska. USGS Bulletin 1108A.

Ridgeway, K. D. 1993. Tectono-Stratigraphic Analysis of the Cantwell Basin, Alaska Range, Alaska. Project proposal to USNPS Denali NP&P.

Tranel, M. J. and P. Spencer. 1994. Draft parkwide reclamation and restoration program: Disturbed lands of Denali National Park and Preserve, Alaska. U. S. Department of the Interior. 79pp.

USNPS. 1988. Management Policies. U. S. Department of the Interior.

USNPS. 1991. NPS-77 Natural Resources Management Guidelines. U. S. Department of the Interior.

Wahrhaftig, C., and R. F. Black. 1958. Quaternary and Engineering Geology in the Central Part of the Alaska Range. Geological Survey Professional Paper 293.

MINERALS MANAGEMENT

PROJECT CODE: DENA-N-313

SERVICEWIDE ISSUES: N10 Disruption of Park Resources Due to Mineral Extraction Activities

STATEMENT OF PROBLEM

Introduction

Exploration for and development of minerals on lands within Denali National Park and Preserve, can adversely affect the resources that the National Park Service (NPS) has been mandated to protect. These potentially at risk resources include: water quality and aquatic communities, air quality, wildlife habitat, plant communities, cultural resources and the natural landscape's aesthetic values.

The natural resources of Denali's particularly sensitive sub-arctic ecosystem are affected by mining operations in a variety of ways. The land is directly altered by moving soils and/or bedrock to recover, test or locate the minerals contained within. Access to the claims may produce tracks, roads, or other scars that can be evident for decades or centuries. Removal of vegetation eliminates or significantly alters habitat, increases erosion, impacts aquatic resources and detracts from the aesthetic value of the wilderness. Diversion of streams for mining operations may reduce stream flow, thereby significantly altering and/or destroying fish habitat and other aquatic communities in the area. Washing of highly mineralized soils or concentrates may increase heavy metal concentrations in streams, degrade water quality and consequently adversely impact aquatic resources. Careless mining operations often increase sediment loads to the point where some species of fish can no longer use the streams for spawning. Haphazard or negligent reclamation of mined areas may not enable the natural ecosystem to restore itself to pre-mining conditions and may actually further amplify resource degradation for many years to come.

Historical Perspective

The first commercial discoveries of gold in the Kantishna Hills occurred on Friday and Eureka Creeks in 1904 setting off a "stampede" by several thousand miners to the area. Mining claims were staked on virtually every creek and intervening ridge in the Kantishna Hills. Small towns

were established in the area, including Glacier at the mouth of Glacier Creek, Diamond at the mouth of Moose Creek, Roosevelt and Square Deal on the Kantishna River, and Eureka at the mouth of Eureka Creek.

Most of the "stampeders" left the new district by early 1906 when it became obvious that only a few streams carried paying quantities of gold. The number of miners in the district declined each year from 50 at the end of the 1906 season to 36 in 1916. The placer miners who stayed confined their efforts to shallow creek gravels, using pick-and-shovel methods. In the 1910s, the technique of groundsluicing off the overburden with automatic or "boomer" dams was introduced. The miners then shoveled the gold-bearing gravels into sluice boxes by hand.

Lode deposits containing lead, zinc, silver, gold, and copper veins were found on Quigley Ridge in 1905 and 1906, and numerous hardrock discoveries were made in the Glen and Eldorado Creek areas from 1907 to 1909. By 1916, numerous lode prospects had been located along a 40-mile corridor stretching from Slate Creek to Stampede Creek. High-grade lead and silver ores became exhausted by 1922 and lode mining ceased in the Kantishna Hills area by 1924.

The first attempts to introduce large-scale placer mining technology to the Kantishna district were made in the early 1920s. Two groups, one on Caribou Creek and the other on Moose Creek, began operating large hydraulic plants in 1922, but both operations lost money and shut down soon thereafter. Placer mining in the district declined in the late 1920s and early 1930s. However, during this time, a few small-scale operators continued to use hand-mining methods.

An increase in the fixed price of gold in 1933 and completion of a road from the railroad to Kantishna in 1937 helped usher in a "golden era" of mining for the district. The Stampede Mine began producing antimony ore in 1936 and, by 1941, became the largest antimony producing mine in Alaska. The Banjo Mine on Wickersham Dome started producing lode gold in 1939 and became the largest lode gold producer in the district's history. Large-scale placer mining was successfully introduced into the district in the late 1930s, as Caribou Mines and another mining firm began operating mechanical draglines on Caribou Creek. The Caribou Mines operation contributed the largest share of the district's gold production in the late 1930s and early 1940s. Annual gold production in the district reached an all-time high of 7,000 ounces of gold in 1940.

After America's entry into World War II, the federal War Production Board closed all "non-essential" gold mining operations in 1942. Only two small-scale placer mines continued to produce antimony as a strategic war material during and after the war years.

Placer mining resumed immediately after the war, but it did not return to prewar production levels because of rising costs, the fixed price of gold, and competition for labor by other markets. The largest placer mining operation during this period was Caribou Mines, which resumed dragline operations on Caribou Creek from 1946 to 1948. Antimony production increased somewhat in the 1970s as it was a strategic mineral needed during the Vietnam War.

In 1972, the deregulation of gold prices brought about a major resurgence of placer mining activity in the 1970s and early 1980s. By 1983 the total mineral production for the Kantishna district was estimated at 85,000 ounces of gold, 265,000 ounces of silver, 504,000 pounds of lead, 4.4 million pounds of antimony, and several million pounds of combined lead and zinc (Salisbury and Dietz 1983).

The Kantishna Hills, although never one of the major placer mining or lode-producing districts in Alaska, has been a consistent producer of minerals over the years. Other less productive mining districts in the park/preserve include the Chulitna River basin, in which the Dunkle mine was developed, and the Yentna district, which includes part of the Tokositna River drainage.

On July 22, 1985, the U.S. District Court for Alaska enjoined the National Park Service from approving plans of operations for mining in National Park System units in Alaska. The court order directed full compliance with the National Environmental Policy Act and National Park Service regulations for mining and mining claims (36 CFR 9A) before taking actions to approve and permit mining operations. In addition, the court called for preparation of an environmental impact statement (EIS) evaluating the cumulative effects of mining in Denali National Park and Preserve.

A record of decision (ROD) was signed by the Alaska Regional Director on August 21, 1990. Alternative D as presented in the Final EIS was selected, calling for acquisition of all mining claims. Interim actions outlined in the ROD require processing of mining plans of operations until acquisition is completed.

Present Condition

The passage of the Alaska National Interest Lands Conservation Act of 1980, added approximately 4 million acres of new land to Denali National Park and Preserve. This new land was withdrawn from the filing of new mining claims according to Public law 94-429, the Mining in the Parks Act of 1976. However, pre-existing valid claims could continue to be operated under the existing laws of the Mining in the Parks Act, as implemented by regulations in 36 CFR part 9A.

There are no valid mining claims in either the original Denali wilderness or in Denali National Preserve. Within the 1980 additions to Denali National Park, however, there still remain 14 patented claims and 282 unpatented claims (U. S. Bureau of Land Management 1996). While some unpatented claims may be abandoned and others ultimately ruled invalid, they all must be presumed valid until mineral validity examinations show otherwise. A permit may possibly be issued for operations on a placer claim on Eureka Creek, but it appears that only one or two other claims have possibilities for activity in the near future. Currently, there are no mining or related operations occurring within Denali National Park and Preserve.

The effects of mining are visible on over 200 acres of land covering 10 drainages in the Kantishna area. Levels of disturbance vary between mining camps. Tailings piles, abandoned since the early 1940s, and disturbed stream channels and floodplains are some of the more obvious signs of past mining activity. However, other scars left from past mining operations that will require hazardous materials removal and full restoration efforts, have been obscured by revegetation.

Potential exists for patented claims to be converted to uses other than mining which may be incompatible with park purposes.

Current Management Actions and Results

Land Acquisition - The NPS has been conducting acquisition procedures and acquiring mining claim interests in Denali since the ROD was signed by the Regional Director in 1990. There are many steps in preparation for actual acquisition of mining claims and the NPS has almost completed these procedures on all claims within Denali. These pre-acquisition steps include: cultural resources surveys, mining claim validity examinations for unpatented claims, hazardous substances surveys, abstracts of title and ownership reports, real estate appraisals and negotiations.

Congress has provided specific funding for this program. In fiscal years 1991, 1992 and 1993, a total of nearly $12 million was earmarked for purchasing mining claims in Denali. However, in 1995, Congress rescinded what remained of that initial appropriation in efforts to reduce the budget. Only a small percentage of that money was reallocated for 1996 and future funding remains uncertain. Funding requests for land acquisition are submitted annually for Congressional appropriations from the Land and Water Conservation Fund. A 1990 NPS priority listing identified the acquisition of unpatented mining claims as a high priority, but factors outside the scope of the plan, such as title defects, validity status, litigation among private ownership interests and takings litigation with the NPS, navigability issues and hazardous substances findings, have affected the planned acquisition sequence. One effect has been that most of the completed appraisals are of patented claims, because navigability is generally not an issue and time-consuming validity examinations are not needed to purchase patented claims.

To date, 29 patented mining claims and portions of 4 others, comprising 611 acres, have been acquired. The NPS has also acquired 7.5 unpatented claims totaling 272.84 acres. Many more acquisitions are pending. Ninety percent of the claims that have yet to be acquired have had pre-acquisition steps (validity reports, hazardous materials surveys, title work, appraisals, etc.) completed. Staffing for the claim acquisition efforts is provided by the Land Resources Program Center of the Alaska Field Area.

Mining Plans of Operations - Because of the court's injunction on the NPS from approving plans of operations, there has been no mining activity on claims on federal land within Denali

since 1985. There is provision for relief from the injunction if it is determined that there will be no adverse cumulative impacts from a proposed operation. All proposed mining plans of operations must meet the regulations as codified in 36 CFR part 9A which were established to ensure that all mining related activities are "... conducted in a manner consistent with the purposes for which the national park system and each unit were created, to prevent or minimize damage to the environment or other resource values, and to ensure that the pristine beauty of the units is preserved for the benefit of future generations.". Although several plans of operations have been submitted under the relief provision, only one has been approved. Mining on claims located under the 1872 mining law cannot resume unless environmental compliance documents conclude that the cumulative effects of the proposed activities will not significantly impact park resources.

An NPS approved plan of operations is required in order to conduct any mineral operations, including assessment work, delineation of the ore body, and development and transport of the ore body. However, in order for any plan of operations to be evaluated, the basic information contained within must be detailed enough to provide the basis and justification for the development of the more detailed environmental assessments and feasibility studies which are necessary to make sound decisions. Claimants interested in mining operations have rarely supplied sufficient information for evaluation of a plan of operations and, therefore, very few proposals have received this level of environmental compliance review. This has resulted in many plan of operation's proposals being neither officially approved nor denied, and causing increased claimant frustrations with the NPS and the process. As a result, Denali makes extra, non-required efforts, to provide the claimants with professional advice and assistance in the preparation and revision of proposals, so that discouragement and possible frustrations can be reduced.

Since the 1990 ROD, Denali has received a total of 19 mining plans of operations proposals. Eight of these proposals are currently being evaluated while eleven proposals have already been processed. Of those eleven processed proposals, only three contained all the elements required by NPS regulations to warrant further evaluation in an environmental assessment (EA). Two of the EAs concluded that the proposals, as submitted, would result in unacceptable environmental impacts and were therefore denied. The other EA approved the operator's proposed mining operations as submitted. However, the operator never posted a reclamation costs security deposit. Therefore, the NPS has not issued a permit to mine.

Reclamation and Hazardous Waste Removal - NPS reclamation and restoration of mined lands started with Glen Creek in 1988. The NPS is conducting an on-going project on Glen Creek to study stream channel characteristics so that additional methods for the establishment of a stable channel/floodplain system can be refined.

Debris and hazardous waste have been removed from areas within Denali, especially along Friday and Eureka Creeks. Large clean-up projects were completed during 1993 and 1994.

These projects included the removal of approximately 200 drums containing hazardous waste and other materials from the Stampede Mine and Crooked Creek areas. In the past, the U.S. Bureau of Mines has proposed to assist the NPS in addressing the hazards to both human safety and the environment that exist on abandoned mine lands. The Bureau of Mines will be unavailable to assist the NPS in future projects, and so the NPS has assumed full responsibility for mine hazards assessment, site analysis and waste removal.

RECOMMENDED ACTIONS

The park will work with the Alaska Support Office's (AKSO) Physical Resources staff to develop and implement a mined lands restoration program and to manage any new mining activity and related access within or adjacent to the park and preserve.

A. Program Administration and Planning

N-313.001: Continue to Acquire Mining Claims According to Land Protection Plan

In 1990 a Congressionally mandated acquisition plan was prepared. While the plan established acquisition priorities, outside factors including the willingness of the property owner to sell, title defects, validity status, navigability issues, litigation and hazardous substance findings affected the proposed sequence. A more flexible approach has since been adopted so that allowances for different conditions can be made until all the mining claims are acquired. Denali minerals management personnel will continue close communication with the AKSO's Lands Division staff to assure that current issues and concerns are being addressed. (Land Resources Management DENA-I-500.)

N-313.002: Complete Restoration Plan for Areas Disturbed by Mining Activities

The effects of mining are visible on over 200 acres of land covering 10 drainages in the Kantishna area alone. A detailed plan for reclamation of these areas was drafted in 1994 which identifies the level of restoration required, documents the level and type of management intervention needed to protect park resources, and sets priorities on restoration projects. This plan needs to be finalized and it's findings implemented in projects to restore disturbed mine areas.

An important component of this reclamation plan is to identify cultural resources management and interpretation needs in the Kantishna Hills and on other mined lands in the park and preserve. All cultural resources requiring preservation should be identified. Protection needs and interpretive potential should also be identified and discussed. A team planning effort may be most appropriate, with both AKSO and park staff involved.

Park minerals management staff would take the leading role. (Ecological Restoration/Reclamation DENA-N-530.)

N-313.003: Continue Processing Mining Plans of Operation as Required in the Record of Decision in the Final Environmental Impact Statement

Until all mining claims can be purchased, operators may continue to submit proposed plans. Plans submitted will be reviewed by the park geologist and environmental specialist for thoroughness and feasibility. These staff members will correspond with the claimants and request additional information as necessary. When adequate information has been received for engineering and environmental assessments to be completed, these will be prepared by park minerals management staff with assistance as needed from the AKSO. Completed assessments will determine if a Finding of No Significant Impact (FONSI) can be signed by the Field Director or if an Environmental Impact Statement must be prepared. If a FONSI is issued and an operator obtains other necessary permits (EPA, Corps of Engineers, etc.), then a permit to mine, within certain stipulations, may be issued by the Field Director.

N-313.004: Improve Organization Of Minerals Management Records

The minerals management record of the park is extensive and complicated. Improvements in records management would be made to facilitate better information recovery and decision making.

B. Research

N-313.011: Conduct Research on Methods to Enhance Riparian Zone Ecosystem Recovery in Watersheds Disturbed by Placer Mining

Research was conducted between 1988 and 1992 in the Glen Creek watershed. The NPS would continue to monitor this area in order to address the development of techniques for stabilization and rehabilitation of stream channels and floodplains disturbed by placer mining activities. Physical, chemical, and biological parameters of the main study site and control site would continue to be monitored intensively each field season. Other old mine sites should be considered for similar research.

Consideration would be given in experimental designs to the comparison of undisturbed sites and reclaimed sites to measure the effectiveness of reclamation efforts.

N-313.012: Conduct Water Quality Research in Areas Affected by Minerals Management Issues

NPS staff have completed three years of field work, in 1996, in support of a comprehensive, problem-oriented research project that should provide management with factual knowledge of water resources in the Kantishna area and other parts of the park affected by minerals extraction. The physical, chemical, and biological quality of major streams in these areas were monitored so that any affects of past mining activities could be documented, so recovery rates after placer mining could be quantified, and so profiles could be developed of various streams that might be affected by proposals for future mining or reclamation projects. After data analysis is completed, decisions on whether or not to continue or expand this investigation will be made.

N-313.013: Work to Characterize Mine Tailings and Acid Mine Drainage Problems

In addition to the on-going monitoring on Glen Creek, Denali could benefit by expanding it's research on other mined lands within the park. Past Bureau of Mines investigations identified hazards on abandoned mine lands to both human safety and the environment. The NPS will now have to assume responsibility for conducting these investigations and make recommendations on mitigating these hazards. Park and AKSO staff will coordinate field work logistics and recommend and review project proposals.

C. Mitigation

N-313.021: Eliminate Safety Hazards from Abandoned Mines

Abandoned mine lands can present safety hazards such as weak or collapsed structures and open shafts in addition to the hazardous materials and water pollution problems discussed separately. These hazards should be identified and marked and potential visitors should be warned accordingly. Hazardous conditions will be eliminated as part of the mined areas restoration plan.

N-313.022: Reclaim Previously Mined Areas

As the NPS purchases mining claims, major reclamation and hazardous waste removal projects will be necessary. Most claims in the Kantishna area lie outside the former Mount McKinley National Park boundaries and were mined before being incorporated into Denali National Park and Preserve in 1980. There was minimal regulation, and reclamation efforts were small and negligent in most cases.

All mining claims purchased to date at Kantishna have either been free of hazardous substances or clean-up arrangements have been made. In the thirteen cases where

substantial contaminant problems have been identified, it is necessary for the seller to clean up the problems before title can be conveyed to the United States, unless mutually satisfactory clean-up arrangements can be agreed upon. In some cases this may mean a lower purchase price and subsequent clean-up efforts by the NPS.

These projects will be outlined in the mined lands reclamation plan mentioned above and will also be described in other project statements (Ecological Restoration/Reclamation DENA-N-530 and Hazardous Materials and Waste Management DENA-I-700).

D. Monitoring

N-313.031: Monitor Minerals Development and Related External Threats

The park would continue to monitor mineral development activities and threats outside the park and preserve that may affect park resources. Most monitoring in the field would be confined to aerial observation of activities and resource impacts. Park staff would continue to meet with mineral owners and mine claimants to establish and maintain working relationships and to ensure adequate protection of park resources. Monitoring actions would be integrated with activities described in other resources management plan project statements.

N-313.032: Monitor Approved Mining Plans of Operations

Until all mining claims have been purchased, it may be possible for an operator to have a plan approved once the required review is completed. A permit for mining may then be issued which would be subject to several NPS stipulations as well as regulations from other government agencies. Park minerals management staff will be required to monitor any mining activity to ensure that all stipulations and permit requirements are followed. Activities outside the provisions of the mining permit will require close consultation with the operator.

N-313.033: Complete Hazardous Substance Recertification for the Kantishna Area

Hazardous substance surveys were completed for the Kantishna area in July, 1993. Subsequent recertifications have occurred each year thereafter and may continue every year depending on whether or not the sites have been disturbed and on land acquisition progress. Any hazardous substance surveys required will be contracted for by the AKSO's Lands Division. (Land Resources Management DENA-I-500.)

N-313.034: Monitor Previously Reclaimed Areas

Research on revegetation is continuing on Lower Glen Creek, where a major reclamation

project was completed in 1992. In addition to this research project, stream channel monitoring should be conducted (Water Resources DENA-N-210). As additional reclamation projects are completed, park minerals management staff will monitor key physical and biological resources affected by minerals extraction and reclamation to identify additional restoration work necessary and to further refine reclamation methods.

E. Interpretation

N-313.004: Provide Public Information on Minerals Management Issues

Although mining has not occurred in the Kantishna district for several years, the issue remains controversial and regular media attention continues. It is essential that the park and AKSO work closely together on public information issues so that accurate and timely information is provided to miners, the Alaska congressional delegation, state government, visitors, and other concerned parties. Visitors to the Kantishna area should be informed of the land status, including locations of private property, and of hazards on abandoned mine lands. Park minerals management staff should review public information being distributed and provide updates as necessary.

F. Protection

N-313.051: Enforce Mining Permit and Access Restrictions

Permits are likely to be issued for access to mining claims and possibly for approved mining operations. Access to claims is governed by regulations in 43 CFR Part 36, and mining operations are governed by 36 CFR Part 9A. Claimants may be subject to additional stipulations and must also follow general park regulations. Enforcement of permit provisions, stipulations, and NPS regulations will be the duty of commissioned personnel from both the Protection Division and the Division of Research and Resource Preservation.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Restoration Plan	11.0/0.3	11.0/0.3	0.0/0.0	0.0/0.0	22.0/0.6
- Process Mining Plans	22.0/0.6	22.0/0.6	22.0/0.6	22.0/0.6	88.0/2.4

RESEARCH					
- Riparian Zones	60.0/0.5	30.0/0.4	30.0/0.4	30.0/0.4	150.0/1.7
- Water Quality	30.0/0.3	30.0/0.3	30.0/0.3	30.0/0.3	120.0/1.2
- B.O.M. Studies	20.0/0.0	0.0/0.0	0.0/0.0	0.0/0.0	20.0/0.0
MITIGATION					
- Safety Hazards	30.0/0.3	30.0/0.3	0.0/0.0	0.0/0.0	60.0/0.6
- Reclaim Mined Areas	60.0/1.0	50.0/0.5	50.0/0.5	50.0/0.4	210.0/2.4
MONITORING					
- Minerals Mgt.	30.0/0.5	30.0/0.5	30.0/0.5	30.0/0.5	120.0/2.0
- Plans of Operations	30.0/0.5	30.0/0.5	30.0/0.5	30.0/0.5	120.0/2.0
- Haz. Recert.	15.0/0.0	15.0/0.0	15.0/0.0	10.0/0.0	55.0/0.0
- Reclaimed Areas	11.0/0.3	11.0/0.3	11.0/0.3	11.0/0.3	44.0/1.2
INTERPRETATION					
- Provide Public Info.	11.0/0.3	11.0/0.3	11.0/0.3	11.0/0.3	44.0/1.2
PROTECTION					
- Permits/Access	2.0/0.1	2.0/0.1	2.0/0.1	2.0/0.1	8.0/0.4
TOTALS	332.0/4.7	272.0/4.1	231.0/3.5	226.0/3.4	1061.0/15.7

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiating any project and will be maintained on file at Denali National Park and Preserve headquarters.

Applicable compliance documents already completed include the following:

1. Final Environmental Impact Statement, Cumulative Impacts of Mining, Denali National Park and Preserve, 1990: meets all National Environmental Policy Act, National Historic Preservation Act and Alaska National Interest Lands Conservation Act Section 810 requirements for implementation of a minerals management program.

2. Environmental Assessment: Mining Claim Acquisition Program, Denali National Park and

Preserve, 1993: This document meets compliance requirements for most land acquisition, validity examination, cultural resources monitoring, and related activities in the Kantishna Hills. It does not cover unusual projects or those with special requirements.

3. Environmental Assessment and Regional Director's Analysis, Plan of Operations, Discovery Claim No. 1, Eureka Creek, Denali National Park and Preserve, 1993: This document meets environmental compliance needs for a mining plan of operations submitted for this claim on Eureka Creek.

4. Environmental Assessment of Mining Plan of Operations for Caribou-Howtay Claims Nos. 7-11. Denali National Park and Preserve, 1991: This document meets environmental compliance needs for a mining plan of operations submitted for these claims.

5. Environmental Assessment, Relocation of Personal Property from Seven Mining Camps in the Kantishna Hills Area of Denali National Park and Preserve, 1994: This document meets the specific compliance requirements for the relocation of personal property from mining claims on Glacier, Caribou, Glen, Eldorado, and Slate Creeks.

6. Environmental Assessment for Access and Mineral Examinations on Eureka #2 & #3 and Silver Dollar #1 Unpatented Lode Mining Claims Kantishna Hills Denali National Park and Preserve, 1994: This document meets the compliance requirements for the NPS pre-acquisition step of mineral validity testing.

7. Environmental Assessment and Regional Director's Analysis, Appraisal Sampling of Mining Claims on Lower Caribou, Glacier and Friday Creeks, 1995: This document meets the compliance needs for a mining plan of operations submitted for these claims.

REFERENCES

Alaska Department of Fish and Game. 1979. Placer mining and water quality. State of Alaska, Juneau, Alaska.

Bundtzen, T. K. 1981. Geology and mineral deposits of the Kantishna Hills in Central Alaska. M.S. Thesis, University of Alaska, Fairbanks.

Deschu, N. 1986. Turbidity and settleable solids in mined and unmined streams in the Kantishna Hills, Denali National Park and Preserve. USNPS, Alaska Regional Office, Research/Resources Management Report AR-7.

Madson, R. J. 1981. Effects of placer mining on hydrologic systems in Alaska - Status of knowledge. Open File Report 81-217. U.S. Geological Survey, Anchorage, Alaska.

Meyer, S. C. 1983. Fish resources and the effects of mining activities in the Kantishna Hills, Denali National Park, 1982. USNPS, Alaska Regional Office.

Thornsberry, V. V., C. J. McKee, and W. G. Salisbury, editors. 1984. 1983 mineral resource studies in the Kantishna Hills and Dunkle Mine areas, Denali National Park and Preserve, Alaska. Salisbury & Dietz, Inc. B.O.M. Contract #S0134031.

U. S. Bureau of Land Management. 1996. Annual status report of unpatented mining claims located within National Park Service units in Alaska. (unpublished memo)

USNPS. 1990. Final environmental impact statement, cumulative impacts of mining. Volume 1. USNPS, Alaska Regional Office.

USNPS. 1994. Status of the mineral examination program in Denali National Park and Preserve. USNPS, Alaska Regional Office (unpublished memo).

N-314

GLACIOLOGY

PROJECT CODE: DENA-N-314

SERVICEWIDE ISSUES:
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
- N24 Other Issues: Threats to Public Health and Safety by Geological Processes

STATEMENT OF PROBLEM

Present Condition

Denali National Park and Preserve is one of many National Park Service units that have glaciers within their boundaries. Significant areas of several parks in Alaska and the western United States are glacier covered. The Geologic Resources Management section of the National Park Service Natural Resource Guidelines (NPS 77) addresses glacier resources only briefly. In that section, it is recommended that the NPS manage glacier features and processes for two primary reasons: (1) for the safety and well being of visitors and employees, and (2) to document glacier movement and changes. NPS 77 also recommends encouraging scientific research on glaciers.

Approximately one million of the six million acres of Denali National Park are covered by glaciers, representing one of the most extensively glaciated areas in northwest North America. Glaciers exist on both sides of the Alaska Range in two major climatic regimes. Glacier types in Denali vary from those which display long term steady flow, to others which undergo periodic episodes of rapid flow known as surges. This diversity provides opportunities to study glacier movements dominated both by climatic forces and by independent internal glacier mechanics.

Denali is taking advantage of those opportunities by implementing a glacier monitoring program which focuses research efforts on selected benchmark glaciers within the park, incorporates previous and ongoing data collection efforts, and calls for the application of new technologies and techniques as they emerge. The objective of this effort is the regional assessment of glacier mass balance conditions and their relation to climate. Therefore, it is necessary to study all glacial process, whether directly related to climate or not, in order to be able to fully understand and discern the effects of climate change on Denali's glaciers.

Priorities for this program include the use of simple and sustainable sampling methods which will allow the long term collection of data. This principle is being applied to both laboratory and field work so that the glacier monitoring program may be continued indefinitely, regardless of changes in personnel. The long term continuance of the glacier monitoring program is critical because glacial processes operate over long time periods. A sustained effort is necessary to fully understand the important relationship between glaciers and climate.

Mayo and Trabant (1984) found that an increase in average annual temperatures (global warming) may result in an increase in the overall snow and ice accumulation on glaciers in southern Alaska, causing those glaciers to grow despite the warmer climate. The capacity for air masses to transport water vapor from the ocean leads to greater deposition of snow on the windward side of mountain ranges near the ocean. This increase in snow deposition probably occurs on glaciers south of the Alaska Range as well, and this change may be detectable. Conversely, increased warming may cause north-side glaciers to decrease in size. A number of hypotheses have been proposed regarding the potential effects of global climate change on glaciers. Only careful examination can reveal what changes are occurring or will occur in the future. Glaciers on both sides of the Alaska Range in Denali should be monitored for mass balance changes and other basic information that may increase our knowledge of glacier/climate relationships.

Glacier surging is among the foremost unsolved research problems in glacier mechanics. Many of the more than 200 surging glaciers in Northwest North America (Post 1969) are located in Denali National Park and Preserve. Surge-type glaciers are defined as those that alternate between brief periods of very rapid flow, lasting usually one to four years, and extended periods of quiescence which last 10 to 100 years (Kamb and others 1985). During a surge, a glacier can accelerate to velocities which are 10 to 100 times greater than normal. Often this results in a dramatic advance of the terminus which has, at times, threatened human constructions (Heinrichs and others 1995), and typically has a great effect on the sediment load and chemistry of the meltwater drainage. This behavior seems not to be linked with climatic influences, an important consideration when looking at glacier fluctuations for indications of climate change. An understanding of surging is, therefore, necessary for both scientific and engineering/management purposes. The abundance of surge-type glaciers in Denali presents an excellent opportunity to study this complex phenomenon for scientific understanding and for management of geologic and aquatic resources.

Glacial meltwaters flow into and affect most of the six million acres of Denali. Stream discharges and rates of flow are seasonally controlled and greatly influence Denali's hydrologic condition and, therefore, much of Denali's biotic productivity. Glacier changes affecting outflow can greatly influence the local and regional hydrologic regime. These effects range from low water drought effects to major hazards such as outburst flooding.

Runoff from glacierized basins in the Alaska Range has gradually increased during the past 10 to 15 years (Mayo and Trabant 1986). Increased glacial runoff, whether due to glacial

thickening and advance or to glacial recession, may have a significant effect on flow, temperature, and sediment regimes in downstream areas. Reduced stream temperatures may eliminate certain invertebrate species or increase the length of their life-cycles. Salmonid developmental rates in terms of egg incubation, fry emergence and growth, and time of smoltification can be altered.

Lloyd (1987) and Lloyd and others (1987) reviewed the effects of turbidity and sediment load on freshwaters in Alaska. They found that turbidity caused by suspended inorganic particles was correlated with decreased primary production, abundance of zooplankton and macroinvertebrates, and fish production. Abiotic factors, particularly glacier outflow and sediment characteristics, appear to determine the long-term overall productivity and structure of the biological communities in these streams.

Glaciers are also an important water resource in Alaska because they are naturally regulated reservoirs that reduce runoff variability by increasing flow during hot, dry periods and by storing water during cool, wet periods (Fountain and others, 1996). The mass wastage of glaciers during this century has diminished the volume of water stored as ice in these natural reservoirs and has reduced the capacity of runoff from the glaciers to limit annual variations in streamflow (Fountain and others, 1996). We need to better define the effects of our glaciers on stream flow because the demands on our water resources are likely to increase in the future.

Glacial recession in Denali has created some of the best examples of glacial and periglacial landforms in the world. Casual observation has identified excellent examples of terminal and lateral moraines, kettles, eskers, drumlins, kames, and many other ice-waste features in the park. These features have not been inventoried, mapped, or dated. The Service requires the inventory of these features and the consideration of preservation or protection as necessary.

Recent concerns over global warming and ecological change have spurred an interest in monitoring glaciers in park units in Alaska. Limited strategies and methods for monitoring glaciers in Denali were devised during, and subsequent to, a glaciology workshop that was held in Anchorage in the winter of 1990-1991. Although glacier monitoring projects began during the FY91 field season in Denali with no NPS program legitimacy or dedicated funding, the new NPS Inventory and Monitoring program (I&M) was configured to include the projects in FY92.

Current Management Actions and Results

Research and Monitoring - In Denali, the glacier monitoring program is currently addressing the questions of glacier mass balance and activity on a park-wide scale using the following methods:

Index Sites (Mass Balance & Flow): Index sites are stakes placed into the ice at certain locations to monitor mass balance, flow, and snow and ice conditions. Single stake index sites are placed at or around the Equilibrium Line Altitude (the elevation where the accumulation and ablation

zones meet, also called the ELA) to obtain area-average mass balance. Additional index stakes may be placed in other locations in the glacier to better ascertain the time variation and gradient of mass balance along the length of the glacier.

Two glacier systems are currently selected in Denali for index site data collection and monitoring. The Kahiltna Glacier on the south side of the Alaska Range has been monitored at one index site since June 1991, and a second index site since May 1992. The Traleika/Muldrow Glacier system on the north side of the Alaska Range has been monitored at one index site on the Tralieka since June 1991, and a second index site since May 1992.

Longitudinal Profiles: Longitudinal Profiles are elevation surveys along the centerline of a glacier that provide information on surge potentials, flow rate changes, and mass balance. These surveys are accomplished by conventional survey methods or by Global Positioning System (GPS) surveying.

A GPS longitudinal survey was completed for the lower Muldrow Glacier in 1991. Survey points at approximately 5 km intervals, over a distance of 56 km, revealed a decreasing thickness below the 30 km point since the 1976 surveys by Bradford Washburn. Thinning on the lower end of the glacier was determined to be approximately 4 m per year since 1976. Additional longitudinal data have been collected by conventional survey methods on Muldrow Glacier in two locations near the flow rate targets (see below).

Longitudinal surveys and flow rate measurements could be extended to the following glaciers which demonstrate historical surge behavior:

Peters	Straightaway	Herron	Chedotlothna
Tokositna	Lacuna-Yentna	West Fork-Eldridge	

Flow Rate Stations: These are targets on glaciers where flow rates and elevations can be surveyed for change relative to fixed monuments adjacent to the glacier. Monitoring of these targets is usually done by conventional survey methods. Surface flow rates can be measured and correlated with longitudinal profiles to better understand surge behavior.

A single target on the Muldrow Glacier near McGonagall Pass was established by Bradford Washburn in 1976 to monitor distance changes between the target and a monument on McGonagall Pass. Re-surveys of this target in 1977, 1981, 1982, 1983, 1984, and 1993 demonstrated an overall flow rate of 160 feet per year. Several re-survey efforts involved multiple days of hourly observations to determine seasonal or other variations in surface motion.

A second flow rate target was placed on the Muldrow Glacier near the bend in the glacier at Anderson Pass during the 1993 field season. This target will be monitored during annual re-survey efforts, as will the McGonagall target.

Other candidate glaciers for flow rate monitoring are those mentioned above under longitudinal profiles.

Terminus Monitoring: Fixed monuments are established near glacial termini for the purpose of identifying terminus position changes by conventional survey and photography. Two monuments are established at each glacier, one as a survey instrument station, and another as a backsight. Survey shots are taken at the terminus, or limit of the active ice, when that limit can be distinguished from stagnant ice. Photographic documentation is also completed at these points to record terminus positions and conditions.

Currently terminus monuments have been installed at the following glaciers:

Middle Fork Toklat	West Fork Toklat	Cantwell
Polychrome West	Polychrome East	Herron (partial)
Cul-de-Sac	Tatina	

Additional glacial termini proposed for terminus monitoring are:

Pendelton	Toklat (other)	Red Mountain
Straightaway	Foraker	Peters
Chedotlothna		

Aerial Reconnaissance and Photography: In August 1996, a program of annual aerial reconnaissance and photography over glaciers in Denali was begun. This work will be completed at least once every year in the month of August, when glacier surfaces are relatively snow free and the summer snow line has retreated to the altitude of the equilibrium line. This monitoring effort will provide a photographic record of glacier conditions and will allow the detection and monitoring of noteworthy features, such as: developing glacier surges, ice-dammed lakes which may produce outburst floods, and landslides which have deposited debris on glaciers which can be tracked for glacier movement. The photographs and/or video which are acquired on each flight are archived at the park.

Miscellaneous Data Collections: Miscellaneous data collections including gravity surveys, seismic depth measurements, radar depth soundings, and aerial photography, will be used for glacier monitoring whenever feasible and appropriate. With the exception of aerial photography, these methods are not planned for continuous monitoring applications.

Interpretation - Programs and visual displays regarding glaciers are occasionally produced by the park Interpretive Division. Recent efforts were assisted by glaciologists from the Geophysical Institute at the University of Alaska to show the 1986-1987 surge activity on the Peters Glacier. Together they produced a poster with maps and photos which is on display at the Eielson Visitors Center.

RECOMMENDED ACTIONS

Recommended actions for the glacial resources program at Denali National Park and Preserve are intended to further the goal of park-wide glacier assessments for mass balance and flow conditions. Prior to 1996, a number of program actions which support this goal were underway. These included efforts to build a park glaciology bibliography, investigations of surge-type glaciers, meteorologic and hydrologic monitoring, terminus monitoring, index site surveys, and the conduct of independent research by outside investigators. These efforts are still underway, as most are long term research or monitoring problems.

A comprehensive strategy for monitoring glaciers in Denali was first considered in 1991. It was recognized at that time that the effects of climate on Denali glaciers, and the differences that may occur as a result of regional climate variations, should be the primary focus of the program. The index monitoring sites on Kahiltna and Traleika Glaciers were then established to begin data collection at locations in vastly different climatic regimes, on the north and south sides of Mt. McKinley. Initial surveys of terminus positions were made to establish a baseline for future monitoring. Surge-type glacier studies have occurred periodically in the park for many years and have been continued in order to characterize glacier activity that may not be related to climate.

In 1996, an expanded glacier monitoring strategy was devised. It employs a nested sampling design which is intended to better characterize glacier conditions on a regional, or park-wide scale. This strategy focuses field data collection efforts on specific benchmark glaciers which are determined to be representative of glaciers in their climatic region. Annual surveys of the benchmark glaciers, using traditional stake networks to measure mass balance, glacier surface elevation, and glacier flow will be made. Meteorologic and hydrologic data collection will take place at these sites to support survey efforts and data interpretation. The selection of one benchmark glacier in each major climatic region of the park is intended to minimize time consuming and costly field research.

The majority of the regional, long term monitoring of glacier conditions will be accomplished using remote sensing techniques. Glaciers will be analyzed in satellite imagery and aerial photography, using the data collected at the benchmark glaciers as a reference (groundtruth). In this way it should be possible to collect information on glacier activity throughout Denali National Park and Preserve in a cost effective and practical manner. This is extremely important because useful data on glacier activity can usually only be collected over long time periods. In order for such a data set to be collected, it will be necessary for changing personnel to understand and continue this research. The simplicity of the program is intended to ensure its survival, despite personnel changes or possible future budgetary constraints.

A. Program Administration and Planning

N-314.001: Develop a Park and Regional Glacial Resource Program

Evaluate park glaciers and address data needs, resource protection & preservation, and other management considerations in conjunction with other Alaskan glacier studies. Encourage the establishment of a glacier resource program for the Alaska Region. This planning requires additional resource inventory data (see sections B and C below). Baseline glaciology data needs would be determined based on hazard demand, resource protection, baseline inventory requirements, and interpretive values. The plan would appraise format, scale, and timing of data needs, and would incorporate associated planning and data needs such as soils, cultural resources, meteorology, seismology, and water resources.

N-314.002: Inventory Existing Glacier Photodocumentation

Research and inventory photographic documentation of historical glacier configurations. With cooperating agencies, institutions, and individuals, collate and interpret existing photographs, aerial photomapping prints, and satellite imagery acquired from the 1940's to the present.

N-314.003: Coordinate Glacial Resource Program with Other Agencies and Institutions

Establish contacts, memoranda of understanding, and cooperative agreements regarding research, monitoring, and other projects as necessary to gain first-hand knowledge of physical resource issues and to disseminate that information to the public. Also encourage and enhance park personnel participation in outside research and other data collection efforts.

N-314.004: Create PFT GS-7/9/11 Geologist or Physical Scientist Position

Workloads in geology, mass movements, glaciology, soils, and climate monitoring, and other geological and physical sciences branch tasks have increased in recent years. The geologist/physical scientist would provide professional-level program oversight for soils, glaciers and/or geology operations. A geologist/physical scientist would provide direction and perspective on many branch management operations. (Geology DENA-N-311.005)

N-314.005: Create GS-5 Seasonal Physical Science Technician Position

The physical science technician would provide program assistance, field support, and data manipulation for many branch operations. Nearly all physical science field programs

require additional help with transportation, logistics, data collection and data reduction. Many of these programs also require significant data input for various reports, papers and other finished products. (Geology DENA-N-311.006)

B. Research

N-314.011: Investigate Surge-Type Glaciers to Determine Surge Mechanism and Periodicity

There are numerous surge-type glaciers in Denali. The causes and mechanisms of surging are poorly understood. This proposal calls for surficial mapping to determine surge histories (glacial drift, abandon channels, and proglacial geomorphology), as well as meltwater stream gauging and water chemistry sampling. Investigator(s) would develop a monitoring scheme to attempt to determine cause and effect factors and an ability to predict future surges.

N-314.012: Produce Surficial Geology Map to Document Glacial Geology and Determine Glacial Histories

The history of glacial activity in Denali is recorded in the deposits of past glaciations. These surficial geology deposits should be classified, dated, and mapped in order to assemble a general history of glaciation for Denali. Surficial geologic mapping may be accomplished by qualified park staff when such staffing exists. The amount of the park which has been glaciated is large, however, and the completion of such a mapping effort will depend on cooperative efforts with other agencies and institutions. Cooperative agreements and memoranda of understanding should be sought with the USGS and academic institutions for the completion of this work. Glacial histories for Denali will enable a greater understanding of the effects of climate change on glaciers and will also allow the NPS to determine the frequency of advances in surge-type glaciers.

N-314.013: Support Independently Funded Inventory and Monitoring Projects

The Service would support independently funded glacier monitoring and research projects in Denali National Park and Preserve by private and public organizations, agencies and universities. The park would provide temporary housing and logistical support for field and laboratory work (Research Administration, DENA-I-410).

C. Mitigation

N-314.021: Evaluate Glacial Flood Potentials

Determine glacial outburst flood potentials in the park. Establish average minimum and maximum flow conditions, and evaluate flood potentials, for streams emanating from

glaciers which have produced, or may produce, outburst floods. In cooperation with the USGS, establish stream flow gauging stations below these glaciers. Develop a predictive capability for these events.

D. Monitoring

N-314.031: Implement Benchmark Glacier Monitoring Network

Determine major climatic regions of Denali National Park and Preserve and select one glacier which is representative of glaciers within each region. This benchmark glacier should be relatively easy to access and travel on, so that logistics for field work are simplified. A complete mass balance stake network should be established on each benchmark glacier. The stake networks should be measured and surveyed twice annually to obtain winter and summer mass balances.

N-314.032: Establish Automated Meteorological and Hydrological Monitoring Stations at Benchmark Glaciers

Basic weather parameters include: total precipitation, snow depth, air temperature, relative humidity, wind speed, wind direction, and solar radiation. These must be logged at the benchmark glaciers so that observed glacier fluctuations may be correlated with climatic trends. (Meteorology DENA-N-120)

Meltwater runoff from benchmark glaciers should be monitored in order to determine what percentage of the total runoff from the glacierized basin is composed of glacial meltwaters. These data will be compared with other measures of glacier mass balance in order to better define glacier fluctuations. Water chemistry and turbidity should also be monitored at these stations in order to asses the glacier's impact on water quality and availability.

N-314.033: Establish Single-Stake Mass Balance Monitoring Sites on Glaciers in Each Benchmark Region

These index sites will provide important information regarding the accuracy of benchmark glacier measurements in representing glaciers throughout a climatic region. Index stakes should be located at the equilibrium line of the selected glaciers.

N-314.034: Implement Satellite Remote Sensing Monitoring Program for Glacier Mass Balance

Establish relationships with appropriate agencies (NASA, DOD), academic institutions, and corporations for the acquisition of satellite imagery and derived data products. These images and data should be used to analyze glacier positions and conditions park-wide.

Image analysis and data manipulations should be carried out on Denali's GIS computer system if possible. Images and data should be archived at Denali.

N-314.035: Continue Mass Balance and Flow Monitoring Kahiltna/Tralieka Glaciers

Continue re-survey of existing index sites (mass balance and ice flow) at selected locations on Kahiltna and Traleika Glaciers for mass balance, surface elevation, and ice flow.

N-314.036: Continue Monitoring Surge-Type Glaciers

Continue the re-survey of surface targets on the Muldrow Glacier to monitor flow rates and elevation changes to anticipate potential surge events. Obtain longitudinal profiles and depth-to-bed profiles for other surge-type glaciers.

N-314.037: Continue and Expand Terminus Monitoring Network

Establish additional survey and/or photo points for monitoring glacier surface and terminus changes. Continue resurvey of existing terminus conditions every 3-5 years, where stations are already established.

N-314.038: Initiate Research and Monitoring of Additional Surge-Type Glaciers

For surge-type glaciers, perform longitudinal surveys (GPS or conventional survey methods) and geophysical studies to monitor ice volume changes and indications of surge potential. Complete profiles at selected glaciers at five year intervals. Establish surface flow targets. Collect data which support surge-type glacier studies including; basic weather parameters, ice depths, longitudinal profiles, gravity surveys, hydrologic surveys and other physical/chemical glacier data.

E. Interpretation

N-314.041: Encourage Public Awareness of Park Glaciers

Develop public displays, provide books, monograms, brochures, slides and or videos, and encourage interpretive programs regarding the glacial phenomena of Denali.

1) Geologic Guide - Continue to develop a comprehensive geologic guide to the park that addresses geology and glacial features park-wide, provides an extensive summary of the geologic literature, and gives a complete geologic history of Denali National Park and Preserve.

2) Glacier Monographs - Develop short and medium length papers on specific geologic

topics of interest.

3) Geologic/Glacier Video - Write and produce a geologic video that highlights the important geologic and glacial features of the park, or provides the complete geologic history.

4) Geologic/Glacier Slides - Provide quality slides of geologic and glacial features within the park for in-house use, or general public sale. (Geology DENA-N-311.141)

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Glacier Program	0.5/0.0	1.0/0.0	5.0/0.0	0.5/0.0	7.0/0.0
- PFT Geol/Phys Scientist	0.0/0.0	15.0/0.5	15.0/0.5	17.5/0.5	47.5/1.5
- Seasonal Geological Technician	0.5/0.2	0.5/0.2	0.5/0.2	0.5/0.2	2.0/0.8
- Photodocument Inventory	2.0/0.0	2.0/0.0	0.5/0.0	0.5/0.0	4.5/0.0
RESEARCH					
- Surficial/Glacial Geology Map	0.0/0.0	10.0/0.0	10.0/0.0	10.0/0.0	30.0/0.0
- Glacier Surge Investigation	1.0/0.0	15.0/0.0	15.0/0.0	15.0/0.0	46.0/0.0
MITIGATION					
- Glacial Flood Potentials	0.0/0.0	3.0/0.0	10.0/0.0	10.0/0.0	23.0/0.0
MONITORING					
- Installation & Monitoring of Benchmark Glacier Network	20.0/0.0	20.0/0.0	0.0/0.0	0.0/0.0	40.0/0.0
- Installation & Monitoring of Index Sites	6.0/0.0	6.0/0.0	3.0/0.0	3.0/0.0	18.0/0.0

- Stream Gauging at Benchmark Glaciers	15.0/0.0	15.0/0.0	0.0/0.0	0.0/0.0	30.0/0.0
- Kahiltna/Tralieka Index	7.0/0.0	7.0/0.0	8.0/0.0	8.0/0.0	30.0/0.0
- Surge Monitoring	5.0/0.0	5.0/0.0	6.0/0.0	6.0/0.0	22.0/0.0
- Terminus Monitoring	2.0/0.0	2.0/0.0	2.0/0.0	3.0/0.0	9.0/0.0
- Monitoring Expansion	10.0/0.0	10.0/0.0	10.0/0.0	10.0/0.0	40.0/0.0
INTERPRETATION					
- Geologic Guide	0.5/0.0	1.5/0.0	0.5/0.0	0.0/0.0	2.5/0.0
- Glacier Monographs	0.5/0.0	2.0/0.0	2.0/0.0	2.0/0.0	6.5/0.0
- Geo-Glacier Video	0.0/0.0	3.0/0.0	10.0/0.0	10.0/0.0	23.0/0.0
- Geo-Glacier Slides	0.5/0.0	0.5/0.0	0.5/0.0	0.5/0.0	2.0/0.0
TOTALS	68.0/0.2	115.5/0.7	91.0/0.7	94.0/0.7	368.0/2.3

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Fountain, A. G., R. M. Krimmel, and D. C. Trabant. 1996. A strategy for monitoring glaciers. U.S. Geological Survey Circular #1132, In Press.

Heinrichs, T.A., L.R. Mayo, D.C. Trabant and R.S. March. 1995. Observations of the surge-type Black Rapids Glacier, Alaska, during a quiescent period, 1970-92. U.S. Geological Survey Open-File Report 94-512.

Kamb, B.C., C.F. Raymond, W.D. Harrison, H. Engelhardt, K.A. Echelmeyer, N. Humphrey, M.M. Brugman and T. Pfeffer. 1985. Glacier surge mechanism: 1982-1983 surge of Variegated Glacier, Alaska. Science, 227(4686), 469-479.

Lloyd, D. S. 1987. Turbidity as a water quality standard for salmonid habitats in alaska. North American Journal of Fisheries Management. 7:34-45.

Lloyd, D. S., J. P. Koenings and J. D. LaPerriere. 1987. Effects of turbidity in fresh waters of Alaska. North American Journal of Fisheries Management. 7:18-33.

Mayo, L.R. and D.C. Trabant. 1984. Observed and predicted effects of climate change on Wolverine Glacier, Southern Alaska. In Potential effects of carbon-induced climatic changes in Alaska. Jennifer McBeath, ed. School of Agriculture and Land Resources Management, UAF, Misc. Publ. 83-1.

Mayo, L. R. and D. C. Trabant. 1986. Recent growth of Gulkana Glacier, Alaska Range and its relation to glacier-fed runoff. pp 91-99 In S. Subitzky (ed) Selected papers in the hydrological sciences. U. S. Geological Survey Water Supply Paper 2290.

SOIL RESOURCES

PROJECT CODE: DENA-N-320

SERVICEWIDE ISSUES:
- N20 Lack of Basic Data: Insufficient Understanding of Park Ecosystems and Threats to Them
- N24 Other Issues: Threats to Public Health and Safety by Geological Processes

STATEMENT OF PROBLEM

Introduction

Baseline soils information is essential to comprehending, managing and protecting all park resources. Understanding the soil, vegetation and water resource relationships as a vital combination is required for effective resources management. Systematic soils or landscape surveys, or other categories of soils investigations, in conjunction with geologic and hydrologic information, provide the fundamental understanding of the abiotic conditions that set the stage for understanding the biotic components and ecosystems within and around Denali National Park. Without this specific and integrated information, park resources cannot be protected and managed as policy requires.

NPS-77, the Natural Resource Guidelines for the National Park Service (USNPS 1991), and NPS Management Policies (USNPS 1988) suggest the following concerning park soil resource management;

The National Park Service shall,

- actively seek to understand and preserve soil resources...
- prevent unnatural erosion, physical removal, or contamination...
- keep soil erosion rates within acceptable limits...
- insure developments are consistent with soil limitations..
- inventory all soil resources in park..

Present Condition

Denali National Park and Preserve contains several physiographic provinces, numerous land resource areas and countless soil/landscape types within its boundaries. The core area, or wilderness portion of the park, is dominated by bedrock and ice exposures, with many areas of glacial-fluvial deposits, some of which are highly erosive and frequently exposed to high energy surface water flow. Nearly a third of the park is comprised of interior lowlands, which consist of loess deposits interspersed with lakes and streams. Most of these lowland areas are covered by alpine tundra vegetation with occasional mixed forest.

The park and preserve lie within the zone of discontinuous permafrost. The lowland areas are frequently veneered with fine-grained glacial and/or eolian materials, which tend to be areas of ice-rich ground. These materials are highly absorptive, which ensures their permafrost condition, but enhances erosion when the permafrost soils are disturbed. A delicate thermal balance exists between the insulating vegetative mat and the underlying frozen ground. Even the slightest impact to the vegetation in this extremely sensitive relationship can initiate thermokarsting and extensive soil erosion.

Existing soils mapping in Denali consists primarily of the United States Department of Agriculture, Soil Conservation Service (USDA-SCS) "Exploratory Soil Survey of Alaska" which provides large soil taxonomic units (classifying to great group or subgroup) and maps at 1:100,000 (Rieger 1979). This document was derived primarily from air photos and USGS topographic maps resulting in single classifications for large areas or watersheds and received little on-ground confirmation. Although adequate for reconnaissance style, state-wide overviews of soil conditions, the 1979 survey does not supply information adequate for impact evaluation or for a baseline inventory database.

A myriad of park land-use activities, including visitor activities, mining, inholder and external commercial development, and park operations, threaten the park soils resources. High visitor impact areas, such as rest stops, campgrounds, and popular trails or routes, demonstrate significant compaction, surface rilling and in some cases, permafrost degradation. Increasing use of ATV's, horses, and even snowmachines to some extent, result in significant damage to trails, as well as many non-designated routes through and into the park. Some areas, such as the Nenana River corridor, are becoming impacted by increasing commercial and recreational use, including riverbank construction and alterations, rafting activities, and hiking.

Approximately 9,000 acres of patented and unpatented mining claims exist within the boundaries of the park, and approximately 1,254 acres of those mining claims are disturbed or barren land areas left by previous mining operations. Some additional impacts may be expected as mining continues as allowed under the "Mining in the Parks Act", as well as from miscellaneous other inholder actions and access activities, but resource protection standards have been set for mining operations and soil impacts have been reduced.

The impacts associated with mining are increased erosion due to particle size separation (tailings piles, abandoned settling ponds and miscellaneous stockpiles), surface runoff erosion due to soil exposure, and compaction in areas of concentrated operations. Impacts also include hydrocarbon and heavy metal or sulfide contamination of soils, as is typical on many lands subjected to mining activity. Additional impacts to water and other resources exist due to heavy metal concentrations that may be mobilized from natural concentrations or contaminated soils, and from increased stream sediment loads that can result from mining or other land use activities.

Other threats to soil resources are NPS and concessionaire operations themselves, including park road or other transportation upgrades, staff housing & facilities, visitor service improvements such as information centers, hotels, roads, trails, and other development that results in short or long term periods of soil disturbance or exposure. In addition to the mining impacts from inholder locatable mineral claims, there are numerous exposed borrow or gravel pits located along the park road. Many of these pits are no longer used or necessary for material sources, yet they remain unreclaimed and often denuded and exposed to continued soil loss and erosion. Ample opportunities exist for soil retention or reclamation measures within the park.

Current Management Actions and Results

Primary soil conservation actions within Denali often occur as a by-product of development actions and surface vegetation restoration activities. Although only cursorily addressed in planning and NEPA documents, soils resources become somewhat preserved by ordinary engineering practices when in-park projects actually occur. It is in the park's best interest that engineering investigations evaluate the soil types and permafrost conditions of a planned facility footprint or travel route, with the intent to minimize problems that would threaten the intended structure or facilities. These potential engineering concerns often relate to maintaining the surface and soil conditions as intact as possible to insure the long-life of the facility.

Restoration and revegetation activities within the park demonstrate a more pro-active effort at soil conservation. Due to the long-term recovery rates of the natural, full compliment-climax vegetation complex, the revegetation projects are more of a soils retention, than one of a soils conservation effort. Fines lost by surface wash or wind action continue for several years on most revegetation plots while the lower ground cover is slowly established. Like the plant complex itself, soil conditions will never be restored to previous "pristine" status.

Numerous direct and indirect soil retention and restoration efforts have occurred within the park, as well as some soil research efforts. The following illustrate specific programs, practices or projects relating to soils resources, including a view of soils issues and problems the park faces at this time:

In 1997, a complete soils inventory of the entire park was started. This project will result in a park soils map and will provide site specific soils information for numerous sample locations.

The project is anticipated to take approximately six years to complete.

Preventive Management Actions:

Park Construction Projects: All proposed facility construction sites receive some soils investigation work, usually of a soils engineering nature. Shallow soil testing for chemical/physical parameters for bearing strength is performed for most building sites, or frequently more extensive subsurface investigations (geophysical or drilling) for permafrost or other special design conditions. Current project planning often includes topsoil stockpiling and vegetation transplants to minimize soil losses both at the new project site and at older sites in need of revegetation. Efforts should be made to require soil resource considerations in all operations and every planning effort.

Gravel Extraction Activities: Gravel extraction for construction purposes within the park (both upland and stream channel sources) are designed with plant and topsoil retention in mind. Current NPS extraction plans (incorporated within the park's gravel acquisition plan) include reclamation efforts which generally address final backslope angles and shape, and revegetation efforts, all designed to minimize soil damage or loss.

Extraction plans and reclamation details on gravel extraction sites have not always been developed or followed on past borrow site activities (see Restorative - Borrow Site Reclamation, below). Additionally, soil resources (fines or topsoil) are only cursorily considered in park initiated (or mining claim initiated) projects, even when efficient storage, retention or recovery is desirable. Efforts to preserve soil resources in future gravel extraction activities should be made by establishing requirements to evaluate soils when any in-park borrow site is considered (see mining lands management below).

Dust Palliatives: Particle loss, or loss of fines on the park road is a principle problem regarding sight visibility and local air quality in the park road corridor. Federal Highway Administration (FHA) documents prepared for evaluating the park road system have speculated the loss of fines from the park road surface at ½" annually. This level of loss on a 93 mile long park road system results in significant effects to air quality and surface water quality, and could result in notable changes to the soil/plant communities due to inordinate air and water sedimentation conditions.

In FY 94, five test sections and several control sections were established on the park road to study the rate of fines loss. These test sections have been resurveyed annually with limited success on determination of material loss, however, significant changes to the road profile changes have been identified. Additionally, at least two dust palliative products are being tested on the road for both effectiveness and environmental effects. See project statement DENA-I-670.

Mining Lands Management: The Alaska National Interest Lands Conservation Act of 1980

(ANILCA) added some 422 patented and unpatented mining claims to Denali National Park and Preserve. Although the park and preserve are now withdrawn from the filing of new mining claims, valid existing claims may continue to be operated under existing laws, including Public Law 94-429, the Mining in the Parks Act of 1976, as implemented by regulations in 36 CFR 9A. The NPS has been acquiring mining claim interests in Denali since directed to by a record of decision signed by the Regional Director in 1990. Presently, following some mining claim acquisitions, there are approximately 370 unpatented and patented mining claims within the park boundaries.

The effects of mining are visible on over 1,200 acres of land covering 10 drainages in the Kantishna area. The level of disturbance varies from mining camps and tailings piles abandoned in the early 1940s where revegetation has obscured much of the damage, to barren ground areas that will require hazardous waste removal and full restoration efforts such as stream contouring, introduction of sediments, and revegetation. Much of the soil resources (topsoil or overburden) on these 200 acres has been lost to the mining activity itself, but additional fines are continually lost by wind and water action on the slowly recovering barren surfaces.

Until the acquisition program extinguishes mining interests within the park, mining plans of operation are accepted on any valid existing claim(s). Current mining plan designs and practices under the NPS 36 CFR 9A regulations, U.S. Army Corps of Engineers (404 permit), EPA requirements (NPDES permit), and other agency requirements generally insure the best management practices regarding water quality, surface discharge, and wetland/riparian zone retention.

However, none of the regulating agencies or their associated requirements directly address upland terrestrial impacts, particularly where those impacts can be related to soil resources. Little consideration is given to limiting soil compaction, controlling particle size separation, and providing for soil retention during stockpiling or storage. As a result, many reclamation efforts become restoration efforts. For instance, usable post-mining fines or "topsoil," which is in limited quantities in even the best of sites, become further limited in usable quantity and condition because of inadequate separation at the start of operations, deficient storage practices, poor storage site selection, and faulty handling methods. Additional fines loss occurs because of unplanned storage durations which frequently expose the highly erodible material to wind and precipitation.

Preservation of soil resources in mining activities should be strongly encouraged when relaying the requirements of a mining plan to potential mining claim operators. The handling, storage, and recovery of fines should be a primary driver in developing a coordinated mining and reclamation plan. Soil retention should be imbued in any surface disturbing proposal within park or preserve boundaries.

Restorative Efforts:

Mined Lands Restoration: A plan for restoration of mined lands was drafted in 1994 which addresses restoration needs and priorities of disturbed lands within the Kantishna Hills. This plan requires additional work, including a review of all park-wide disturbed lands and their respective reclamation/restoration needs. Among the many resource concerns, soil restoration/retention is a primary concern, and will certainly be an integral part of the final plan.

Glen Creek Project: Perhaps the most pro-active effort toward soil and other park resource "restoration" in Denali National Park and Preserve is the Glen Creek Restoration Study. The reclamation of Lower Glen Creek was begun in 1989 and consists of approximately three miles of redesigned stream channel and flood plain morphology to enhance fine sediment retention and re-invasion of natural plant species (Water Resources Management DENA-N-210, Ecological Reclamation and Restoration DENA-N-530). The area was historically placer mined numerous times, and little remained of the original stream or valley configuration, not to mention the topsoil. This is a pilot project which will provide a design model for reclamation and restoration of other placer mined valleys in the Kantishna Hills section of the park. This type of project should be extended to other disturbed locations where stream profiles may not evolve fast enough to maximize soil retention.

Parkwide Revegetation Projects: Several revegetation projects have been initiated along the park road which include both road cut stabilization efforts, abandoned route restoration sites, and construction site restoration. Some of these projects stem from slope failures of various degrees on the west end of the park road at Stoney Dome and Thorofare Pass vicinities.

Borrow Site Restoration: Of some 20 "historic" material borrow sites on the park road system (those no longer considered likely candidates for additional extraction), very few have received any reclamation or final contouring. The Stoney Creek Pit (MP 59.7 on the park road) which was last used as a borrow source in 1985, received some bench and slope recontouring and leveling and scarifying of the compacted operations area in 1992. Reclamation and restoration actions on several of the remaining abandoned pits would enhance the soil retention and recovery of these sites.

Research Activities:

Drunken Forest: Investigations of a slump-mudflow informally called the "Drunken Forest," located near headquarters in Denali National Park, began in 1986 with the installation of survey stations within the flow to measure the rate and configuration of the movement. Significant quantities of fine-grained soils (clays) have been identified within the movement which interact with other soils to provide an ideal view of surface processes. Additional process and soil evaluations are ongoing.

Rock Creek LTEM: In 1991, Denali National Park and Preserve was one of four national parks selected to institute a prototype Long-term Ecological Monitoring (LTEM) program. Some 2040 acres of the Rock Creek watershed near headquarters were mapped by the Soil Conservation Service (SCS) in 1992 under this LTEM program. This effort resulted in the mapping of 8 soils units at a scale of 1:24,000 within the 3.2 sq. mile watershed, and associated reports containing physical characteristics and laboratory analysis (Moore 1993).

A long-term soils component of this program includes active monitoring and instrumentation of wet and permafrost soils to interphase the atmospheric and soil environmental parameters with vegetation associations, and to establish the feedback process that may result in environmental (regional or global) change. Currently, there are soil monitoring sites in four vegetation communities (white spruce forest, permafrost tundra, treeline, and alpine tundra) which are partially or fully instrumented to monitor micro-meteorology (air temperature, relative humidity, wind speed and direction, and direct and reflected radiation), subsurface soil conditions (soil temperature at 5-7 horizons, soil moisture at 3-5 soil horizons, and oxidation/reduction potentials), and atmospheric gas conditions (carbon dioxide and methane). Additionally, the soils at these sites will be sampled for numerous physical and chemical changes in 3-5 year intervals.

Related Programs and Projects:

As described in the introduction and other sections above, soils play an important roll in many resource conditions and other related components of the ecosystem. Listed below are the primary Resource Management Plan Project Statements that should interact, directly or indirectly with soils resources.

Interdisciplinary Project Statements
- DENA-I-210 Long Term Ecological Monitoring
- DENA-I-220 Resource Inventory and Mapping
- DENA-I-500 Land Resources Management
- DENA-I-610 through 670 - Visitor Use Issues
- DENA-I-700 Hazardous Materials and Waste Management

Natural Resource Project Statements
- Air Resources
  - DENA-N-110 Air Quality Management
- Aquatic Resources
  - DENA-N-210 through 250
- Geologic Resources
  - DENA-N-311 Geology
  - DENA-N-312 Geologic Hazards Management
  - DENA-N-313 Minerals Management
- Terrestrial Biota

DENA-N-330 through 369
Integrated Multi-resource Activities
DENA-N-530 Ecological Restoration and Reclamation

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-320.001: Coordinate Soils Resource Programs with Other Agencies and Institutions

Establish contacts, memoranda of understanding, and cooperative agreements regarding research, monitoring and other projects as necessary to gain first-hand knowledge of physical resource issues and to disseminate that information to the public. Also encourage and enhance park personnel participation in outside research and other data collection endeavors. Establish and maintain contacts with soil resource personnel and groups.

N-320.002: Create PFT GS-7/9/11 Geologist or Physical Scientist Position

Workloads in geology, mass movements, glaciology, soils and climate monitoring, and other geological and physical sciences branch tasks have increased in recent years. The geologist/physical scientist would provide professional-level program oversight for soils, glaciers and/or geology operations. Depending upon the specialty, this individual would be the primary soils, glacier or other earth science lead, including the task of primary investigator regarding research or monitoring efforts and developing and implementing physical science activities. A geologist/physical scientist would be able to provide direction and perspective on many branch management operations. (DENA-N-311.005, DENA-N-314.006)

N-320.003: Create Temporary Seasonal Physical Science Position

A physical science technician would provide program assistance, field support, and data manipulation for many branch operations. Nearly all physical science field programs require additional help regarding transportation, logistics, data collection and data reduction. Additionally, many of these programs also require significant data input time for various reports, papers and other accomplishment products. (DENA-N-311.006, DENA-N-314.007)

B. Research

N-320.011: Parkwide Soil Inventory

Soils/landscape mapping can provide a unifying method of collecting and communicating inventory and monitoring data. Areas can be divided along natural boundaries into subregions, each with a unique combination of geologic deposits, landforms, hydrologic conditions, soils, and vegetation. These subregions or landscape units could be used as habitat classes for wildlife management, fire ecology management units, and other land classifications for management purposes. Planning and research projects can benefit from landscape categorizing by supplying comparable units for specific management emphasis, selecting sites for research or extrapolating research results.

Additional benefits from soil inventory efforts might include the delineation of unstable soils (slope stability or frost susceptible soils), the identification of heavy metal concentrations, and the location of wildlife mineral licks.

Suggested subregions to initiate a soil inventory effort are most appropriately driven by park land-use planning efforts. The following are those suggestions:

- Frontcountry Area
- Road Corridor
- South Side visitor site & use areas
- Kantishna Hills

N-320.012: Initiate Detailed Watershed Soils Mapping

Initiate soils mapping related to inventory and monitoring or similar programs where baseline resource information is lacking and desired. Watershed boundaries are the conventional area delineations for such mapping, however, detailed soils mapping may be preferable for smaller areas where information on physical or chemical parameters is desirable. Such locations might include partial drainages for geochemical control on stream chemistry, browse or vegetation plots, and potential building or other development sites.

N-320-013: Inventory Soil Biota

Initiate soil testing of imported and in place soil volumes or plots for biotic content, to avert potential introduction of exotics. Establish standards and protocols for soil purchase and handling to minimize the threat of exotic introduction into the park. Relates to Exotic Plant Management DENA-N-342.

N-320-014: Initiate NPS and Cooperative Special Studies and Soils Investigations

Work with other agencies and academia to accomplish soils project goals.

N-320.015: Inventory & Evaluate Recreational Impacts

Inventory visitor use or recreation impacts to soil resources on campgrounds, trailheads, trails, roads, and other sites of concentrated use. Inventory emphasis should be placed on trails and other facilities where horses and/or ORV use is allowed or expected.

N-320.016: Support Independently Funded Soils/Geologic Projects

The service would support independently funded soils/geologic research or other projects in Denali National Park and Preserve by private and public organizations, agencies, and universities when deemed appropriate by park management. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management, DENA-I-410).

C. Mitigation

N-320.021: Continue Glen Creek & Other Projects

Glen Creek Restoration research and monitoring should be continued to evaluate progress and to refine the methodology, especially for the application of that methodology to new restoration projects.

N-320.022: Institute Soil Restoration Activities at Disturbed Sites

Refer to Project Statements DENA-I-800, DENA-N-313, DENA-N-330, and DENA-N-530.

D. Monitoring

N-320.031: Monitor Recreational Impacts to Soils

Recreational impacts, particularly on trails and in campgrounds and backcountry campsites would be monitored to direct restoration efforts.

N-320.032: Support Park Engineering Needs

Investigate slope stability & other engineering soil hazards as they threaten or may threaten park facilities or park lands. Develop knowledge of soil types and stability factors for evaluation of slope stability in all areas of the park. Provide input to facility location and design as appropriate. Relates to Geologic Hazards DENA-N-312.

N-320.033 Continue Rock Creek LTEM - Soils Component

Continue inventory and monitoring of the soils and geology component of the Rock Creek and other potential sites for Long-Term Ecological Monitoring program. This program is aimed at monitoring soil functions in the ecosystem, including its relationship with productivity (terrestrial and aquatic biota), its function as a trap for aquatic and atmospheric contamination, and its suitability as a stand alone physical or chemical indicator of local or global change. Understanding and monitoring these soil functions and relationships requires an intimate relationship with vegetation, aquatic, and atmospheric components of the study.

E. Interpretation

N-320.041: Encourage and Enhance Soils Interpretation

Provide soils information and opportunities for relaying soils information to the public. Emphasize unusual soils conditions (i.e. permafrost conditions, mass movements, paleo sand dunes) and assist the interpretive division in such endeavors.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- PFT Geologist/Physical Scientist		30.5/1.0	30.5/1.0	35.5/1.0	96.5/3.0
- Seasonal Temp.	10.0/0.5	10.0/0.5	10.0/0.5	10.0/0.5	40.0/2.0
RESEARCH					
- Park-wide Soil Inventory (helicopter)		75.5/0.0	75.5/0.0	75.5/0.0	225.0/0.0
- Rock Creek LTEM	2.5/0.0	2.5/0.0	2.5/0.0	2.5/0.0	10.0/0.0

- Watershed Mapping	2.5/0.0	5.0/0.0	5.0/0.0	5.0/0.0	17.5/0.0
- Soil Biota Inventory	2.0/0.0	3.0/0.0	3.0/0.0	3.0/0.0	11.0/0.0
- Special Studies/Projects	3.0/0.0	3.0/0.0	3.0/0.0	3.0/0.0	12.0/0.0
MITIGATION AND MONITORING					
- Glen Creek	1.0/0.0	1.0/0.0	1.0/0.0	1.0/0.0	4.0/0.0
- Engineering Projects	2.5/0.0	5.0/0.0	5.0/0.0	5.0/0.0	17.5/0.0
INTERPRETATION					
- Soils information	1.5/0.0	1.5/0.0	1.5/0.0	1.5/0.0	6.0/0.0
TOTALS	25.0/0.5	137.0/1.5	137.0/1.5	142.0/1.5	449.5/5.0

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Moore, J. P. 1993. Rock Creek Watershed, Denali National Park, Alaska. USDA Soil Conservation Service Soil Survey Investigation.

Rieger, S., et al. 1975. Exploratory Soil Survey of Alaska. USDA Soil Conservation Service.

USNPS. 1988. Management Policies. U. S. Department of the Interior.

USNPS. 1991. NPS-77 Natural Resources Management Guidelines. U. S. Department of the Interior.

TERRESTRIAL VEGETATION MANAGEMENT

PROJECT CODE: DENA-N-330

SERVICEWIDE ISSUES:
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
- N24 Other Issues: Threats to Public Health and Safety
- N17 Biodiversity

STATEMENT OF PROBLEM

Present Condition

Denali National Park and Preserve is recognized as a premier example of a naturally functioning sub-arctic ecosystem. The terrestrial flora of Denali are the foundation for many ecosystem functions; they are primary producers, provide wildlife forage and habitat, and affect geomorphology through their influence upon edaphic (soils) and hydrologic (water movements) characteristics. Floristic species and communities are quite varied in Denali representing both maritime and continental climatic regimes. The Denali ecosystem offers unparalleled opportunities for personal experiences and education, as well as an important scientific reference area acknowledged by the scientific community.

The valuable resources of Denali are not immune to degradation. An outstanding interior Alaska ecosystem, with abundant wildlife and spectacular vistas, combined with an easily accessible location make Denali a prime Alaska destination for visitors. With visitors come the transportation, lodging and other systems required to support large groups of people, which cause direct and indirect impacts upon the ecosystem. Some roadside areas have already been documented as showing impacts from park activities and/or visitor use (Furbish 1996, Tranel and Spencer 1994).

In addition to tourism, Denali is subject to impacts from other anthropogenic activities. Past mining operations within Denali have left tailings piles, altered streams, hazardous wastes and evidence of transportation. Future mining, logging or agricultural operations could impact resources within Denali if they expanded to areas adjacent to the park. Increased industrialization of interior Alaska could cause additional impacts, particularly degradation of air quality through power plant emissions. Planet-wide factors, such as global warming, could

affect glacier behavior and vegetative community distributions. Each of these activities or circumstances contribute to ecosystem disturbance.

Resource management for terrestrial vascular plants revolves around the maintenance and restoration of natural plant communities. In addition, management goals include the protection of sensitive, rare, threatened or endangered species and habitats, and protection of public health and safety. Since our present knowledge of sub-arctic plant ecology is limited, a strong research component is needed to assure that information for responsible management decisions is available in the future.

Current Management Actions and Results

A cohesive strategy for management of Denali's plants and vegetative communities, including their habitat value and ecological significance, does not currently exist. Management activity is presently driven by specific funded projects, without the overall coordination among projects needed to address ecological relationships or long-term issues. While the attention given to specific funded projects is not inappropriate, lack of a vegetation management plan results in little or no attention given to other projects which are also important from a holistic, ecological perspective.

Established scientific information about plant ecology pertinent to Denali ecosystems is generally not available on-site, nor is the scanty reference material already in the park organized and readily accessible. Other plant ecology tools have not been developed, such as a field reference plant collection, computer database of flora and their characteristics, descriptions of vegetative communities and habitat suitability criteria, and GIS themes relating to vegetation.

Coordinated research is needed to provide information so that threats to plant resources can be assessed, proposed management actions can be appraised, and methodologies to execute management decisions can be developed, tested, and evaluated. Some of this work has already been accomplished, such as restoration studies (Densmore 1987) and restoration techniques (VanderMeer 1995). Without additional research, however, effective plant management will be hampered by lack of scientifically reliable information.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-330.001: Develop Vegetation Management Plan

A vegetation management plan is needed to assure responsible management of Denali's plants and vegetative communities. The vegetation management plan should be developed following the general strategy of obtaining basic floristic information, obtaining information about ecological relationships, protection of plant resources from degradation, restoration of previously degraded areas to naturally functioning plant communities, provision of public health and safety, and appropriate data management.

- produce annual and other reports on vegetation management programs;
- keep all data and reference materials organized in a systematic manner and easily accessible;

Other project statements address parts of this strategy, including:

I-210 Long-Term Ecological Monitoring
I-220 Resource Inventory and Mapping
I-300 Curatorial Management
I-410 Research Administration & Management
I-670 Road Use Impacts
N-340 Hazardous Tree Management
N-343 Rare Plant Management
N-342 Exotic Plant Management
N-344 Firewood & Cabin Log Management
N-520 Wildland Fire Ecology and Management
N-530 Ecological Restoration & Reclamation
N-560 Plant & Animal Disease Program

However, a comprehensive vegetation management plan is needed to assure coordination among the various projects and programs.

N-330.002: Re-establish Plant Ecologist/Botanist Position

This position would provide overall professional direction to the park's vegetation management program including inventories, revegetation and restoration projects, exotic plant control, vegetation monitoring, rare plant protection, and would coordinate with independent researchers and other agency ecologists.

N-330.003: Acquire Information on Past Plant Ecology Studies within Denali NP&P

Denali has some information on past plant ecological studies performed within Denali, but the consistency of that information varies from completed reports and publications to subject-matter references without any supporting documentation. Past plant-related studies at Denali will be investigated, with the goal of obtaining data, reports, methods,

or any other information associated with the studies. The studies will also be evaluated to determine their applicability to future vegetation management programs at Denali.

N-330.004: Verify Historic Collections

Denali has been host to numerous floral collections over the years. The specimens obtained during these collections are housed at various institutions within the United States and abroad. Verification of the scope of these collections, and confirmation of the taxonomic assignments is needed to establish the historic composition of vegetation at Denali. The collections will be documented and evaluated by a qualified plant taxonomist. (Resource Inventory and Mapping DENA-I-220)

N-330.005: Develop Parkwide Vegetation/Landcover Map for GIS

A vegetation/landcover GIS theme is needed to establish baseline information and provide the basis for future research and monitoring studies. In addition, vegetation/landcover information is the foundation for many derived ecological characteristics, such as habitat suitability assessments. Also, park planning activities and developments require vegetation/landcover data for site selection and evaluation. (Resource Inventory and Mapping DENA-I-220)

N-330.006: Establish Permanent-Subject-to-Furlough Biological Technician (Vegetation) Positions - GS-404-5/6/7

At least two vegetation management biological technicians are currently needed to accomplish the vegetation management program at Denali. These technicians are needed for (1) revegetation and exotic plant control, and (2) long-term ecological monitoring. Both functions have been partially addressed with seasonal employees over the past several years, however, both functions are ongoing and recurring needs. (Long-Term Ecological Monitoring DENA-I-210, Exotic Plant Management DENA-N-342)

B. Research

N-330.011: Create and Maintain Databases on Flora and Other Plant Ecology Information

Some fundamental inventory information is maintained in the NPFLORA database. NPFLORA will be updated and kept current. Also, supplemental information not contained in NPFLORA, but important for plant ecological investigations, will be assembled and complied into interactive databases. The databases will be an important scientific, management and interpretive tool. (Resource Inventory and Mapping DENA-I-220)

N-330.012: Augment Herbarium Collections

Denali's on-site herbarium will be expanded through collections to augment the species and subspecies coverage, as well as spatial coverage within Denali. (Curation DENA-I-300) A working collection would also be established for use in day-to-day operations.

N-330.013: Floristic Inventories

Inventory plant species through surveys in areas not previously examined, maintenance and augmentation of herbarium collection, maintenance of computer collections database. Identification of rare, threatened or endangered (RTE) species, identification of habitats likely to contain RTE species, surveys for RTE species occurrence, obtain accurate mapping coordinates for occurrences. Identification of exotic plant species, resolve status of uncertain species, identify habitats potentially susceptible to exotic plants, surveys for exotic species occurrence, obtain accurate mapping coordinates.

N-330.014: Floral Autecology and Other Plant Related Ecological Investigations

Information about plant species, vegetative communities, habitat value, ecological relationships (for example, mycorrhizal associates and other fungi), or ecosystem functions (for example, competition and dominance relationships) will be solicited and/or sponsored to provide the scientifically reliable information needed for management of Denali vegetation.

Sponsor, solicit or perform ecological investigations to provide information needed short-term for responsible management (such as plant response to ongoing threats, wildlife habitat requirements, etc), and that increase scientific understanding of ecosystem functions (such as fire ecology, competition and dominance relationships, etc), recognizing that long-term responsible management will require such knowledge.

N-330.015: Restoration/Revegetation Techniques Development

Develop restoration techniques for revegetation of degraded areas.

N-330.016: Develop Vegetative Monitoring Techniques

Ecological and threat related monitoring techniques for application in subarctic plant communities would be developed.

N-330.017: Support Independently Funded Plant Ecology Research

The service would support independently funded plant ecological investigations in Denali by private and public organizations, agencies, and universities. The park would provide temporary housing and logistical support for field and laboratory work, if possible. (Research Administration and Management DENA-I-410)

C. Mitigation

N-330.021: Implement Various Mitigation Programs

Implement mitigation programs and monitor to determine effectiveness of management actions at degraded mining sites, degraded areas within road corridor (gravel pits & maintenance staging areas, visitor use impact areas, road shoulder vegetation, etc.), and to address exotic plant invasions. See Project Statements DENA-I-610, DENA-I-700, DENA-N-313, and DENA-N-530.

C. Monitoring

N-330.031: Develop and Implement Long Term Ecological Monitoring for Vegetative Ecological Characteristics

Floral and plant ecological characteristics needed to address long-term monitoring questions will be identified. Parameters and methodologies will be developed for field data collection, data analysis will be structured to provide ongoing trends as well as eventual change detection and hypothesis testing. (Long-Term Ecological Monitoring DENA-I-210)

N-330.032: Implement Monitoring of Threats Associated with Park Flora

Identify threats and implement monitoring to determine severity level of threat (construction and maintenance activities, visitor impacts, road physical impacts, adjacent land development, air pollution, etc.) and identify and monitor areas likely to be impacted by threats, detect changes and determine links to threats.

D. Interpretation

N-330.041 Support Interpretation of Denali's Vegetation

Interpretation, especially environmental education, will be supported by direct interaction and by development of user-friendly products for access to databases, research, and program reports. An interactive, random-access plant identification key is a potential

example of such a product. Internet capabilities and home page information could also be developed.

Public information will be distributed regarding tree hazards, hazard fuels and fire management, and forest and human pests.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Vegetation Mgmt Plan		20.0/0.2	20.0/0.2		40.0/0.4
- Plant Ecologist	50.0/1.0	50.0/1.0	50.0/1.0	50.0/1.0	200.0/4.0
- Document Past Research	15.0/0.1	15.0/0.1	15.0/0.1	15.0/0.1	60.0/0.4
- Verify Collections	10.0/0.0	10.0/0.0	10.0/0.0		30.0/0.0
- GIS Landcover Map	50.0/0.0	50.0/0.0	50.0/0.0		150.0/0.0
- Two Permanent Subject-to-Furlough Biological Technicians	50.0/1.4	50.0/1.4	55.0/1.4	55.0/1.4	210.0/5.6
RESEARCH					
- Plant Ecology Studies	40.0/0.0	40.0/0.0	40.0/0.0	40.0/0.0	120.0/0.0
- Database Development	15.0/0.3	15.0/0.3	15.0/0.3		45.0/0.9
- Augment Herbarium	10.0/0.0	10.0/0.0	10.0/0.0	10.0/0.0	40.0/0.0
MONITORING					
- Long Term Ecological Monitoring	10.0/0.0	10.0/0.0	10.0/0.0	10.0/0.0	40.0/0.0
INTERPRETATION					
- Develop User-Friendly Tools	15.0/0.2	15.0/0.2	15.0/0.2		45.0/0.6

TOTALS	265.0/3.0	285.0/3.2	295.0/3.2	185.0/2.5	1020.0/11.9

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Densmore, R. V. 1987. Assisted revegetation in Denali National Park, Alaska, USA. Arctic and Alpine Research 19:4:544-548

Densmore, R. V., L. Dalle-Molle and K. E. Holmes. 1990. Restoration of alpine and subalpine plant communities in Denali National Park & Preserve, Alaska. Proceedings of the First Annual Conference of the Society for Ecological Restoration. pp509-519

Furbish, C. E. 1996. Denali National Park - Trails and nodes monitoring program, Report on progress at end of 1995 season. USNPS Denali NP&P, Technical Report 61pp.

Pratt, V.E. and F.G. Pratt. 1993. Wildflowers of Denali National Park. Alaskakrafts, Inc., Anchorage, Alaska.

Tranel, Michael J. and P. Spencer. 1994. Draft Parkwide Reclamation and Restoration Program: Disturbed Lands of Denali National Park and Preserve, Alaska. USNPS. 79pp.

VanderMeer, Mark E. 1995 On-Site Vegetation Restoration Techniques Developed and Applied in Denali National Park and Preserve, Alaska. Master's Thesis, University of Montana, 155pp.

N-341

HAZARDOUS TREE MANAGEMENT

PROJECT CODE: DENA-N-341

SERVICEWIDE ISSUES:

N18	Visitor Use Impacts on Backcountry Park Resources
N22	Impacts to Recreation (Development) Zones
N20	Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
N24	Other Issues: Threats to Public Health and Safety
C17	Control of Environmental Impacts

STATEMENT OF PROBLEM

Present Condition

Tree or limb failures sometimes occur in developed areas, along roads and trails, at campsites, and at day use sites. Denali National Park and Preserve currently has no systematic, proactive program to correct tree or limb hazards in order to reduce risk of damage to property and injury to visitors. Failure to carry out periodic inspections and to correct reasonably detectible tree hazards could leave the National Park Service open to costly lawsuits and liable in the event of property damage, an injury or death.

Growth of the tourism industry and consequent visitation to Denali has been dramatic over the last 20 years; over a third of out-of-state visitors to Alaska come to the park. Approximately three hundred and fifty thousand people currently visit the developed areas of Denali each summer. As use increases, impacts which cause tree failure increase and the likelihood of accidents rises. These situations are incompatible with Denali's legislative mandates, National Park Service policies and guidelines, and the Federal Tort Claims Act. The National Park Service needs to develop and implement a hazardous tree management program at Denali that will reasonably protect visitors as invitees to park lands.

Concern for trees as hazards to people and property is part of an overall federal responsibility to users of federal land. The Federal Tort Claims Act of 1946 (28 USC 2671-2680 and 1346 (b)) requires the National Park Service to exercise reasonable care to prevent injury to any visitor, vehicle or other property. The Service must also act with reasonable care to discover and correct any unreasonably dangerous conditions, warn of the danger and risk involved, or close the area to public use. Reasonable care to protect visitors has been determined to consist

of evaluating areas for safety hazards by a qualified person, correcting the hazards and carrying out documented safety inspections regularly. Even this does not insure that an accident will not occur.

In Middough vs. U.S. (1968), the court decided that the National Park Service had a duty to protect the visitor from obvious tree hazards and that the service had a duty to inspect camping areas for obvious safety hazards. Based on this court decision, the Service was directed to act in a reasonable and prudent manner to reduce tree hazards. Tree hazards however can never be eliminated on forested recreation sites as long as any trees remain standing (Paine 1973). Managers of NPS units to which the public is specifically invited are held responsible for the elimination of hazards. Because managers are also responsible for maintaining attractive recreation sites within a forested environment, they must arrive at a balance between too great a hazard and too few trees.

Removal of large, potentially hazardous trees from Denali's developed areas would locally reduce habitat for animals requiring dead snags and insect infested trees, especially cavity nesting birds. The need to maintain some overmature or dead trees in Denali's developed areas for cavity users must be carefully balanced with the need to protect people and property from hazardous trees.

Current Management Actions and Results

Denali's Hazard Tree Removal Policy (Park Policy No. 47, August 13, 1991) states that hazardous trees will be reported to the park's research plant ecologist through the park safety officer. They will investigate reported trees, and determine and schedule appropriate actions which may include removal, topping, boring and analysis, or documented monitoring. The park botanist will keep a written record of identified hazardous trees. Only persons qualified in technical falling of hazardous trees, and designated in writing by the park safety officer, shall perform removal. Details of this policy are now out of date and the policy should be revised.

Despite this policy, developed areas are not systematically surveyed annually for hazard trees by qualified personnel and removal priorities are not determined. This is primarily a result of insufficient staff time and position vacancies.

During the past several years, maintenance crews have felled and removed trees and limbs annually in Denali. All trees removed were obviously hazardous to people or property, and operations were confined to developed sites or within striking distance of roads. In spite of such efforts, a few structurally weak or dead trees and limbs have fallen each year, damaging facilities and personal property and threatening the safety and well-being of visitors and park employees alike.

Accidents involving hazardous trees have been few but they do occur. In both 1992 and 1995, motor vehicles were involved in two incidents and several large trees, with advanced decay have been removed from the headquarters complex before an accident has occurred.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-341.001: Develop Hazardous Tree Management Plan and Program

A comprehensive, parkwide hazardous tree management plan would be developed and implemented in Denali. The plan would stratify the park into tree hazard risk zones, would outline inspection procedures, and set forth hazard abatement procedures. It would also outline procedures for documenting tree failures.

The objective of the program would be to minimize disturbance of the park's forest cover and ecosystem processes, to minimize adverse impacts on aesthetic values, and to control management costs consistent with providing reasonable safety to persons and property.

N-341.002: Consider Hazardous Trees in Park Planning and Development

Consideration of existing and potential tree hazards in planning new developments, carrying out construction projects, and altering sites within forested areas would greatly reduce adverse impacts on people, property, historic structures, and natural resources. Health and age of trees should be considered when deciding where to locate buildings, campgrounds, day use sites, trails, etc. Forest cover and screening in developed areas would be maintained indefinitely by planting immature stands of mixed species of uneven age.

Bulldozer and other machinery damage should be prevented altogether through personnel training, close supervision, and clearly worded specifications in construction contracts. If damage to trees is prevented during construction, development of future hazardous trees will be limited. After considerable vegetation or tree removal, the forest should be allowed to stabilize several years if possible before permitting public use. This will allow the remaining trees to adjust to changed wind pressures, increased solar radiation, and soil temperature. This requires many years of careful advance planning, but is important to insure a safe recreation area.

N-341.003: Hazardous Tree Management Training and Authorization

The park would have several persons designated for hazardous tree inspections. This

responsibility would be explicit in individual performance standards. Hazardous trees and limbs that require corrective action would be identified only by trained evaluators. The park's Wildlife and Vegetation Branch Chief, the park botanist, and at least one employee in each ranger district, in the buildings and utilities group, and in the roads and trails group would be trained and qualified to evaluate and document tree hazards.

Maintenance personnel would periodically receive hazardous tree and limb removal training utilizing specialized equipment and techniques. Only persons qualified in technical falling of hazardous trees, and designated in writing by the park safety officer, shall perform removals or other corrective actions.

B. Research

N-341.011: Support Independently Funded Hazardous Tree Research Projects

The National Park Service would support independently funded research projects related to forest insects and disease, resource impacts in developed areas, and natural resource hazards in Denali National Park and Preserve by private and public organizations, agencies, and universities when deemed appropriate by park management. The park would provide temporary housing and logistical support for field and laboratory work (Research Administration and Management DENA-I-410).

C. Mitigation

N-341.021: Hazardous Tree and Limb Inspection and Removal

Hazardous trees and limbs would be removed annually and/or following severe windstorms from park developed areas and along park roads and trails based on inspection recommendations. Some felled trees and limbs could be used as temporary sources of firewood at no cost to visitors and employees, while others could be left on site to decompose naturally.

N-341.022: Increase Protection of Archeological and Historical Resources from Hazardous Trees and Limbs Corrective Actions

All known archeological and historic resources would be protected during hazardous tree and limb removal operations to the greatest degree possible. Where proposed removal work could adversely affect cultural resources, mitigation measures would be prescribed and appropriate clearances would be obtained.

D. Monitoring

N-341.031: Implement Annual Inspections of Hazardous Trees and Limbs

The Divisions of Research and Resources Preservation and Maintenance would annually inspect and delineate hazardous trees and limbs within park developed areas and within striking distance of roads, campsites, day use sites, viewpoints, trails, parking lots, buildings, or any place where people congregate. Additional inspections may be necessary after a severe summer storm.

Surveys and program evaluations would be conducted under the direction of the Wildlife and Vegetation Branch Chief and the park botanist. The following types of inspections would be conducted by a team of at least two persons with the form of inspection selected based on potential risks to people and property: individual tree surveys, walk through surveys, and drive-by or windshield surveys. Trees requiring follow-up action would be marked and documented. More detailed inspections would be completed as appropriate. Park areas that are closed for the winter would be inspected just prior to reopening in the spring. Inspections should include recommendations for abatement of hazards. Areas should remain closed or be closed until hazardous tree conditions are eliminated. Written and photographic records of inspections and corrective actions would be maintained.

Maintenance, protection, interpretive, and resources management division employees should be constantly alert for potential tree hazards. Potential problems must be reported immediately to the Chief, Branch of Wildlife and Vegetation and the park safety officer and proper warnings made until correction is completed.

N-341.032: Track Hazard Tree Data

Records of hazardous tree and limb surveys, corrective actions, and tree and limb failures would be maintained in a computerized data management system in the Division of Research and Resources Preservation Office at park headquarters. Hazard tree management zones and locations of individual trees subject to inspection and treatment, or failure would be digitized and included in the park's geographic information system.

E. Interpretation

N-341.041: Increase Public Information and Notification about Hazardous Trees and Limbs When Necessary

Visitors and employees would be sensitized to the potential hazards from falling trees and limbs during high winds, particularly where recreational activities are concentrated along

the edges of rivers or forest openings and along the shorelines of lakes. The public should also be informed about the risk to campers from falling trees or limbs during an ice or snow storm. While obtaining a permit, the camper or visitor can be notified that he or she may be asked to vacate the campsite or park in the event of adverse weather conditions. Visitors would also be informed about how damage and vandalism to tree roots and boles at campsites and day use sites increases a tree's susceptibility to disease and insect attack, and its chances of becoming a hazardous tree. Where extensive risk may exist from falling trees which are not classified as hazardous, public notification and warning of potential hazards is required.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Hazardous Tree Mgmt Plan		15.0/0.0	2.0/0.0	2.0/0.0	19.0/0.0
- Training	2.0/0.0	2.0/0.0	2.0/0.0	2.0/0.0	8.0/0.0
MITIGATION					
- Hazard Tree/Limb Removal		29.0/0.3	15.0/0.1	15.0/0.1	59.0/0.5
MONITORING					
- Annual Inspections	2.0/0.1	2.0/0.1	2.0/0.1	2.0/0.1	8.0/0.4
- Database Development	2.0/0.1	2.0/0.1	2.0/0.1	2.0/0.1	8.0/0.4
INTERPRETATION					
- Public Information		1.0/0.0	1.0/0.0	1.0/0.0	3.0/0.0
TOTALS	6.0/0.2	51.0/0.6	24.0/0.3	24.0/0.3	91.0/1.4

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Gaidula, P. 1982. Tree hazard control guidelines and standards for use in the California State Park System. State of California, Department of Parks and Recreation, The Resources Agency, Sacramento, California.

Hlsten, E. H., P. Hennon, and R. Werner. 1985. Insects and diseases of Alaskan forests. U. S. Forest Service, Alaska Region, Anchorage, Alaska.

Johnson, D. W. 1981. Tree hazards: Recognition and reduction in recreation sites. U. S. Forest Service, Rocky Mountain Region, Lakewood, Colorado.

Mott, W. P., Jr. 1969. Tree hazard control policy and administration in the California State Park System. State of California, Department of Parks and Recreation, The Resources Agency, Sacramento, California.

Paine, L. A. 1971. Accident hazard evaluation and control decisions on forested recreation sites. Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

Paine, L. A. 1973. Administrative goals and safety standards for hazard control on forested recreation sites. Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

Robbins, K. 1986. How to recognize and reduce tree hazards in recreation sites. U. S. Forest Service, Northeastern Area, St. Paul, Minnesota.

Shigo, A. L. 1983. Tree defects: A photo guide. U. S. Forest Service, Northeastern Forest Experiment Station, Durham, New Hampshire.

EXOTIC PLANT MANAGEMENT

PROJECT CODE: DENA-N-342

SERVICEWIDE ISSUES:

- N05 Degradation of Park Resources Due to Non-Native Plants
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
- N24 Human Impacts Within and Adjacent to Park

STATEMENT OF PROBLEM

Present Condition

The National Park Service (USNPS 1991) defines exotic plants as "species occurring in a given place as a result of direct or indirect, deliberate, or accidental actions by humans". However, the service also recognizes that plants occurring through historic activities of indigenous peoples and plants that have a cultural/historic connotation pertinent to a park's mission, should be evaluated for "exotic" status beyond the direct measure of human-caused vs. non-human-caused introduction into an area. Management of exotic plant species is determined by their potential for disruption of natural systems and cultural resources, as well as the practicality of control measures (USNPS 1988).

During the past 100 years, a number of exotic plant species have been introduced into Alaska. Many of these plants are from environments similar to or more severe than those found in Alaska and, in the absence of their natural limiting agents, are able to share or dominate the habitats of native plants. Moreover, the state of Alaska is developing and using hybrid strains of non-native vegetation, specifically designed to compete well in harsh environments, for roadside stabilization and reclamation purposes.

The relative ease of access and high level of visitor use, compared with other National Park Service units in Alaska, places Denali National Park and Preserve in a particularly vulnerable position regarding exotic plants. Some exotic plant species have become established within Denali; however, the exotic status of other plants is undetermined. Exotic plant diversity, abundance, and distribution, have not been adequately documented or mapped. Anecdotal evidence of exotic plant invasion resulting from various facility construction efforts since the

completion of the George Parks Highway is not documented. No systematically applied program for monitoring or controlling exotic species within and adjacent to the park currently exists.

There are two primary sources of exotic plants in the park (1) internal introductions where humans move plant parts directly into the park, and (2) external introductions where plant parts are moved into the park from outside Denali by wind, animals or other natural processes. An internal source of exotic plants is the Kantishna area where lodging facilities and mining operations occur on private property within park boundaries. In addition, the potential for internal spread of exotic plants exists through the activities of Denali employees, visitors, concessions operations and contractors. External exotic plant sources of note include the Department of Transportation, the Alaska Railroad, and the Usibelli Coal Mine. Each of these entities are utilizing exotic or "modified" native species for revegetation programs.

Exotic plants often become established and persist where the native vegetation has been disturbed or destroyed by either natural or human activities, such as on construction sites, road shoulders, areas trampled by heavy human use, campsites, trailways, and burned areas. If the disturbance is minor and temporary, plant succession may lead to re-establishment of the native vegetation and exclusion of exotics. The persistence of exotics is enhanced on sites where disturbance recurs. An example at Denali National Park is the grading of the gravel park road. This activity creates a continuous disturbance throughout the summer months, enhancing the spread of some exotic species.

In-park revegetation projects have spread exotic plants from potting and soil materials brought into the park. Denali's roadside revegetation project, initiated in 1990 near the park entrance, resulted in the apparent introduction of *Bromus inermis* (brome grass). Plant materials, grown through contract by the Plant Materials Center in Palmer, Alaska, have come into the park infested with non-native seeds.

The revegetation staging area located adjacent to the headquarters residence complex consisted of a number of raised planting containers. These containers were infested with *Taraxacum officinale* (dandelions) and were dismantled in 1996. However, the headquarters residence area remains heavily infested with dandelions in the old revegetation staging area, around the housing units, and throughout the office building complex. Other areas near the park hotel, visitor access center, and Riley Creek campground also have dense populations of dandelions.

The following exotic or potentially exotic (status not yet determined) plants are known to occur within Denali, although some verification of species/subspecies taxonomy is needed:

Bromus inermis
Chenopodium album
Chrysanthemum leucanthemum
Descurainia sophia
Heiracium scabriusculum
Hordeum jubatum
Lepidium densiflorum
Matricaria matricarioides

Melilotus albus
Plantago major
Stellaria media
Taraxacum officinale
Trifolium repens
Trifolium pratense
Vicia cracca

Control of exotic plant species is warranted when the exotics threaten natural vegetation or the habitat value of an area, could damage cultural or historic resources (including historic landscapes), or interfere with the public's ability to learn about and enjoy the natural and cultural resources of Denali National Park and Preserve.

Current Management Actions and Results

An exotic plant management plan has not been developed for Denali. Therefore, exotic plant control activities have been limited to small episodes of attention given to some of the more apparent and severe infestations. Past management efforts to control exotic plants via manual eradication have been only marginally successful due to insufficient personnel and ineffective control techniques.

The control efforts that have been attempted in the past few years were limited to a few species. *Melilotus albus* (sweet clover) populations have been kept somewhat in check through annual removal of most flowering plants along the park road (from the entrance at mile 0 to headquarters at mile 4) and along the George Parks Highway within park boundaries. The most apparent weed, *Taraxacum officinale* (dandelion), is abundant in almost all disturbed areas within the park. Dandelions have been seen along the park road and at campgrounds and other park facilities all the way to Wonder Lake and the Kantishna area, but the highest concentrations are in the park headquarters and residence areas. Only intermittent and marginally effective manual eradication efforts, along the park road past Savage Check Station (mile 14), have been made toward holding this species in check.

In 1995 and 1996, mapping work for five of the more abundant exotic species in the headquarters/visitor center area was accomplished using volunteer help. The quality of information from these maps is variable, but will be useful when developing an exotic plant management plan. The map for one of the species, *Taraxacum officinale* (dandelion), has been digitized into Denali's geographic information system (GIS).

RECOMMENDED ACTIONS

Management of exotic plants within Denali requires the development of an exotic Plant management plan to coordinate and direct control activities. Information on the exotic status, spatial distribution and potential for ecological or cultural damage of exotic plants is necessary to evaluate the need for control measures. Additional information on potential control methods will be required to initiate control practices following integrated pest management guidelines. In the meantime, labor-intensive manual control of *Taraxacum officinale* (dandelion) and *Melilotus albus* (sweet clover) should be implemented around the park entrance and housing areas, since these two plants have unquestioned exotic status, have already been roughly mapped, and have a high potential for spread and invasion of all disturbed areas along the Park Road. Once spatial distribution information is better understood, the strategy of working in the park entrance area first should be reevaluated.

A. Program Administration and Planning

N-342.001: Develop an Exotic Plant Management Plan

An exotic plant management plan would be developed to provide guidelines for re-establishing and maintaining exotic-free plant communities. The management plan will incorporate information on exotic plants and control measures developed through research projects (DENA-N-342.011, DENA-N-342.012). Cooperative agreements with adjoining land management agencies will be sought as needed to control exotic species along mutual boundaries. Plant use on highway and railroad right-of-ways will be addressed.

Management policies and strategies would be formulated to minimize the introduction of exotic plants and for the control of exotics presently within the park.

Certified weed-free (exotic-free) products and materials would be required for park and concession operations and specified in park contracts for acquiring products and materials. Private inholders would be encouraged to cooperate with these policies.

N-342.002: Develop and Implement Revegetation Guidelines for Disturbed Areas

Revegetation guidelines would be developed which would address the use of non-native plant materials and encourage the reestablishment of native vegetation in developed and disturbed areas (i.e. residences, landscaped areas, hotel grounds, cabin sites, campsites, mining camps, trails and trailheads, utility and road right-of-ways, etc.). Many exotic plants would continue to re-invade disturbed areas following removal efforts and continue to out-compete native species on badly trampled or disturbed sites. It is therefore extremely important to encourage the re-establishment of native vegetation throughout

the park when rehabilitation of developed sites occurs.

N-342.003: Create Seasonal Vegetation Technician Positions

Two seasonal technicians would be needed to implement the exotic plant management program. Technicians would conduct surveys, record, map, and monitor populations, and apply control techniques. See Terrestrial Vegetation Management DENA-N-330.

N-342.004: Provide Plant Identification, Protection and Control Training

Field employees would be trained to identify exotic plant species. A field guide, depicting exotic species of concern, would be developed and provided to all employees. A voucher specimen collection, consisting of all species of concern, would be prepared. Special training on how to map and record the abundance of exotic plants would be required for park employees managing these species. Exotic control training would be provided for park field personnel involved in eradication efforts. Park personnel applying and handling herbicides to control plants will obtain appropriate certification.

B. Research

N-342.011: Identify Exotic or Potential Exotic Plants, and Describe Their Ecological Characteristics

This research will investigate the exotic status of all known exotic plants within Denali. It will also include plants that have not been documented within the park, but have the potential for introduction because of their proximity to the park, the availability of suitable habitat within the park, or their record of expansion within the state of Alaska. Investigations would include the potential impacts to park vegetative communities from the hybrid species developed by the state of Alaska. These species, in use along highway and railroad right-of-ways, have been specifically developed to compete in harsh climates. Information on the habitat requirements, life cycles, dissemination mechanisms, and capacity for ecologic or cultural impacts of all exotic plants will be researched and described.

N-342.012: Inventory Spatial Extent of Exotic Plants

A comprehensive inventory of exotic plants to determine their spatial extent would be conducted. GIS and global positioning system technologies should be used in this effort. The combination of ecological characteristics, spatial distribution, and information about visitor use will be used to establish a strategy for control.

N-342-013: Investigate Control Methods for Exotic Plants Identified as Threats to Natural or Cultural Resources

Integrated pest management (IPM) practices call for control of undesirable organisms through coordinated use of different minimum-impact methods. Methods for control of common exotic plants have likely been developed elsewhere and may be applicable to Denali. However, established control methods may not be effective in a sub-arctic climate. This research will evaluate established control methods and develop new control methods, within an IPM context, for exotic plants at Denali.

N-342-014: Support Independently Funded Exotic Plant Research

The service would support independently funded exotic plant research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management DENA-I-410).

C. Mitigation

N-342.021: Implement Minimum-Impact Control Measures for Dandelion and Sweet Clover

The exotic status of these two plants is indisputable. They have already become established at the park entrance area, and they have a high potential for spread along the park road into any disturbed areas. Control measures should be implemented without waiting for completion of research projects. Minimum-impact control methods, with primary emphasis on labor-intensive manual removal by volunteers, will be used to prevent dispersal of these plants.

N-342.022: Implement Exotic Plant Control as Described in Exotic Plant Management Plan

Comprehensive management actions to control exotic plants would be implemented as described in the exotic plant management plan.

N-342.023: Manage Pack Stock Use of Park Trails

If pack stock are determined to be contributors to the alien plant problem in the park, trail use restrictions would be implemented. This action, designed to minimize the spread and establishment of exotics, would require issuance of special use permits for commercial pack stock using the park. Regulations will be imposed which prohibit riders

from bringing in hay or seed source feed. As park knowledge of exotic plants increases, this policy would be periodically reviewed and refined so that both visitors and native plant communities would benefit.

D. Monitoring

N-342.031: Survey Park Areas at Risk for Exotic Introductions

Monitoring would be conducted periodically within areas where there is potential for exotics to become established and persist, annually for the most susceptible areas and less often for other areas. Information about exotic plant habitat requirements (DENA-N-342.011) will be used in conjunction with GIS data to identify areas likely to experience introductions of exotic species.

N-342.032: Monitor Known Infestations of Exotic Plants

Quantitative data would be collected to determine abundance, population growth trends, and range expansions. Maps will be generated and entered into the park's GIS. The effectiveness of control measures will be evaluated through data collected in conjunction with annual or biannual monitoring, as described in the exotic plant management plan.

E. Interpretation

N-342.041: Maintain Adequate Public Information about Exotic Plants

Park staff are likely to experience visitor complaints when exotic plants are being controlled along the roadside. The park's interpretive, visitor services and resources management personnel would cooperatively develop and implement programs aimed at informing park visitors, neighbors, inholders, and employees about exotic plants. An explanation of exotic plant problems in the park newspaper, the "Alpenglow", would explain exotic plant concerns and management actions. Briefing bus drivers about the process of exotic plant management during their early-season orientation will help the drivers answer inquiries from passengers. Information about exotic plant control would be provided to private inholders and park staff would assist them in controlling exotics on their property.

F. Protection

N-342.051: Enforce Permit/Contract Requirements

Park staff would develop requirements for use in concessioner and contractor operations

that would govern use of plant material and importation of soils and gravels in construction projects. Compliance with requirements would be monitored.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Exotic Plant Mgmt Plan			20.0/0.1	20.0/0.1	40.0/0.2
- Inventory	30.0	30.0			60.0
- Develop Revegetation Guidelines	12.0/0.1				12.0/0.1
- Training/Field Guide	20.0/0.1	8.0/0.0	8.0/0.0	8.0/0.0	44.0/0.1
RESEARCH					
- Research Ecology of Exotic Plants	40.0/0.2	40.0/0.2			80.0/0.4
- Develop Control Methods		40.0/0.2	40.0/0.2	40.0/0.2	120.0/0.6
MITIGATION					
- Implement Short-Term Control	15.0/0.2	15.0/0.2	15.0/0.2	15.0/0.2	60.0/0.8
- Implement Long-Term Control				20.0/0.3	20.0/0.3
- Pack Stock Restrictions			10.0/0.1	10.0/0.1	20.0/0.2
MONITORING					
- Survey At-Risk Areas			25.0/0.3	25.0/0.3	50.0/0.6
- Monitor Infestations	5.0/0.1	10.0/0.2	5.0/0.1	10.0/0.2	30.0/0.8
INTERPRETATION					
- Public Information		10.0/0.2	10.0/0.2	10.0/0.2	30.0/0.6
TOTALS	122.0/0.7	153.0/1.0	133.0/1.2	158.0/1.6	566.0/4.7

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Craighead, J. J., F. L. Craighead, D. J. Craighead, and R. L. Redmond. 1988. Mapping arctic vegetation in northwest Alaska using Landsat MSS imagery. National Geographic Research 4(4):496-527.

Dean, F. C., and D. K. Heebner. 1982. Landsat-based vegetation mapping of Mount McKinley National Park Region, Alaska. Alaska Cooperative Park Studies Unit, Final Report NPS Contract No. CX-9000-6-E084, University of Alaska, Fairbanks. 198 pp.

Heebner, D. K. 1982. The numerical analysis of vegetation plots in Denali National Park and Preserve. MS Thesis, Alaska Cooperative Park Studies Unit, University of Alaska, Fairbanks. 243 pp.

USNPS. 1982. Park road corridor development concept plan environmental assessment, Denali National Park and Preserve. USNPS, Denver Service Center, Denver, CO. 132 pp.

USNPS. 1983. Park road corridor development concept plan, Denali National Park and Preserve. USNPS, Denver Service Center, Denver, CO. 98 pp.

USNPS. 1988. Management policies. U. S. Department of the Interior. pp 4:11-4:13

USNPS. 1990. Cumulative impacts of mining final environmental impact statement, Denali National Park and Preserve: Volumes 1 and 2. USNPS, Denver Service Center, Denver, CO. 364 and 307 pages, respectively.

USNPS. 1991. NPS-77 natural resources management guidelines. U. S. Department of the Interior. pp 283-381

USNPS. 1996a. Final development concept plan/abbreviated final environmental impact statement, entrance area and road corridor Denali National Park & Preserve, Alaska. U. S. Department of the Interior. 353pp.

USNPS. 1996b. Preserving our natural heritage, a strategic plan for managing invasive nonnative plants on National Park System lands. U.S. Department of the Interior, NPS. Washington, DC. 16pp.

SUBSISTENCE
FIREWOOD AND LOG USE

PROJECT CODE: DENA-N-344

SERVICEWIDE ISSUES:
- N19 Loss of Park Resources Due to Consumptive Practices
- N20 Lack of Basic Data

STATEMENT OF PROBLEM

Introduction

Language in ANILCA specific to Denali states that subsistence uses by local residents shall be permitted in the park additions, where such uses are traditional, in accordance with the provisions of Title VIII. Subsistence uses are also allowed in Denali National Preserve (ANILCA 201(3)(a), 203)(Project Statement DENA-S-100). Subsistence uses include the collection of timber resources for shelters and structures; such as cabin logs, caches, smoke houses, dog houses and pitching tents. For fuel, it could include firewood for heating cabins and homes, drying meat and smoking fish. Subsistence uses also include wood for constructing dog sleds, fish drying racks, fish wheels, and snowshoes.

Local rural residents of Cantwell, Lake Minchumina, Telida and Nikolai are eligible subsistence users for Denali National Park and Preserve. Individuals who reside outside of these resident zone communities, who have customarily and traditionally used park resources, may apply to the superintendent for a subsistence use permit. Approximately 320 local rural residents qualify for subsistence use activities within Denali National Park and Preserve.

Through NPS rulemaking in 1981, regulatory guidelines for harvest of live standing timber was established requiring subsistence timber harvest permit for cutting live standing trees larger than 3" in diameter at ground height. Collecting dead or down timber for firewood by subsistence users is allowed without a permit (36 CFR 13.49).

The demand for and use of subsistence timber resources by qualified subsistence users in Denali

is likely to increase in the future. Several requests have been received from subsistence users for cabin logs to re-roof existing trapline cabins, and to reconstruct cabins that have been destroyed by wildland fires and undercutting by river channels.

In addition, some of Denali's resident zone communities have increased in population which could lead to more requests for timber resources. A timber management plan would be useful to guide harvest and monitoring of timber resources.

Present Condition

Cantwell is Denali's largest subsistence use community and has the potential to focus use on a relatively small geographic area. Cantwell's population has increased from 89 in the 1980 census to 147 in the 1990 census, this represents a 65% change. The community of Cantwell is located just 3 miles from Denali National Park and has relatively easy access to park resources (U.S. Census Bureau, 1990).

The demand for subsistence timber resources from Denali National Park could be heightened further by Cantwell Native Village Corporation closure of its land surrounding the community to the harvest of timber by non-shareholders. Cantwell Native Village Corporation owns all the land between the community of Cantwell and Denali National Park. Because of the close proximity to the community, much of the subsistence timber harvest used to occur on these lands before they were selected and conveyed to the village corporation. The corporation's management policy limiting access to timber resources could focus Cantwell's non-native subsistence timber harvest on Park lands.

Mining activities in upper Windy Creek drainage in the 1960's opened the first cat trail routes from Cantwell to Windy Creek. This primitive mining access route also provided local residents an opportunity to access Windy Creek for harvesting timber and wildlife resources. The Windy Creek mine failed to pass validity tests and was never put into production, but use of the Windy Creek area by subsistence and recreational users has expanded because of the improved access along the mine road. Use of this area predates the ANILCA additions to Denali National Park.

Aerial over-flights of the ANILCA additions in the Windy Creek area show a well defined dirt road leading from the community of Cantwell to Windy Creek. From this road there are a number of side ORV trails that lead into the timber and tundra areas. Tree stumps present in these areas indicate that these trails are used to access timber resources.

In the northern region of the park, three subsistence trapline cabin reconstruction permits have been issued and two other requests are pending. Harvest of 30 mature white spruce trees was authorized for reconstruction of the small trapline cabins. In addition, a subsistence user with land inholdings within the preserve, but with very limited white spruce timber resources, has requested a timber harvest permit for cabin logs to rebuild a collapsed cabin on his property.

Current Management Actions and Results

Denali National Park and Preserve does not have a subsistence firewood and log management program. No formal assessments have been made of timber resources, local management practices or timber use strategies. Currently, NPS regulations in 36 CFR 13.20 "Preservation of natural features" and 13.49 "Subsistence use of timber and plant material" guides harvest and use of timber resources. Subsistence users are required to obtain a permit from the park superintendent to harvest live standing timber resources with a diameter greater than three inches at ground height. For live standing timber of diameter less than three inches, cutting is permitted unless restricted by the superintendent.

In addition to subsistence purposes, some firewood is collected in the park for administrative uses. Visitors may also collect 'dead and down' firewood for use in park campground campfires. See Project Statement DENA-I-800 for a complete description.

Inventorying and monitoring of forest resources should occur. Information on past and contemporary use, harvest areas and means of transportation is needed to facilitate a forest resources management program.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-344.001: Develop Firewood/Log Management Plan and Program

A comprehensive, parkwide firewood/log management plan for qualified subsistence users would be developed and implemented in Denali. This plan and program would be based on ANILCA and requirements in 36 CFR 13.49. The Denali Subsistence Resource Commission (SRC) would be consulted, and would review the plan and program annually. Park staff would periodically evaluate and report the status of firewood and log use for Denali's four resident zones communities and other qualified subsistence users to the SRC. The park's draft cabin study report "Use of cabins and other shelters associated with subsistence activities in selected areas of the north additions to Denali National Park and Preserve," would be amended to reflect management policies developed for this plan.

B. Research

N-344.011: Research Forest Resource Use

This study will describe the traditional and contemporary subsistence use of forest resources by Denali's resident zone communities and qualified subsistence use residents. The study will identify local customs governing the harvest, distribution, and conservation of forest resources. Information on what species are harvested, when the harvest occurs, what are the preferred harvesting sites, what quantities of timber resources are harvested, what the mode of access has been, and for what purpose the timber resources are being used will be documented.

Other impacts associated with the subsistence harvest such as roads, erosion, vegetative loss, clear cutting and alteration of stand composition will be documented and mitigative alternatives suggested.

The study would focus on timber use near the town of Cantwell. Biological assessment of Windy Creek and Cantwell Creek drainages will be made to document species present, the age class structure, composition, height, and density of timber stands will be recorded. Qualitative character of the forest resources will be described by assessing disease, heart rot, insect infestations and age of the timber stands.

C. Monitoring

N-344.031: Monitor Timber Use

A timber monitoring program would be initiated consisting of permanent ground monitoring plots and aerial photography. Information gathered will lead to the formulation of a subsistence firewood and log management plan for Denali National Park and Preserve.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Develop Firewood-Log Management Plan	2.0/0.1	2.0/0.1	2.0/0.1		6.0/0.3

RESEARCH					
- Research Forest Resource Use	3.0/0.2	3.0/0.2	1.0/0.0	1.0/0.0	8.0/0.4
MONITORING					
- Monitor Timber Use	3.0/0.2	3.0/0.2	3.0/0.2	1.0/0.1	10.0/0.7
TOTALS	8.0/0.5	8.0/0.5	6.0/0.3	2.0/0.1	24.0/1.4

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Alaska National Interest Conservation Act. Public Law 96-487, 96th Congress.

Code of Federal Regulations. 36 CFR Part 13. 1995.

USNPS. 1986. Final general management plan, land protection plan. USNPS, Denali NP&P. 231pp.

USNPS. 1996. Use of cabins and other shelters associated with subsistence activities in selected areas of the north additions to Denali National Park and Preserve. Draft Cabin Study Report. On File at Denali NP&P, Division of Research and Resource Preservation.

PASSERINE BIRDS

PROJECT CODE: DENA-N-361.1

SERVICEWIDE ISSUES:
N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
N24 Human Impacts Within and Adjacent to Park

STATEMENT OF PROBLEM

Present Condition

Much baseline information exists on passerine bird populations in Denali. Descriptions of species present were made in the mid 1900's (Dixon 1938, Murie 1963). Numerous surveys have been conducted, though none consistently (Muse 1990, 1992, 1993; Schempf and Titus 1988; USFWS BBS Data 1982, 1983, 1986, 1987, 1994, 1995, 1996; Wilbor 1992). Park files contain wildlife observation records that will be useful in documenting arrival dates, nest locations, and other avian information.

Declines of migratory landbirds documented in North America since the 1940's have prompted an international initiative for the conservation of those that breed in North America and winter in Central and South America. This initiative, known as the Neotropical Migratory Bird Conservation Program, *Partners In Flight* (PIF), was created to develop conservation programs for Neotropical migratory birds. Numerous organizations have become signatories to PIF, including the National Park Service (Partners in Flight 1992). The program includes the inventory and monitoring of landbirds by state and federal agencies responsible for managing large tracts of undisturbed land. As part of a National Park Service initiative, Denali was selected as a prototype park for the development of protocols to conduct long-term scientific research and to monitor environmental trends (Van Horn et al. 1992). The objective of the proposed program for migratory birds in Denali is to measure the natural range of variation in the abundance and demography of breeding bird populations.

Passerine birds comprise a large portion of the landbird species addressed by the PIF program. Many passerines that breed in Denali winter in other states, countries and continents where the potential for habitat alteration is great. These species can be sensitive indicators of regional and global environmental changes (Van Horn et al. 1992). Passerines provide an important prey base for higher trophic level species and are predators in their own right. They are also

important for the viewing pleasure of park visitors. For sound management decisions to be made, reliable and accessible resource information must be available. Only systematic long term studies of the basic breeding biology of these species will allow the detection of changes and subsequent indication of some problem.

Current Management Actions and Results

As part of the Long-Term Ecological Monitoring Program (LTEM), Denali has contracted for the operation of a Monitoring Avian Productivity and Survivorship (MAPS) program. Five constant-effort mist net and point count stations have been operated annually since 1992. The purposes of MAPS are to provide annual indices and estimates of adult population size, post-fledgling productivity, recruitment into the adult population, and adult survivorship for various landbird species (DeSante 1993). This is a labor intensive method combining banding-recapture and point count survey methods. The program provides rough habitat maps and semi-quantitative habitat descriptions for the vegetation at each banding station. Since the MAPS operation was initiated as one aspect of a larger program, it has been confined to a restricted study area.

Breeding Bird Surveys (BBS) have been conducted intermittently in Denali since the mid 1980's. This method of surveying species of birds breeding along road corridors has been a main method of monitoring population trends in North America since 1966 (Peterjohn and Sauer 1993). Overseen by the U.S. Geological Survey, Biological Resources Division, this method requires one early morning survey per route during the breeding season. Though the BBS program is the oldest and most widely used program for monitoring breeding birds, it has deficiencies, since it does not allow for sampling of specific habitats or areas where roads do not exist. The BBS does not measure productivity or survival, which are more sensitive indicators of population change.

Off-road point counts have been conducted in the Rock Creek watershed as part of the LTEM program since 1992 (Pogson and Rexstad 1993). Off-road point counts were expanded to other areas of the park and on-road counts were added in 1993. Currently, nine off-road routes and four BBS style on-road routes are surveyed annually to monitor avian populations and determine interannual differences in relative abundance of breeding landbirds in Denali (Paton and Springer 1997). Variable circular plot surveys for species density estimation have been conducted in conjunction with a recent merlin study (Schempf and Titus 1989, Wilbor 1992). These surveys have been aimed at determining prey abundance and availability for merlins. Additional survey and monitoring programs conducted at Denali include Christmas Counts and North American Migration Counts.

Though some work has been done on passerine bird species in Denali, there are many questions yet to be answered. It is unknown whether the Denali Park Road has an impact on passerine bird species along its corridor. The possible effects of vehicular traffic and fugitive dust have

not been investigated. The formation and use of social trails and their impact on passerine species is unknown. Human disturbance to passerines in the form of construction of roads and structures has not been addressed. Also unknown are the impacts to passerines as a result of snowmachine use or subsistence timber harvest in areas of Denali where these activities are permitted. The response of passerines to habitat alteration caused by fires is unknown. The fire management plan for Denali will include the removal of hazard fuel and continued fire suppression around developed areas. The impact of such activities on passerines is unknown. In addition to direct effects, activities such as alteration of habitat could result in indirect effects to individuals.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-361.101: Create a Management Ornithologist Position

The management ornithologist would provide professional-level oversight for all bird management operations including coordinating monitoring efforts, and developing and implementing interagency bird management activities. An ornithologist would provide direction and perspective on bird management operations. A program manager concentrating on bird management can follow through on objectives and goals set for monitoring bird species.

N-361.102: Create Seasonal Wildlife Technician Positions

Seasonal technicians would be needed to implement the avian management program under the direction of the ornithologist. Technicians would conduct surveys, and record, map, and monitor populations of birds.

B. Research

N-361.111: Develop and Implement a Passerine Bird Research Program

1. Determine distribution, diversity, and abundance of passerine species in Denali. Identify species of special concern and important nesting habitats. Conduct surveys in geographic areas where no data currently exist.

2. Investigate and implement methods to detect changes in passerine bird populations due to the effects of road traffic, road dust, social trails, construction, snow machine use, subsistence timber harvest, hazard fuel management, natural fire, and fire suppression

(Frontcountry Management DENA-I-610, Winter Recreation Management DENA-I-640, Road Use Impacts DENA-I-670, and Wildland Fire Ecology and Management DENA-N-520).

N-361.112: Initiate Northern Shrike Research

Initiate research on northern shrikes (*Lanius exubitor*) due to suspected population decline. Determine abundance, annual productivity, population trends, habitat requirements, and seasonal movements.

N-361.113: Support Independently Funded Passerine Research

The service would support independently funded passerine bird research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management DENA-I-410).

C. Mitigation

N-361.121: Provide Consideration for Passerine Species and Their Habitats

Ensure adequate consideration for passerines and their habitats in all land-use planning, decision making processes, and operations (roadside brushing, hazard fuel removal, etc.) by mitigating impacts to the maximum extent mandated by law or appropriate under existing policy.

D. Monitoring

N-361.131: Continue Breeding Bird Surveys

Continue to conduct Breeding Bird Surveys annually by a qualified observer. Modify and expand the Breeding Bird Survey to include backcountry sites. To maintain consistency assign a permanent staff member to perform the surveys. Provide training to ensure that the observer is competent at visual and audio identification of local bird species.

N-361.132: Continue Constant Effort Mist Netting

Continue and expand the MAPS program. To attain observer consistency, employ and train a permanent staff member to operate the stations with the assistance of seasonal biological technicians. Enlarge the area covered by the program to effectively sample

all passerine habitats of this large park.

N-361.133: Continue to Conduct Point Counts

Continue to conduct point counts on established routes around the Park, both on-road and off-road, on an annual basis. Follow protocol for off-road point counts.

N-361.134: Participate in National Monitoring Programs

Park staff will support national monitoring programs including Christmas Bird Counts, North American Migrations Counts, and so forth.

E. Interpretation

N-361.141: Maintain Adequate Public Information about Passerine Birds

Promote public awareness of passerines and their habitat needs among all users of Denali including park staff and visitors, local land owners, concessionaires, subsistence users, and miners.

N-361.142: Improve Information Gathering System

Improve system for gathering wildlife observation information. Much natural history information can be gained from interested individuals through the reporting of wildlife observations. Such a system has been in effect in Denali for some years but needs much refinement. If properly publicized and handled this system can be useful for providing information on species with little or no intensive research.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Ornithologist			40.0/1.0	40.0/1.0	80.0/2.0
- Seasonal Biological Techs.			20.0/0.5	20.0/0.5	40.0/1.0
RESEARCH					

- Passerine Research Program	40.0/0.13	40.0/0.13	40.0/0.13	40.0/0.13	160.0/0.52
- Shrike Research	28.0/0.9	28.0/0.9	28.0/0.9	28.0/0.9	112.0/3.6
MONITORING					
- Breeding Bird Survey	1.0/0.02	1.0/0.02	1.0/0.02	1.0/0.02	4.0/0.08
- Constant Effort Mist Netting	21.0/0.0	21.0/0.0	21.0/0.0	21.0/0.0	84.0/0.0
- Point Counts	8.0/0.0	8.0/0.0	8.0/0.0	8.0/0.0	32.0/0.0
INTERPRETATION					
- Public Information		2.0/0.04	2.0/0.04	2.0/0.04	6.0/0.12
TOTALS	98.0/1.05	100.0/1.09	160.0/2.59	160.0/2.59	520.0/7.32

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

DeSante, D. F., and K. Burton. 1993. The 1992 annual report of the monitoring avian productivity and survivorship (MAPS) program in Denali National Park. The Institute for Bird Populations, P.O. Box 1346, Point Reyes, CA 94956-1346. 12pp.

Dixon, J. S. 1938. Birds and mammals of Mt. McKinley National Park. Fauna of the National Parks, Fauna Series No. 3. 1938. 236pp.

Kertell, K. and A. Seegert. 1984. Denali National Park bird finding guide. Alaska Natural History Association. Denali Park, Alaska.

Murie, A. 1963. Birds of Mt. McKinley National Park, Alaska. Mt. McKinley Natural History Assoc. 85pp.

Muse, S. 1990. Investigator's annual report. Research and Resource Management Files, Denali NP&P.

Muse, S. 1992. Investigator's annual report. Research and Resource Management Files, Denali NP&P.

Muse, S. 1993. Investigator's annual report. Research and Resource Management Files, Denali NP&P.

Partners in Flight. 1992. Annual report: *Partners in Flight-Aves de las Americas.* National Fish and Wildl. Found. 1120 Connecticut Ave. NW, St. 900, Washington, D.C. 32pp.

Paton, P.W.C. and S.K. Springer. 1997. Monitoring landbirds in Denali National Park using on-road and off-road point counts. Alaska Bird Observatory, P.O. Box 80505, Fairbanks, Alaska. 41pp.

Peterjohn, B. G. and J. R. Sauer. 1993. North American breeding bird survey annual summary 1990-1991. Bird Populations, Vol.1. 15pp.

Pogson, T. H., and E. Rexstad. 1993. Abundance of landbirds breeding in the Rock Creek watershed of Denali National Park and Preserve, 1992. Development of Methodology for Monitoring Long-Term Trends of Landbird Populations. The Alaska Bird Observatory, P.O. Box 80505, Fairbanks, AK 99708-0505. 22pp.

Schempf, P. and K. Titus. 1989. Status of the merlin (*Falco c. columbarius*) in Interior Alaska, 1988 Progress Report. Raptor Management Studies, U.S. Fish and Wildlife Service, P.O. Box 021287, Juneau, AK 99802. 16pp.

Van Horn, J. et.al. 1992. Long-term ecological monitoring proposal. U.S. Department of the Interior, NPS, Denali National Park and Preserve. Denali Park, Alaska.

Wilbor, S. 1992. Investigator's annual report. Research and Resource Management Files, Denali NP&P.

U.S. Fish and Wildlife Service. Breeding bird survey. Patuxent Wildlife Research Center, 12100 Beech Forest Rd. Laurel, MD 20708.

SHOREBIRDS

PROJECT CODE: DENA-N-361.2

SERVICEWIDE ISSUES:
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
- N24 Human Impacts Within and Adjacent to Park

STATEMENT OF PROBLEM

Present Condition

Shorebirds are difficult to study in interior Alaska. Unlike coastal areas where they occur in relatively limited habitat, shorebirds in Denali National Park and Preserve occur over a wide range of habitats including lakes and ponds, moist tundra, alpine tundra, and rivers and streams. This array of habitat preferences precludes the use of one survey method to study the group as a whole. Survey methods therefore must be geared toward groups of species that share common habitat types. Other than montane species, effective survey methods for non-coastal shorebirds are lacking (Gill pers. comm.).

As a large, relatively undisturbed area, Denali provides unfragmented habitat that is considerably free from human disturbance and other potential threats for many species. It provides important nesting habitat for many shorebirds. Though there are no immediate threats to shorebirds within the Park, consideration should be given to monitoring shorebird populations and their habitats.

The amount of information on shorebird species in Denali is sparse. Limited information exists on the presence of shorebirds and nesting activity (Dixon 1938, Murie 1963, Natural History Wildlife Observation Card File).

To make sound management decisions, reliable and accessible resource information must be available. This information is lacking for shorebirds in the park which may result in the inability to detect problems affecting shorebirds in Denali. With increasing Park visitation come problems of human disturbance and habitat alteration. The distribution and abundance of shorebirds within the park makes the detection of population changes difficult. Long term studies of the basic breeding biology of these species will allow the detection of such changes and hence, an indication of some problem.

Current Management Actions and Results

At present there is no dedicated work being conducted in the park on shorebirds. The only shorebird information being gathered is incidental to other studies such as passerine surveys, which are conducted in habitats where shorebirds occur.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-361.201: Create an Ornithologist Position

See Project Statement Passerine Birds DENA-N-361.1

N-361.202: Create Seasonal Wildlife Technician Positions

See Project Statement Passerine Birds DENA-N-361.1

B. Research

N-361.211: Implement a Shorebird Inventory Program

Determine distribution, diversity, and abundance of shorebird species within Denali. Determine seasonal movements, annual productivity, population trends, and habitat requirements. Identify species of special concern and important nesting areas. Conduct surveys in areas where no data currently exist.

N-361.212: Develop Shorebird Monitoring Protocols

Develop a protocol which can be effectively used to monitor shorebirds based on habitat preference. Investigate and implement methods to detect changes in shorebird populations due to the effects of road traffic, road dust, social trails, construction, snow machine use, subsistence hunting, fishing, hazard fuel management, natural fire, and fire suppression (Frontcountry Management DENA-I-610, Winter Recreation Management DENA-I-640, Road Use Impacts DENA-I-670, and Wildland Fire Ecology and Management DENA-N-520).

N-361.213: Support Independently Funded Shorebird Research

The service would support independently funded shorebird research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management DENA-I-410).

C. Mitigation

N-361.221: Provide Consideration for Shorebird Species and Their Habitats

Ensure adequate consideration for shorebird and their habitats in all land-use planning and decision making processes by mitigating impacts to the maximum extent mandated by law or appropriate under existing policy. Circumstances where this is important include gravel extraction sites and trail locations.

N-361.222: Restrict Activity Around Shorebird Nesting Areas

Establish seasonal closures around shorebird nesting areas to avoid disturbance by hikers and campers. Provide adequate signing of these areas to alert those using the area of the closure boundaries.

D. Monitoring

N-361.231: Initiate a Shorebird Monitoring Program

A program to systematically monitor shorebirds within the park would be initiated.

E. Interpretation

N-361.241: Maintain Adequate Public Information about Shorebirds

Promote public awareness of shorebirds and their habitat needs among all users of Denali including park staff and visitors, local land owners, concessionaires, subsistence users, and miners.

F. Protection

N-361.251: Enforce Public Use Closures

Enforce restrictions around nesting sites.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Ornithologist	See DENA-N-361.1				
- Seasonal Biological Techs.	See DENA-N-361.1				
RESEARCH					
- Develop and Implement Research Program	40.0/0.0	40.0/0.0	40.0/0.0	40.0/0.0	160.0/0.0
MONITORING					
- Monitor Population Dynamics	13.0/0.13	13.0/0.13	13.0/0.13	13.0/0.13	52.0/0.52
INTERPRETATION					
- Public Information		10.0/0.2	10.0/0.2	10.0/0.2	30.0/0.2
TOTALS					

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared prior to initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Dixon, J. S. 1938. Birds and mammals of Mt. McKinley National Park. Fauna of the National Parks, Fauna Series No. 3. 1938. 236pp.

Gill, B. 1993. United States Fish and Wildlife Service. Office of Ecological Services. Anchorage, AK. Personal Communication.

Kertell, K. and A. Seegert. 1984. Denali National Park bird finding guide. Alaska Natural History Association. Denali Park, Alaska.

Murie, A. 1963. Birds of Mt. McKinley National Park, Alaska. Mt. McKinley Natural History Assoc. 85pp.

WATERFOWL

PROJECT CODE: DENA-N-361.3

SERVICEWIDE ISSUES:

N19	Loss of Park Resources /Hunting
N20	Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
N24	Human Impacts Within and Adjacent to Park

STATEMENT OF PROBLEM

Present Condition

Waterfowl are a prominent group of migratory birds. They attract the attention of large numbers of people who simply enjoy watching them. Additionally, they serve as a subsistence species for some native groups, and as indicators of a healthy environment (NAWMP 1986). Little is known about waterfowl populations in Denali National Park and Preserve.

The biggest issue of concern for waterfowl nationwide is degradation of habitat. Though there are no immediate habitat threats to waterfowl in the park, priority should be given to monitoring waterfowl populations and their supporting habitats. Monitoring is required for long-term trend detection to be successful.

Numerous ponds and lakes in the park have fairly high concentrations of nesting waterfowl and may be important as staging areas prior to fall migration. Cold, rapid flowing streams often surrounded by forest are important breeding areas for Harlequin ducks (*Histrionicus histrionicus*) (Armstrong 1991). Harlequin ducks are a species of concern being considered for protection under the Endangered Species Act. Under a species of concern designation, listing may be warranted but there is not adequate information for thorough evaluation.

Waterfowl are hunted both for subsistence and sport throughout Alaska. In the park, the harvest of waterfowl is currently believed to be limited (Twitchell pers. comm.). There is no information regarding the occurrence of sport hunting of waterfowl in the park.

Current Management Actions and Results

The amount of effort dedicated to the study of waterfowl species in the park has been limited. Information on the status of waterfowl in the park consists of nesting reports and incidental observations (Dixon 1938, Murie 1963, park files). At present, most waterfowl information is of this same type.

Trumpeter swan (*Cygnus buccinator*) surveys have been conducted in the Tokositna and Yentna river drainages by park personnel (Troyer 1979, 1980). Loons have nested for many years on Wonder Lake. During the past five years, small closures have been put in place around loon nests because they are readily accessible and because of the concentration of visitor use adjacent to nest sites. All other accounts of waterfowl by park or affiliated personnel have been incidental.

The United States Fish and Wildlife Service (FWS) conducts swan surveys statewide every five years. The FWS also conducts waterfowl breeding pair and brood surveys annually. Of these aerial surveys conducted north of the Alaska Range, some include areas in the northwest portion of the park. Though some plots lie within park boundaries, these surveys are not of sufficient intensity to provide adequate parkwide waterfowl data (Brackne pers.comm.).

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-361.301: Create an Ornithologist Position

See Project Statement Passerine Birds DENA-N-361.1.

N-361.302: Create Seasonal Wildlife Technician Positions

See Project Statement Passerine Birds DENA-N-361.1.

B. Research

N-361.311: Implement a Waterfowl Inventory Program

Determine distribution, diversity, and abundance of waterfowl species within Denali. Determine seasonal movements, annual productivity, population trends, and habitat requirements of waterfowl species within Denali. Identify species of special concern and important nesting, staging and stop-over areas. Conduct surveys in areas where no data

currently exist. Particular attention should be given to the Tule white-fronted goose.

N-361.312: Develop Waterfowl Monitoring Procedures

Develop waterfowl monitoring protocol. Investigate and implement methods to detect changes in waterfowl populations due to the effects of road traffic, road dust, social trails, construction, snow machine use, subsistence hunting, fishing, hazard fuel management, natural fire, and fire suppression (Frontcountry Management DENA-I-610, Winter Recreation Management DENA-I-640, Road Use Impacts DENA-I-670, and Wildland Fire Ecology and Management DENA-N-520).

N-361.313: Initiate Harlequin Duck Research

Initiate research to gather data on distribution, abundance, and productivity of harlequin ducks. The Harlequin duck is the only duck in the northern hemisphere to breed almost exclusively along swift flowing mountain streams (Harlequin Duck Working Group, 1993). Harlequins usually nest close to streams, but nesting habits are highly variable.

Harlequin ducks were listed as an endangered species in eastern Canada in 1990, and in 1991 were designated a category II (now species of concern) candidate for threatened or endangered status throughout the United States.

N-361.314: Support Independently Funded Waterfowl Research

The service would support independently funded waterfowl research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management DENA-I-410).

C. Mitigation

N-361.321: Provide Consideration for Waterfowl Species and Their Habitats

Ensure adequate consideration for waterfowl and their habitats in all land-use planning and decision making processes by mitigating impacts to the maximum extent mandated by law or appropriate under existing policy.

N-361.322: Restrict Activity Around Waterfowl Nesting Areas

Establish seasonal closures around waterfowl nesting areas to avoid disturbance by hikers

and campers. Provide adequate signing o these areas to alert those using the area of the closure boundary.

D. Monitoring

N-361.331: Initiate a Waterfowl Monitoring Program

A program to systematically monitor waterfowl within the park would be initiated. Such a program would follow FWS protocol for conducting waterfowl surveys in Alaska. Determine a schedule for conducting breeding pair as well as brood (reproduction) surveys. Of particular initial concern are swans, loons, and Harlequin ducks because of their presence in close proximity to visitor activities and park development and because of their population status.

E. Interpretation

N-361.341: Maintain Adequate Public Information about Waterfowl

Promote public awareness of waterfowl and their habitat needs among all users of Denali including park staff and visitors, local land owners, concessionaires, subsistence users, and miners.

F. Protection

N-361.351: Provide Protection for Waterfowl During Hunting Season

Patrol areas in the park where and when hunting is not permitted to provide protection from illegal taking of waterfowl species.

N-361.352: Enforce Public Use Closures

Enforce restrictions around nesting sites.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Ornithologist	See DENA-N-361.1				
- Seasonal Biological Techs.	See DENA-N-361.1				
RESEARCH					
- Inventory	40.0/0.0	40.0/0.0	40.0/0.0	40.0/0.0	160.0/0.0
- Monitoring Procedures		30.0/0.0	30.0/0.0	30.0/0.0	90.0/0.0
MONITORING					
- Monitor Population Dynamics	18.0/0.13	18.0/0.13	18.0/0.13	18.0/0.13	72.0/0.52
INTERPRETATION					
- Public Information		10.0/0.2	10.0/0.2	10.0/0.2	30.0/0.6
PROTECTION					
- Hunting Patrols	14.0/0.1	14.0/0.1	14.0/0.1	14.0/0.1	56.0/0.4
TOTALS	72.0/0.23	112.0/0.43	112.0/0.43	112.0/0.43	408.0/1.52

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Armstrong, R. H. 1990. Guide to the birds of Alaska. Alaska Northwest Books. 342pp.

Brackne, Allen. 1993. United States Fish and Wildlife Service. Office of Waterfowl Management, Fairbanks, AK. Personal communication.

Dixon, J. S. 1938. Birds and mammals of Mt. McKinley National Park. Fauna of the National Parks, Fauna Series No. 3. 236pp.

Harlequin Duck Working Group. 1993. Status of harlequin ducks (*Histrionicus histrionicus*). Unpublished document, Harlequin Duck Working Group. 83pp.

Kertell, K. and A. Seegert. 1984. Denali National Park bird finding guide. Alaska Natural History Association. Denali Park, Alaska.

Murie, A. 1963. Birds of Mt. McKinley National Park, Alaska. Mt. McKinley Natural History Assoc. 85pp.

Twitchell, H. 1993. USNPS. Denali NP&P, Subsistence Branch, Denali Park, AK. Personal Communication.

RAPTORS

PROJECT CODE: DENA-N-361.4

SERVICEWIDE ISSUES:
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
- N24 Human Impacts Within and Adjacent to Park

STATEMENT OF PROBLEM

Present Condition

Denali exists as a relatively large undisturbed area. It provides unfragmented habitat that is considerably free from human disturbance and other potential threats for many species. It provides important nesting habitat for raptors. Raptor populations and their habitat can only be protected if threats to them have been determined. Raptors are top-level predators and usually live in relatively low densities and are therefore sensitive to human induced environmental changes.

Fifteen species of raptors are known to breed within the boundaries of Denali National Park and Preserve. Five are known or are thought to migrate to Central and South America (Peregrine falcon (*Falco peregrinus*), Merlin (*Falco columbarius*), American kestrel (*Falco parverius*), Short-eared owl (*Asio flammeus*), and Northern harrier (*Circus cyaneus*). Four migrate to Canada or the lower 48 states (Sharp-shinned hawk (*Accipter striatus*), Red-tailed hawk (*Buteo jamaicensis*), Golden eagle (*Aquila chrysaetos*), and Bald eagle (*Haliaeetus luecocephalus*). Six are considered resident to the Denali area (Northern goshawk (*Accipter gentilis*, Gyrfalcon (*Falco rusticolus*), Great-horned owl (*Bubo virginianus*), Great gray owl (*Strix nebulosa*), Northern hawk owl (*Surnia ulula*), and Boreal owl (*Aegolius funereus*). Of the species that migrate to Central and South America, pesticides are known to affect two (Peregrine falcon and Merlin). Deforestation and land management practices could affect the others. Loss of wetlands or habitat alteration may also be problems. Movements of resident species are unknown. Local species that cross political boundaries deserve special attention. Distribution, abundance, and productivity data are lacking for most species. Two other raptor species (Snowy owls (*Nyctia scandiaca*) and Rough-legged hawks (*Buteo lagopus*) are regular winter visitors or migrants. Their role in the Denali ecosystem is poorly understood.

To make sound management decisions, reliable and accessible resource information must be available. In general, the amount of information on raptor species in Denali is sparse. Only four of these species (Golden eagles, Gyrfalcons, Merlins, and Northern hawk owls) have been the subjects of dedicated research. This lack of information may result in the inability to detect problems affecting raptors in Denali. With increasing park visitation come problems of human disturbance and habitat alteration. The distribution and abundance of raptors within the Park makes the detection of population changes difficult. Only long term studies of the basic breeding biology of these species will allow the detection of such changes and hence, an indication of some problem.

Current Management Actions and Results

Information on raptors in Denali has been gathered since the mid 1900's (Sheldon 1930, Murie 1944, 1963, Dixon 1938) mostly in the form of reports on nesting activity and food habits. From 1979 through 1987 a raptor nest inventory project (RNI) was conducted. The purpose of the project was to provide standardization for raptor nest site reporting and recording, and to conduct raptor nest searches. The bulk of information included in the RNI to date pertains to Golden eagles and Merlins, both of which are subjects of other research projects. Information on Gyrfalcons was collected simultaneously to that of Golden eagles due to their preference for similar habitats (McIntyre and Britten 1988). Also included is information on Northern hawk owls gained from a small but intensive study of food habits and breeding biology (Kertell 1982). Incidental observations of other raptor species have been made in the course of these studies and a large collection of natural history observation records, including records of raptor sightings, is available for many years.

Research on the nesting ecology of golden eagles has been ongoing in Denali since 1987 (Britten and McIntyre 1988). The purpose of the project is to provide baseline data to monitor the reproductive success of Golden eagles. The objectives of the project are to annually determine occupancy and reproductive success at all known golden eagle nesting areas (McIntyre pers. comm.). Data are also collected on nesting phenology, nest site characteristics, food habits, and between year differences in reproductive success among nesting areas. Additionally, data on migration routes and wintering areas have been collected using satellite radio telemetry. Occupancy and productivity data on Gyrfalcons have been collected simultaneously with the Golden eagle study since 1989.

Since 1983 research to document the reproductive success, nest site characteristics and food habits of Merlins has been conducted in Denali. Viable and addled eggs have been collected and analyzed to assess environmental contaminant related impacts. High levels of contaminants, particularly DDE, as well as eggshell thinning have been found in the eggs of Merlins (Titus and Schempf 1990, Wilbor 1992). Factors influencing reproductive performance, particularly prey abundance, contaminants, weather variables, and nest site selection are currently being analyzed

to determine their respective influence on merlin reproductive performance (Wilbor pers. comm.). Park staff and volunteers have attempted to sustain Merlin monitoring since 1993 when formal research was completed.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-361.401: Develop and Implement a Raptor Management Program

Incorporate standardized raptor population and habitat monitoring techniques that will give reliable information for development of species management plans, land use plans, environmental assessments, etc. Establish cooperative raptor research and management programs that encompass federal, state, and adjacent private lands; cooperate with interagency raptor studies and efforts to address raptor protection and conservation. Coordinate efforts for population monitoring, surveys, and research among all entities gathering such information to avoid duplication of effort and undue disturbance to birds.

N-361.402: Create an Ornithologist Position

See Project Statement Passerine Birds DENA-N-361.1.

N-361.403: Establish Research and Management Priorities for Raptors

Identify raptor species of special concern. Determine distribution, abundance, and movement/migration patterns for those species that have the highest potential for human impact. Assess the ecological importance of visitor and migrant species in the role of the Denali ecosystem.

N-361.404: Create Seasonal Wildlife Technician Positions

See Project Statement Passerine Birds DENA-N-361.1.

N-361.405: Provide Interagency Coordination

Coordinate and cooperate with efforts of the USFWS, Endangered Species Office, to comply with the Endangered Species Act of 1973, as amended, and to support additional programs which give appropriate attention to candidate, sensitive, and other unlisted species.

B. Research

N-361.411: Investigate Historical Raptor Nest Data

Investigate pre-1979 raptor nest data and compare to current raptor inventory. Photographic and narrative information exists that could be correlated to known numbered nest sites to give decades of nest use information.

N-363.412: Continue Golden Eagle Research

Continue intensive Golden eagle research in Denali, particularly monitoring reproductive success. Identify the influence of changes in abundance and availability of prey on the reproductive success. Denali supports the largest known Golden eagle nesting population in Alaska and data collected on the species in Denali can provide information on the overall health of Golden eagle populations in the northern latitudes of North America (McIntyre pers. comm.). Identify winter ranges of Denali Golden eagles and threats on the winter range.

N-361.413: Develop Ecosystem Research

Change emphasis in research from single species toward links with prey population changes. Monitor small mammals and ptarmigan in such a way as to mesh with raptor monitoring (i.e., more intensive look at raptors in same areas as better prey monitoring.

N-361.414: Investigate Bald Eagle and Osprey Nesting

Initiate a program to inventory Bald eagles (*Haliaeetus leucocephalus*) and Osprey (*Pandion haliaetus*) on the south side of the Alaska Range within the Park boundaries and also in the Park's northern additions. Bald eagles and Osprey have reportedly nested in these two areas (Van Horn pers. comm., McIntyre pers. comm.). These regions are the most likely for development and increased human use.

N-361.415: Support Independently Funded Raptor Research

The service would support independently funded raptor research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management DENA-I-410).

C. Mitigation

N-361.421: Provide Consideration for Raptor Species and Their Habitats

Ensure adequate consideration for raptors and their habitats in all land-use planning and decision making processes by mitigating impacts to the maximum extent mandated by law or appropriate under existing policy. Situations wherein this consideration should be given include such things as trail routing, construction and maintenance scheduling, and hazard tree removal.

N-361.422: Restrict Activity Around Raptor Nest Sites

1. Establish seasonal wildlife closures around raptor nest sites to avoid disturbance by hikers and campers. Provide adequate signing of these areas to alert those using the area of the closure boundaries.

2. Control use of aircraft around raptor nest sites. Inform all potential users of the need to avoid raptor nest disturbance by aircraft. Provide information on nest site location to aircraft users.

D. Monitoring

N-361.431: Continue Raptor Monitoring Program

Update the raptor nest inventory. Conduct surveys in areas where no data currently exists. Initiate a program to monitor those raptor species that are not already subjects of ongoing programs.

N-361.432: Continue Merlin Study

Continue research to determine the influence of environmental contaminants on Merlin reproductive success. Develop protocol for monitoring reproductive success, influence of environmental contaminant levels, and nesting area occupancy of merlins in selected study areas in Denali.

N-361.433: Continue Gyrfalcon Study

Continue to collect data on nesting area occupancy and reproductive success of Gyrfalcons, concurrent with golden eagle research. Little research is conducted on Gyrfalcons in Alaska and data from Denali provides useful information on the species in a relatively undisturbed environment (McIntyre pers. comm.). Identify the influence of changes in prey abundance and availability on Gyrfalcon nesting area occupancy and

reproductive success.

N-361.434: Continue Peregrine falcon Monitoring

Continue periodic monitoring of known Peregrine falcon nesting areas.

E. Interpretation

N-361.441: Maintain Adequate Public Information about Raptors

Promote public awareness of raptors and their habitat needs among all users of Denali including park staff and visitors, local land owners, concessionaires, subsistence users, and miners.

F. Protection

N-361.451: Enforce Public Use Closures

Enforce restrictions around nests.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Raptor Mgmt Plan	13.25/.025	13.25/.025	13.25/.025	13.25/.025	53.0/1.0
- Ornithologist	See DENA-N-361.1				
- Seasonal Biological Techs.	See DENA-N-361.1				
- Investigate Historical Raptor Nest Data	6.0/0.25	6.0/0.25	6.0/0.25	6.0/0.25	24.0/1.0
RESEARCH					
- Golden Eagle Research	31.0/0.16	31.0/0.16	31.0/0.16	31.0/0.16	124.0/0.64
- Research Bald Eagle and Osprey Nesting	15.0/0.16	15.0/0.16	15.0/0.16	15.0/0.16	60.0/0.64

MITIGATION					
- Restrict Activity Around Nest Sites	2.0/0.04	2.0/0.04	2.0/0.04	2.0/0.04	8.0/0.16
MONITORING					
- Continue Raptor Nest Inventory	18.0/0.13	18.0/0.13	18.0/0.13	18.0/0.13	72.0/0.52
- Continue Merlin Study	10.0/0.25		10.0/0.25		20.0/0.5
- Continue Gyrfalcon Study	4.0/0.08	4.0/0.08	4.0/0.08	4.0/0.08	16.0/0.32
- Continue Peregrine Falcon Study			4.0/0.08		4.0/0.08
INTERPRETATION					
- Public Information		10.0/0.2	10.0/0.2	10.0/0.2	30.0/0.6
TOTALS	99.25/1.32	99.25/1.27	113.25/1.6	99.25/1.27	411.0/5.46

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Britten, M. W. and C. L. McIntyre. 1988. Preliminary investigations for the development of a long-term monitoring program for golden eagles nesting in Denali National Park and Preserve, AK. USNPS, Natural Resources Progress Report AR-88/02, April, 1988.

Dixon, J. S. 1938. Birds and mammals of Mt. McKinley National Park. Fauna of the National Parks, Fauna Series No. 3. 1938. 236pp.

Kertell, K. 1982. Reproductive biology of hawk owls (*Surnia ulula*) in Denali National Park, Alaska. Unpubl. Masters Thesis, Humboldt State Univ., CA.

Kertell, K. and A. Seegert. 1984. Denali National Park bird finding guide. Alaska Natural History Association. Denali Park, Alaska.

McIntyre, C. L. and M. W. Britten. 1988. Raptor nest inventory, Denali National Park and Preserve, 1979-1987. USNPS, Natural Resources Progress Report AR-88/03, April, 1988.

Murie, A. 1944. The wolves of Mt. McKinley. Fauna of the National Parks, Fauna Series No. 5. 238pp.

Sheldon, C. 1930. The wilderness of Denali--explorations of a hunter-naturalist in northern Alaska. C. Scribner's Sons, NY. XXV+ 412pp.

Titus, K., and P.F. Schempf, 1990. Status of the merlin (*Falco c. columbarius*) in Interior Alaska, 1989 Progress Report.

Wilbor, S. 1992. Investigator's annual report. Research and Resource Management Files, Denali NP&P.

N-361.5

PTARMIGAN AND GROUSE

PROJECT CODE: DENA-N-361.5

SERVICEWIDE ISSUES:
- N19 Loss of Park Resources/Hunting
- N20 Lack of Basic Data- Insufficient Understanding of Park Ecosystem and Threats to Them
- N24 Human Impacts Within and Adjacent to the Park

STATEMENT OF PROBLEM

Present Condition

Three species of ptarmigan and two species of grouse inhabit Denali National Park and Preserve. These are Willow Ptarmigan (*Lagopus lagopus*), Rock Ptarmigan (*Lagopus mutus*), White-tailed Ptarmigan (*Lagopus leucurus*), Spruce Grouse (*Dendragapus canadensis*), and Ruffed Grouse (*Bonasa umbellus*). Habitat requirements of each grouse or ptarmigan species are very different. Willow Ptarmigan select willow shrub thickets, Rock Ptarmigan occur in alpine tundra areas (Armstrong 1990), and White-tailed Ptarmigan inhabit upland tundra where they occupy rugged terrain with low, sparse vegetation interrupted by boulder fields, talus, and glaciers (Weeden 1962). Grouse are forest dwellers. Spruce Grouse are found mainly in coniferous forests and deciduous-mixed woodlands (Armstrong 1990). Ruffed Grouse inhabit deciduous woodlands (Armstrong 1990) and are often found in stands of aspen (Weeden 1965).

Ptarmigan and grouse have been an important subsistence resource and may have historically contributed to the food supply of Alaskans more than any other avian group (Weeden 1965). More recently, they are eagerly sought out by recreational hunters, but they are still important to some people for food (Weeden 1968).

Sport and subsistence take of ptarmigan and grouse in Denali is believed to be minimal. Very little information exists for ptarmigan and grouse populations within the park. Populations are believed to be naturally regulated.

Roberts (1963) believed that appreciable fluctuations in ptarmigan and grouse populations take place although historic records were inconclusive. More recent research has documented very drastic fluctuations in Ruffed Grouse populations. Population densities of Ruffed Grouse follow a ten-year cycle that roughly corresponds to snowshoe hare (*Lepus americanus*) cycles (Keith,

1963). Ptarmigan and Spruce Grouse populations appear to follow the same cycles. It is important to understand how fluctuations in ptarmigan and grouse population numbers affect predator populations.

Biologists recognize the importance of ptarmigan and grouse in predator-prey cycles. Grouse and ptarmigan provide an important prey item for avian predators, such as Golden Eagles, Gyrfalcons, and Goshawks. They are also important prey items for mammalian predators such as foxes and coyotes (Mossop 1988, Bergerud 1988). Poor recruitment in Golden Eagle populations during some years is suspected to be the result of low prey population densities. Research indicates that predation accounts for as much as 85% of recorded mortalities of ptarmigan and grouse (Bergerud 1988).

Current Management Actions and Results

Very little research on ptarmigan or grouse has been conducted in the park. Brood counts of Willow Ptarmigan were conducted in the Savage and Sanctuary river drainage in 1951 (De Leonardis 1953). Another project focused on monitoring ptarmigan population trends along the park road. This study enumerated adult birds from Headquarters to the Savage River bridge during 1980 and 1981 (USNPS No date). Further observations of ptarmigan and grouse have been incidental to other projects.

The state has been monitoring ruffed grouse population trends since 1993 just north of the park through spring drumming counts in the Clear Air Force Base area. Ptarmigan population trends have been monitored through "males-on-territory densities" by the state east of the park in the Paxson-MaClaren section of the Denali Highway beginning in 1994.

The state of Alaska monitors grouse and ptarmigan harvests by soliciting information from hunters. Harvest limits are typically lower in areas with easy access that may be susceptible to over harvest. Season lengths may also be limited during low population cycles. Controlled burns have been implemented in some areas to improve wildlife habitat.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-361.501: Create a Management Ornithologist Position

See Project Statement Passerine Birds DENA-N-361.1.

N-361.502: Create Seasonal Wildlife Technician Positions

See Project Statement Passerine Birds DENA-N-361.1.

B. Research

N-361.511: Ptarmigan and Grouse Inventory Programs

Determine distribution and abundance of ptarmigan and grouse species in Denali. Identify species of special concern and important nesting areas.

N-361.512: Ptarmigan and Grouse Monitoring Procedures

Investigate and implement methods to detect changes in ptarmigan and grouse populations due to the effects of road traffic, road dust, social trails, construction, snow machine use, subsistence timber harvest, subsistence hunting, sport hunting, hazard fuel management, natural fire, and fire suppression.

N-361.513: Support Independently Funded Ptarmigan and Grouse Research

The service would support independently funded ptarmigan and grouse research projects in the park by private and public organizations, agencies and universities. The park would provide temporary housing and logistical support for field and laboratory work if possible.

C. Monitoring

N-361.531: Initiate a Ptarmigan and Grouse Monitoring Program

A program to monitor ptarmigan and grouse distribution, abundance, harvest, and population trends within the park and preserve would be initiated once survey techniques were identified and tested. This effort would be coordinated with the Alaska Department of Fish and Game.

N-361.532: Improve Information Gathering System

Improve system for gathering wildlife observation information. Natural history information can be gathered by interviewing interested individuals and through the reporting of wildlife observations. Such a system has been in effect in Denali for some years but needs much refinement. If properly publicized and handled this system can be useful for providing information on species with little or no intensive research.

D. Interpretation

N-361.541: Maintain Adequate Public Information about Ptarmigan and Grouse

Promote public awareness of ptarmigan and grouse and their habitat needs among all user groups.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Ornithologist	See DENA-N-361.1				
- Seasonal Biological Techs.	See DENA-N-361.1				
RESEARCH					
- Inventory	40.0	40.0			80.0
- Develop Monitoring Program	40.0/1.0	40.0/1.0	40.0/1.0	40.0/1.0	160.0/4.0
MONITORING					
- Annual Monitoring	20.0/0.1	20.0/0.1	20.0/0.1	20.0/0.1	80.0/4.0
INTERPRETATION					
- Public Information	2.0/0.1	2.0/0.1	2.0/0.1	2.0/0.1	8.0/0.4
TOTALS	102.0/1.2	102.0/1.2	62.0/1.2	62.0/1.2	328.0/4.8

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Armstrong, R. H. 1990. Guide to the birds of Alaska. Revised edition. Alaska Northwest Books, Bothell, WA. 342pp.

Bergerud, A. T. 1988. Population ecology of grouse. In: Adaptive strategies and population ecology of northern grouse. A.T. Bergerud and M.W. Gratson, eds. U of MN Press. 809pp.

De Leonardis, S. 1953. Productivity of rock and willow ptarmigan. Science in Alaska:334-336.

Keith, L. B. 1963. Wildlife's ten year cycle. University of Wisconsin Press, Madison.

Kertell, K. and A. Seegert. 1984. Denali National Park bird finding guide. Alaska Natural History Association. Denali Park, Alaska.

Mossop, D. H. 1988. Winter survival and spring breeding strategies of willow ptarmigan. In: Adaptive strategies and population ecology of northern grouse. A.T. Bergerud and M.W. Gratson, eds. U of MN Press. 809pp

Murie, A. 1963. Birds of Mt. Mc Kinley, Alaska. Mount McKinley Natural History Association. 86pp.

USNPS. No date. Ptarmigan trend counts. Study No. 209. Denali NP&P files.

Roberts, H. 1963. Aspects of the life history and food habits of rock and willow ptarmigan. Unpublished M.S. Thesis, University of Alaska. 108pp.

Weeden, R. B. 1962. Alaska wildlife investigations: game bird investigations Vol II No. 8. Characteristics of rock and willow ptarmigan. Alaska Dept of Fish and Game. 77pp.

Weeden, R. B. 1965. Alaska wildlife investigations: grouse and ptarmigan in Alaska: their ecology and management. Alaska Department of Fish and Game. llOpp.

Weeden, R. B. 1968. Upland game birds of forest and tundra. Wildlife Booklet Series: No.3. Alaska Department of Fish and Game. 44pp.Insert description of current management actions here.

N-362.1

DALL SHEEP

PROJECT CODE: DENA-N-362.1

SERVICEWIDE ISSUES:

- N18 Visitor Use Impacts on Backcountry Park Resources
- N19 Loss of Park Resources Due to Consumptive Practices (Hunting and Trapping)
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Present Condition

Mount McKinley National Park was established in 1917 to protect an outstanding assemblage of wildlife resources. Naturalist-hunter-conservationist Charles Sheldon began pressing for protection of the area, now known as Denali National Park and Preserve, in the early 1900's. Sheldon was concerned about the continued preservation of wildlife resources, specifically the Dall sheep (*Ovis dalli*). During the early gold mining boom, miners, trappers, and market hunters, working to provide meat for railroad camps, over-utilized the Dall sheep population to the extent that there were local extirpations.

The establishment of Mount McKinley National Park afforded protection of wildlife within its boundaries. Dall sheep within the park continue to be naturally regulated and are usually observable in historic sheep habitat throughout the park. Dall sheep are a major visitor attraction. Dall sheep also play a role as a vital component of the ecosystem within Denali National Park as well as throughout the Alaska Range.

Denali National Park and Preserve straddles an east-west trending range of towering mountains in central Alaska known as the Alaska Range. Dall sheep are prevalent throughout the high mountain peaks within the eastern and western-most portions of the park. The population within the "old park" is of great interest to wildlife managers because it is one of the few populations in North America that is naturally regulated and shares its range with a natural complement of large predators. The population within the 1980 new park and preserve additions is of particular concern to park managers because of the perceived decline of large adult rams. In addition, anecdotal evidence indicates that population of sheep that inhabited the Tokosha Mountains is

now extirpated.

There is a need to understand the factors that influence Dall sheep population characteristics so that natural processes can be maintained and anthropogenic forces mitigated. Dall sheep throughout the park are faced with a host of natural and anthropogenic influences with potential to affect population parameters and distribution. These include weather, predation, loss of habitat due to human development, disturbance of natural travel routes, energetic costs associated with displacement by motor vehicles, aircraft, backcountry hiking and camping, harvest and poaching. It is possible that impacts to sheep population dynamics are occurring as a result of anthropogenic influences.

Park visitation has increased dramatically over the past two decades. Consequently, the potential for impacts to wildlife populations also increases as facility development expands and wildlife/human interactions increase. The increase in visitor use resulted in an increase in vehicular traffic on the Park Road. The park implemented a shuttle bus system to reduce vehicular traffic and to help mitigate potential impacts of increasing traffic.

Park managers have expressed concern regarding the impact that vehicle traffic on the Park Road might have on natural migrations and distribution patterns of Dall sheep. Adolph Murie documented an established migration of sheep from wintering grounds in the Outer Range, south to a summer range near the main crest of the Alaska Range. Observations of sheep attempting to move along these same corridors continue today. Sheep migrations between winter and summer ranges have been interrupted by vehicles traveling the Park Road (Dalle-Molle and Van Horn 1991). The impact of vehicular traffic on sheep migrations across the road corridor is not known. It is impossible to determine biologically-based vehicle use limits and mitigate vehicle impact without this information.

Drastic increases have occurred in flight-seeing operations over Denali. Additionally, NPS conducts numerous low-level aircraft operations over the park for various purposes. Aircraft may affect park resources or impact the quality of visitor experiences. Recent legislation by the U.S. Congress has addressed the disruption of natural quiet and potential impacts of aircraft disturbance to visitors and wildlife over the Grand Canyon and Rocky Mountain National Parks by creating flight free zones. Dall sheep are popular attractions for people utilizing flight-seeing operations. Sheep throughout the park, including those inhabiting Igloo Mountain, Toklat, Primrose, and Windy Creek, could be subject to disturbance from aircraft. The extent of disturbance and impact from these activities and the resultant effects on the sheep population is not known.

Dall sheep are subject to harvest by sport and subsistence hunters within the 1980 new park and preserve additions. Local big game guides have commented that the number of full-curl rams on preserve lands in the southwest portion of the park have declined. Sheep populations have fluctuated significantly and recruitment of some cohorts may be very low due to severe weather.

The effects of weather and harvest on sheep populations within the park need more investigation.

Management of Dall sheep in Denali National Park must be based on sound scientific information. Statistically valid surveying techniques must be employed to gather population information. Managers must be able to track population abundance, sex and age composition, and recruitment to mitigate the effects of anthropogenic influences and to ensure that ecosystem processes can be maintained.

Basic population information is required to examine the relationship among Dall sheep, sheep habitat, and predators. Population information is also needed to formulate management strategies to minimize anthropogenic disturbances to the natural sheep population. Monitoring population dynamics, density, disturbance from ground and aerial traffic, and the effects of harvest, will provide information critical to the management of Denali National Park as a functioning ecosystem.

Dall sheep population information is also needed to assist studies in progress on predator-prey relationships. Sheep are a prey species for large mammalian predators inhabiting Denali and may play an integral role in predator-prey dynamics. In addition, the naturally regulated population within Denali National Park can be used for comparisons with hunted populations throughout North America.

Current Management Actions and Results

Current sheep monitoring efforts, initiated in 1974, involve annual, ground-based, composition counts of lambs and ewe-like animals along the road system within the old park. Aerial surveys also extend back into the 1970s. Beginning in 1991, the ground counts have occasionally been supplemented with aerial surveys of more remote portions of the park. While these counts provide long term data on lamb/ewe ratios in a small area of the park, they do little to provide an index to park-wide population abundance or sex composition. Ground-based efforts are very limited in sample size and geographic area and do not cover areas subject to harvests. During 1996, a cooperative sheep survey was conducted on the southside of the Alaska Range by the Alaska Department of Fish and Game (ADF&G) and the National Park Service. A study to investigate sheep migrations and vehicle/sheep interactions was initiated in 1995 by the Biological Resources Division (BRD) of the U.S. Geological Survey. In 1996, BRD personnel also undertook a parkwide sheep survey.

The State of Alaska manages for a sustained opportunity to harvest full curl rams east and west of Denali. Harvest and population objectives are defined in Annual Performance Reports. Harvest is monitored through hunter harvest ticket reporting (Hicks 1995). Periodic population and trend area surveys are conducted on lands adjacent to Denali.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-362.101: Develop an Interagency Dall Sheep Management Program

The park would work cooperatively with state and Federal management agencies as well as private citizens and corporations to develop an interagency working plan to manage Dall sheep in and adjacent to the park. The National Park Service, ADF&G, Denali Subsistence Resource Commission (SRC), Federal Subsistence Board (FSB), and the Alaska Board of Game (BOG) would develop and implement sheep management strategies.

B. Research

N-362.111: Coordinate With Ongoing Predator-Prey Research

Ongoing predator-prey research, conducted by BRD scientists, would be supported by the park and encouraged to continue. An integrated systems approach would be taken to study resource interactions throughout the park. Dall sheep population information would be included as a component of ongoing work to the extent possible.

N-362.112: Modify Dall Sheep Survey Techniques

Ongoing efforts are not providing an adequate level of Dall sheep population monitoring. The existing monitoring strategy would need to be modified so it can be carried out by park managers at an adequate level for hunted and unhunted populations. Site-specific attention is needed to ensure feasible, statistically sound techniques which can be implemented by the park on a long term basis. Methods for estimating Dall sheep population abundance and composition for selected populations in the park and preserve will be evaluated and tested. The park will cooperate with other agencies to utilize results of other Dall sheep monitoring protocol development efforts and to ensure comparability. Selected methods will be modified and evaluated, as necessary, to provide an acceptable protocol for implementation at Denali.

N-362.113: Recover Historic Data for Inclusion in Park Data Bases

Survey reports and individual observations from researchers, bus drivers, wildlife observation cards, case incident reports, and interviews would be used to develop a park database. Dall sheep population dynamics, distributions, movements, licks, lambing

grounds, and habitat use will be recorded. Efforts would be made to ensure that the data base is complete and up-to-date. Whenever possible these data would be incorporated into the park geographic information system.

N-362.114: Determine and Map Areal Extent of Sheep Use Areas

Dall sheep migration and habitat use would be determined and mapped. Current lambing areas and mineral licks would also be located and mapped. These data would be incorporated into park data bases and the park geographic information system.

N-362.115: Investigate Road Use Disturbance to Dall Sheep Populations

See Road Use Impacts to Resources DENA-I-670.

N-362.116: Investigate Aerial Traffic Disturbance to Dall Sheep Populations

Studies will be initiated to determine the levels of disturbance from low-level aircraft activity. Data will be collected for frequency of disturbance, sheep response, composition of sheep group involved, areas of avoidance, etc. (Aircraft Management DENA-I-650).

N-362.117: Investigate Foot Traffic Disturbance to Dall Sheep Populations

Studies will be initiated to determine the levels of disturbance from hiker and photographer activity in off-road locations. Data will be collected for frequency of disturbance, sheep response, composition of sheep group involved, areas of avoidance, etc.

N-362.118: Support Independently Funded Dall Sheep Research Projects

The Service would support independently funded Dall sheep monitoring and research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities when deemed appropriate by park management. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management DENA-I-410).

C. Monitoring

N-362.131: Conduct Annual Dall Sheep Survey

The park would implement new survey techniques, developed in DENA-N-362.112 above, to acquire annual sheep population information. Cooperative efforts with

ADF&G would be pursued to maximize area coverage.

N-362.132: Track Sport and Subsistence Use Harvest Data on Lands Adjacent to and Within the Park and Preserve

A data base would be developed and maintained of Dall sheep harvest on lands within the 1980 park and preserve additions. This effort would be accomplished in concert with the Alaska Department of Fish and Game.

D. Interpretation

N-362.141: Provide Public Information about Dall Sheep

Park officials would cooperate with groups concerned about the management and conservation of Dall sheep in the development of information plans and strategies. Park interpreters, researchers, and resource managers would work closely to ensure accuracy of information. These educational efforts would be an ongoing aspect of a total management scheme.

Dall sheep displays at visitor contact stations, slide and videotape programs, wayside exhibits, and articles in the park newspaper would inform visitors about sheep ecology. Interpretive programs about the realities of Dall sheep management would be maintained. A program encouraging visitors to report human-Dall sheep conflicts to park officials would facilitate the location of critical use areas and travel routes throughout the park. This information would be recorded and mapped annually.

E. Protection

N-362.151: Enforcement of Dall Sheep Protection Regulations

Protection of Dall sheep and their habitat would be enhanced by maintaining an adequate level of regulation enforcement. Human disturbances near Dall sheep use areas would be stopped when encountered by park rangers and resource personnel and violations would be immediately reported to the Ranger Activities Division. Aerial patrols would be conducted over the park, concentrating on sheep use areas. Aerial patrol routes will be mapped and reported in a consistent manner. The park would utilize ADF&G's Violation Reporting Program to encourage visitors to turn in individuals intentionally harassing or disturbing Dall sheep.

STAFFING AND FUNDING

PROJECT/ACTIVITY	YEAR01	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Dall Sheep Management Plan		60.1/0.1	20.0/0.1	20.0/0.1	100.0/0.3
RESEARCH					
- Modify Monitoring Program	50.0/1.1	550.0/1.1	550.0/1.1	50.0/1.1	200.0/4.4
-Determine Sheep Migration	50.0/0.8	50.0/0.8			100.0/1.6
-Investigate Disturbance	70.0/1.6	770.0/1.6	70.0/1.6	70.0/1.6	280.0/6.4
MONITORING					
- Annual Monitoring	50.0/0.1	50.0/0.1	50.0/0.1	50.0/0.1	200.0/0.4
INTERPRETATION					
- Public Information		10.0/0.2	10.0/0.2	10.0/0.2	30.0/0.6
PROTECTION					

-Enforcement		14.0/0.3	14.0/0.3	14.0/0.3	42.0/0.9
TOTALS	220.0/2.8	234.0/2.2	94.0/0.6	94.0/0.6	642.0/14.6

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Dalle-Molle, J., and J. Van Horn. 1991. Observations of vehicle traffic interfering with migration of Dall's Sheep, *Ovis dalli dalli*, in Denali National Park, Alaska. Canadian Field Naturalist 105(3):409-411.

Dalle-Molle, J., and J. Van Horn. 1981, 1982, 1983, 1984, 1986, 1987. Dall sheep composition counts, Denali National Park and Preserve. USNPS, Denali NP&P, Alaska.

Heimer, W. E. Dall sheep responses to human activity: final report. Alaska Dept. of Fish and Game, Juneau, Alaska.

Hicks, M. V. 1995. Dall sheep: annual performance report of survey-inventory activities. AK. Dept. of Fish and Game.

Murie, A. 1944. The wolves of Mount McKinley. Fauna of the National Parks of the United States, Fauna Series No.5.

Murie, A. 1945. A review of the mountain sheep situation in Mount McKinley National Park, Alaska. U.S. National Park Service Mount McKinley National Park, Alaska.

Murie, A. 1946. Wolf-mountain sheep relationships in Mount McKinley National Park, Alaska - 1946. USNPS, Mount McKinley National Park, Alaska.

Rachlow, J. 1991. Maternal movement and habitat selection by Dall's Sheep. University of Alaska Institute of Arctic Biology, Fairbanks, Alaska.

Rachlow, J. L., and T. R. Bowyer. 1989. Selection of lambing habitat by Dall's Sheep. University of Alaska Institute of Arctic Biology, Fairbanks, Alaska.

Tracy, D. M. 1977. Reactions of wildlife to human activity along Mount McKinley National Park road. M.S. Thesis, University of Alaska, Fairbanks.

Troyer, W. 1974, 1975, 1977, 1978. Aerial Dall sheep census USNPS, Denali NP&P, Alaska.

Whitten, K. R. 1975. Habitat relationships and population dynamics of Dall sheep (Ovis Dalli Dalli) in Mt. McKinley National Park, Alaska. MS thesis. Unpublished University of Alaska, Fairbanks, Alaska.

N-362.2

MOOSE

PROJECT CODE: DENA-N-362.2

SERVICEWIDE ISSUES:

- N19 Loss of Park Resources Due to Consumptive Practices (Hunting and Trapping)
- N18 Visitor Use Impacts on Backcountry Park Resources
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Present Condition

Historic moose (*Alces alces*) population information, during the early 1900's in the area that now makes up Denali National Park and Preserve, is lacking. By the early 1920's, Murie reported that moose were scarce (Murie 1944). Alaska Department of Fish and Game (ADF&G) reported low to moderate numbers through interior Alaska for the same time period. In the late 1940's through the early 1960's moose populations increased in abundance. A series of relatively mild winters contributed to high overwinter survival combined with predator control programs resulted in population growth. However, a series of severe winters during the mid 1960's marked a turning point for moose populations. Heavy snowfall during the winter of 1965-66 lead to poor overwinter survival, and a severe drop in populations resulted. Mild conditions again returned in 1967 through 1970 and moose numbers increased. Deep snows during the winter of 1970-71 caused another serious decline in moose numbers. The State of Alaska reported winter mortality rates of 50% (Coady 1976). Populations rebounded somewhat following 1971, but Van Ballenberghe reports a steady decline in moose numbers on the east side of Denali beginning in the late 1970's (Van Ballenberghe, pers. comm.). Currently, the park does not have enough information about moose movements to determine whether this decline is occurring in one or multiple subpopulations.

Moose inhabiting Denali National Park and Preserve are faced with many natural and anthropogenic factors that have potential to affect behavior, distribution and population numbers. These factors include weather, predation by wolves and bears, human development, road and railroad conflicts, frontcountry hiking and camping, backcountry hiking and camping, visitor transportation system use, harvest and poaching.

Park visitation has increased dramatically over the past two decades. Consequently, the potential for impacts to wildlife populations has also increased as facility development expands and wildlife/human interactions increase. Moose have exhibited habituation to humans. The habituation of moose and their subsequent use of high human use areas may become a visitor safety issue. Currently, moose use the area near Park headquarters and the visitor center for calving; bears are also seen in these areas hunting for moose calves.

The increase in visitor use over the years has resulted in an increase in vehicular traffic on the Park Road. The park established the visitor transportation system in the early 1970's in an attempt to reduce traffic and its potential impact to wildlife populations. The resulting shuttle bus system was intended to minimize disturbance to wildlife while providing wildlife viewing opportunities to visitors. The impact of the visitor transportation system to wildlife is not understood. Occasionally, animal movements across the road corridor are disrupted or blocked by vehicles stopped to observe wildlife. It is impossible to mitigate vehicle impacts to wildlife with our current level of knowledge.

In addition to the consequences associated with increased visitor use, moose are subject to harvest by sport and subsistence hunters within the 1980 new park and preserve additions. Moose are the single most important species harvested by subsistence users in Denali National Park and Preserve. There has been increasing interest by eligible subsistence users to hunt on federal lands under the federal subsistence regulations within the park additions. Subsistence seasons are generally longer and provide more opportunity to harvest a moose than sport seasons.

Moose harvest within the new park and preserve may occur under a federal subsistence registration permit. In addition, harvest within the preserve may occur under commercially guided moose hunts conducted by three different NPS-authorized big game guides, general sport hunts for Alaska residents and non-residents, and State Tier II subsistence permit hunts.

The increasing human population near Denali and easier modes of travel have resulted in an ever-increasing competition for limited moose resources. Specific areas of concern are the portions of Game Management Unit (GMU) 13E within Denali Park and the portion of GMU-16B within the preserve on the south side of the Alaska Range. Moose populations on the south side of the Alaska Range have decreased during the last decade. Severe winters and increased predation are suspected for the recent population declines.

The close proximity of south side park and preserve lands to neighboring communities, villages, airstrips, and roads makes access much easier for both subsistence and sport users. South side lands have the highest human harvest potential yet contain relatively small geographic areas of productive moose habitat. Moose habitat on the south side is very limited; additional habitat outside the park and preserve is required to support a self-sustaining population of moose. Coordination and cooperation with ADF&G Managers is necessary to ensure proper management

of south side moose populations.

Subsistence users from the villages of Minchumina and Telida utilize moose populations in the northwest region of the park and preserve in GMU-19D and GMU-20C for meat. Sport hunters may harvest moose in the preserve area of GMUs 19C and 20C. Predator populations inhabiting these areas also affect moose population dynamics. Increased hunting pressure is suspected in the "Wolf Townships" adjacent to the northeast region of the park, within GMU-20C. Increased hunting pressure on adjacent non-park lands may affect moose that immigrate or emigrate.

Management involving harvested species requires information on population numbers and sex and age composition. A variety of moose surveys have been conducted in Denali National Park and Preserve since 1970. Different survey methodologies and conditions have made direct comparisons very difficult, which further negates the possibility to determine long term population trends.

Current Management Actions and Results

The U.S. Forest Service is investigating moose foraging ecology, behavior, and population dynamics of a naturally regulated population in the eastern end of the park. Studies by scientists with the U.S. Geological Survey, Biological Resources Division (BRD) are also underway which address predator-prey relations. These studies deal more specifically with the relationships between caribou and the predatory behavior of grizzly bears and wolves. However, research plans are currently being developed to include moose in the predator-prey studies. The role that moose play in predator-prey population relationships is not fully understood. These investigations involve the use of radio-collars and may be regarded as intrusive by some.

The state of Alaska strives to maintain a bull:cow ratio of at least 20:100 with some units being higher for GMU's 13, 16, 19, and 20 (Hicks 1995). Harvest and population objectives are defined in Annual Performance Reports and vary with the unit. Population censuses and trend area surveys are conducted by ADF&G in areas adjacent to Denali.

Protection of moose in Denali National Park should be based on sound scientific principles. Seasonal habitat selection, availability of forage, and distribution affect population dynamics and trends. Research is necessary to understand human/moose interactions within the park. The development of management strategies to mitigate anthropogenic impacts requires a sound understanding of local moose population dynamics. Monitoring moose population dynamics, movements, and demography, will provide necessary management information specific to Denali National Park. Information on moose population status would aid the analysis of several ongoing large mammal studies by providing an additional covariate to help explain variability in population parameters among species that prey on moose or may directly or indirectly compete with moose for forage. Studies currently in progress are examining bear ecology, predator-prey relationships, and the effects of traffic on wildlife use of the road corridor. In

addition, the naturally regulated population within Denali National Park can be used as a comparison for harvested populations.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-362.201: Develop an Interagency Moose Management Program

The park would work cooperatively with state and federal management agencies, as well as private citizens and corporations, to develop an interagency plan to manage moose populations in and adjacent to the park. The National Park Service, ADF&G, Denali Subsistence Resource Commission (SRC), Federal Subsistence Board (FSB), and the Alaska Board of Game would be encouraged to work cooperatively to develop and implement joint moose management strategies. Information derived from research would be used for population management.

B. Research

N-362.211: Coordinate with Ongoing Predator-Prey Research

Ongoing predator-prey research, conducted by BRD scientists, would be supported and encouraged by the park. Research efforts would be expanded to incorporate the role of moose as a prey species. A systems approach would be taken to study resource interactions throughout the park. This work would be particularly useful as a comparison in evaluating the response of moose populations to predator control efforts on lands adjacent to the park.

N-362.212: Investigate Modifications to Gasaway Moose Survey Technique

Research would be initiated to evaluate the feasibility of modifying the Gasaway et al. moose survey method. This technique has been adopted by most agencies throughout Alaska as the standard for moose surveys. Unfortunately, the technique is expensive to implement and is not ideal for the habitat situations encountered within the park. Site-specific research is needed to determine whether a feasible, less expensive option can be developed for mountainous terrain. Coordination with the Alaska Department of Fish and Game would be sought to determine what progress they have made on this subject.

N-362.213: Research Seasonal Moose Movements

Ongoing moose ecology research focuses primarily on late-spring through early-fall behavioral characteristics of moose on the eastern end of the park. Little is known about seasonal movements and those induced by snow depth. Research would be conducted, utilizing existing collared animals and additional animals in western and southern areas of the park, to better understand and document these movements. Information obtained through this effort would contribute to the design of modified survey techniques.

N-362.214: Investigate East-End Calving Habitat Use and Availability

The area extending from the Nenana River, west to approximately mile 3.5 of the park road, north to the southern edge of Horseshoe Lake, and south to the south side of Hines Creek has been identified as "important calving habitat". Calf survival in this area has been two times that of survival in other areas utilized by this segment of the moose population. The use and availability of this habitat would be studied to evaluate the effects of habitat fragmentation from ongoing human use and facility development.

N-362.215: Investigate Effects of Selective Moose Harvest on Population Structure and Dynamics

Research would be initiated to test assumptions regarding the applicability of current moose harvest strategies. Moose harvest strategies are designed to be sex and age-specific. The effects of this strategy on the sex and age structure and the dynamics of the moose component of the naturally-regulated predator-prey system within Denali would be investigated. The Alaska Department of Fish and Game would be consulted in this effort.

N-362.216: Recover Historic Data for Inclusion in Park Data Bases

Survey reports from Murie, Dean, Singer, other researchers, bus drivers, wildlife observation cards, case incident reports, and interviews would be used to develop a data base of past moose population dynamics and distributions, and habitat use. Whenever possible these data would be included in current park data bases and in a geographic information system.

N-362.217: Investigate Road Use Disturbance to Moose Populations

See Road Use Impacts to Resources DENA-I-670.

N-362.218: Investigate the Status of the Broad Pass Moose Population

Park and ADF&G staff would collaborate on an investigation into the status of moose that utilize the Broad Pass area to determine their condition, movements, and harvest levels.

N-362.219: Support Independently Funded Moose Research Projects

The service would support independently funded moose monitoring and research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities when deemed appropriate by park management. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management I-410).

C. Monitoring

N-362.231: Implement Moose Survey Program

A modified Gasaway et al. technique, or a feasible alternative (DENA-N-362.212), would be conducted on the entire north side of the park in October or November every annually to gain information on moose densities, numbers, distribution, composition, size class of bulls, and productivity. Trend areas would be established and monitored during years when the north side survey was not conducted. Cooperative survey efforts with ADF&G Biologists would be pursued especially in areas on the south side. Data from surveys in federal registration permit areas within the park would be used by park managers, SRC, and FSB to evaluate subsistence regulations.

N-362.232: Track Sport and Subsistence Use Harvest Data on Lands Adjacent to and Within the Park and Preserve

A data base would be developed and maintained of moose harvest on lands adjacent to and within the new park additions and preserve. This effort would be accomplished in concert with ADF&G.

N-362.233: Track Road and Rail-Kill Numbers Within and Adjacent to the Park

A data base would be maintained of moose killed by automobiles and trains on lands adjacent to and within the park. An effective dialogue would be established with Alaska Department of Fish and Game staff and Alaska State Troopers to ensure data quality.

D. Interpretation

N-362.241: Provide Public Information about Moose

Park officials would cooperate with groups concerned about moose management and conservation. Concerned groups would be encouraged to assist in the development of public information plans and strategies. Park interpreters, researchers, and resource managers would work closely to ensure information accuracy. These interpretive efforts would continue to evolve as new information becomes available. Interpretative displays at visitor contact stations, slide and videotape programs, wayside exhibits, and articles in the park newspaper would inform visitors about moose ecology.

E. Protection

N-362.251: Enforcement of Moose Protection Regulations

Protection of moose and their habitat would be enhanced by maintaining an adequate level of enforcement. Human disturbances near moose use areas would be stopped when encountered by park rangers and resource personnel and the violations would be immediately reported to the Ranger Division. Aerial patrols would be conducted over the park, concentrating on moose use areas. Aerial patrol routes will be mapped and reported in a consistent manner. The park would utilize the Department of Public Safety, Division of Fish and Wildlife Protection's Violation Reporting Program to encourage visitors to turn in individuals harassing or disturbing moose.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Moose Mgmt Plan		60.0/0.1	20.0/0.1	20.0/0.1	100.0/0.3
RESEARCH					
- Develop Monitoring Program			60.0/0.0	60.0/0.0	120.0/0.0

- Research Seasonal Movements	20.0/0.1	15.0/0.1	15.0/0.1	15.0/0.1	65.0/0.4
MONITORING					
- Annual Monitoring	30.0/0.1	30.0/0.1	30.0/0.1	30.0/0.1	120.0/0.4
INTERPRETATION					
- Public Information		10.0/0.2	10.0/0.2	10.0/0.2	30.0/0.6
PROTECTION					
- Enforcement		14.0/0.3	14.0/0.3	14.0/0.3	42.0/0.9
TOTALS	50.0/0.2	129.0/0.8	149.0/0.8	149.0/0.8	477.0/2.6

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Anonymous. 1992. Subsistence management regulations for Federal public lands in Alaska. U.S. Fish and Wildlife Service, Anchorage Alaska.

Coady, J. W. 1976. Status of moose populations in interior Alaska. Wildlife Information Leaflet #2. Alaska Fish and Game.

Gasaway, W. C., S.D. Dubois, D.J. Reed, and S.J. Harbo. 1986. Estimating moose population parameters from aerial surveys. Institute of Arctic Biology, University of Alaska Papers No.22.

Hicks, M. V. 1995. Moose. Annual performance report of survey - inventory activities. AK Dept. of Fish and Game.

Mech, L. D., T.J. Meier, J.W. Burch, and L.G. Adams. 1991. Demography and distribution of wolves, Denali National Park and Preserve. Progress report. North Central Forest Experiment Station, St. Paul, MN.

Molvar, E. M., R. T. Bowyer, and V. Van Ballenberghe. 1993. Moose herbivory, browse quality, and nutrient cycling in an Alaskan treeline community. Oecologia, 94:472-479.

Murie, A. 1944. The wolves of Mount McKinley. Fauna National Parks U.S. Fauna Series No.5.

Peterson, R. O. 1977. Management implications of wolf-moose research, Isle Royale National Park, Michigan. Final Report, Department of Biological Sciences, Michigan Technological University, Houghton, Michigan.

USNPS. 1984. 1984 aerial moose survey, Denali National Park and Preserve. Survey and Inventory Report AR-84-1.

Van Ballenberghe, V. 1992. Behavioral adaptations of moose to treeline habitats in subarctic Alaska. Alces Supplement 1, pp. 193-206.

Van Ballenberghe, V. 1987. Effects of predation on moose numbers: a review of recent North American studies. Swedish Wildlife Research, Supplement 1, Part 2, 431-460.

Van Ballenberghe, V., and D. G. Miquelle. 1990. Activity of moose during spring and summer in interior Alaska. Journal of Wildlife Management, Vol. 54, No. 3, 391-396.

Van Ballenberghe, V., and D. G. Miquelle. 1993. Mating in moose: timing, behavior, and male access patterns. Canadian Journal of Zoology, Vol. 71, No. 8.

N-362.3

CARIBOU

PROJECT CODE: DENA-N-362.3

SERVICEWIDE ISSUES:
- N18 Visitor Use Impacts on Backcountry Park Resources
- N19 Loss of Park Resources Due to Consumptive Practices (Hunting and Trapping)
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Present Condition

Four distinct caribou (*Rangifer tarandus*) herds inhabit portions of Denali National Park and Preserve on either a seasonal or year-round basis. These include the Nelchina, Delta, Tonzona, and Denali Herds. The Nelchina Caribou Herd ranges east of the park and south of the Alaska Range. It is believed that only a few members of the Nelchina Herd occasionally enter the park near Cantwell during the summer months. Caribou from the Delta Caribou Herd occasionally are observed south of the park headquarters along the eastern boundary of the park, but usually the majority of the herd ranges east of the park and north of the Alaska Range. The Tonzona Caribou Herd occasionally occupies a portion of the park west of the Herron River during the spring, summer, and autumn months. The range of the Denali Caribou Herd (formerly the McKinley Caribou Herd) is almost exclusively within the boundaries of Denali National Park and Preserve. The Denali Herd inhabits most of the park east of the Foraker River and north of the Alaska Range throughout the entire year. Some animals of the Denali Herd will range south of the Alaska Range in the vicinity of Cantwell during the calving season.

Although the park may contain homeranges of four separate herds, the Denali Herd is of most concern to park management. The Denali Caribou Herd's homerange is almost entirely contained within the park; therefore, it is of great interest to wildlife managers. Biologists place great value on the research conducted on the Denali Herd, because it is the only barren-ground herd of its large size class in North America that is currently not hunted. It also shares its range with a natural complement of large predators, and both predator and prey populations within Denali are naturally regulated.

The size of the Denali Caribou Herd has fluctuated greatly over the last 80 years. It once

numbered over 20,000 caribou during the 1920's and 1930's. During the 1940's through the 1960's, the herd declined to 10,000 animals but remained somewhat stable. Further declines occurred during the 1970's when numbers reached a low of approximately 1,000. The herd was open to harvest until the mid 1970's but all harvest was discontinued as a result of the precipitous decline. Studies from the late 1970's indicated that early calf survival was very poor even though adult cow caribou were in good condition and had adequate food resources. Predation on young calves was thought to be a major factor, by limiting recruitment which maintained the population at a low level (Boertje 1981).

Most caribou herds throughout the state of Alaska experienced precipitous declines in population numbers during the mid 1970's. In the fall of 1975, the park's resource management specialist called for a closure of hunting, initiation of research, and areas of closure to human access during migration to protect the Denali Caribou Herd (Buskirk 1975). In many areas of the state, the hunting seasons or bag limits were reduced to limit harvest of caribou. The Denali Caribou Herd was subject to hunting prior to this period; however, all hunting was discontinued when the population reached approximately 1000 animals. Hunting was expected to remain closed until the population rebounded.

The Denali Caribou Herd has experienced periods of growth during the last 20 years. It increased by approximately 10% per year between 1977 and 1990 (Adams et al 1989). By 1990, the herd numbered 3,700 animals, a four-fold increase from the low of 1,000 in the mid-1970s. However, the winter of 1990-91 was very severe, setting new records for winter snowfall. The herd declined as much as 30% between 1990 and 1991, likely due to weather induced stresses and increased vulnerability to predation. The population experienced low production of calves, poorer than usual calf survival, and very low survival of adult bulls.

The Denali Herd is currently one of the few herds in Alaska that has not recovered to pre-decline population levels. Due to its naturally-regulated condition, an understanding of this system can provide critical information for management of caribou and predator populations throughout North America. The decline of the Denali Herd and the continued low population levels has been of interest to the National Park Service. There is a need to understand the factors that influence caribou population characteristics so that natural processes can be maintained and human influences are minimized or mitigated. Caribou within Denali National Park and Preserve are faced with a host of natural and anthropogenic influences including weather, predation, human development, road and railroad conflicts, backcountry hiking and camping, visitor transportation system use, legal harvest and poaching.

Park visitation has increased dramatically over the past two decades. Consequently, the potential for impacts to wildlife populations also increases as facility development expands and wildlife/human interactions increase. Caribou have recently exhibited habituation to humans at visitor use facilities such as the Eielson Visitor Center. The habituation of caribou and their subsequent use of high human use areas has become a visitor safety issue. Currently, the use

of the area surrounding the Eielson Visitor Center by caribou is limited to less than 10 bulls. This is a learned behavior and is limited to the same individuals during the summer months. The caribou appear to receive relief from insects and are not usually harassed by predators.

The increase in visitor use over the years has resulted in an increase in vehicular traffic on the park's primary artery. The park established the visitor transportation system in the early 1970's in an attempt to reduce traffic and its potential to impact wildlife populations. The resulting shuttle bus system was intended to minimize disturbance to wildlife while providing wildlife viewing opportunities. The impact of the visitor transportation system is not understood. Occasionally, animal movements across the road corridor are disrupted or blocked by vehicles stopped to observe. It is impossible to mitigate vehicle impacts to wildlife with our current level of knowledge.

Anthropogenic impacts to caribou may also include harvest by sport and subsistence hunters within the 1980 new park and preserve additions. While hunting of the Denali Herd has been discontinued, the Nelchina, Delta, and Tonzona Herds are subject to sport and subsistence hunting. The management of harvested wildlife populations require information on population demography, trends and numbers. Current research, conducted by the U.S. Geological Service (USGS), Biological Resources Division (BRD), provides up-to-date and accurate population numbers for the Denali Herd. Similarly, Alaska Department of Fish and Game (ADF&G) research and management efforts provide population numbers for the Nelchina, Delta, and Tonzona Herds.

Management of caribou in Denali National Park must be based on sound scientific principles. Scientific research is necessary to provide an understanding of caribou/human interactions. Research may provide the necessary information to formulate management strategies to mitigate anthropogenic influences. Caribou research within Denali will provide information critical to the management of Denali National Park as an intact and pristine ecosystem. Information on caribou population numbers and distribution is needed to understand predator-prey relationships. The naturally regulated status of the Denial Caribou Herd can provide a unique opportunity for comparisons with intensively managed populations throughout North America.

Current Management Actions and Results

Current research, conducted by BRD, is aimed at monitoring population trends of the Denali Caribou Herd while investigating factors that affect population dynamics. Calf production/survival and predator-caribou relationships have been primary focuses. Research goals include: identification of calf mortality factors, investigation of factors that may influence calf production and survival, monitoring population trends and composition, and the examination of predator-caribou relationships.

Research investigating calf mortality began in 1984 and has continued through 1996. During

the calving season, newborn calves are radio-collared and located on a daily basis until they are a couple of weeks old. Calves that survive their first several weeks are monitored on a monthly basis for the remainder of the calf's first year. Research indicates that calf mortality rates are over 50% within the first 15 days of life. Predators are responsible for 90% of this mortality. Predation by grizzly bears and wolves were responsible for approximately 50% and >33% of calf mortalities, respectively. Aerial surveys are conducted in the fall to determine population size, calf survival, and adult sex ratio. Approximately 80 radio-collared caribou cows are monitored to determine their distribution, survival, and calf production. In some instances, collars on park wildlife may cause concern for animal well-being and about aesthetics.

The state of Alaska has identified management objectives for the Nelchina, Tonzona and Delta Herds. Harvest and population objectives are defined in Annual Performance Reports (Hicks, 1995). Aerial surveys are conducted by ADF&G to determine herd composition and population size. Population objectives for the Nelchina, Tonzona, and Delta herds are 40,000, 1,800-2,000, and 6,000-8,000, respectively. Sex ratio objectives range from 30 to 40 bulls per 100 cows (Hicks 1995).

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-362.301: Develop an Interagency Caribou Management Program

The park would work cooperatively with state and Federal management agencies as well as private citizens and corporations to develop an interagency working team to manage caribou populations in and adjacent to the park. The National Park Service, ADF&G, Denali Subsistence Resource Commission (SRC), Federal Subsistence Board (FSB), and the Alaska Board of Game would be encouraged to work cooperatively to develop and implement joint caribou management strategies.

B. Research

N-362.311: Coordinate with Ongoing Predator-Prey Research

Ongoing predator-prey research, conducted by BRD scientists, would be supported by the park and encouraged to continue. An integrated, systems approach would be taken to studying resource interactions throughout the park. This work would be particularly useful as a comparison in evaluating the response of caribou populations to predator control efforts on lands adjacent to the park.

N-362.312: Modify Caribou Survey Technique

Ongoing research is currently providing an excellent level of caribou population monitoring. However, in the event of a reduction in funding for research, the existing monitoring strategy would need to be modified so it can be implemented by park managers.

N-362.313: Recover Historic Data for Inclusion in Park Data Bases

Survey reports from Murie (1944), Haber, Troyer, Singer (1986), Adams (1989), and other researchers, and incidental information from individuals, bus drivers, wildlife observation cards, case incident reports, and interviews would be used to develop an information database. A great deal of this information has already been compiled by Singer and Adams (Singer 1986, Adams 1989). Whenever possible, data would be incorporated into park data bases and the park geographic information system.

N-362.314: Investigate Road Use Disturbance to Caribou Populations

See Road Use Impacts to Resources DENA-I-670.

N-362.315: Support Independently Funded Caribou Research Projects

The Service would support independently funded caribou monitoring and research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities when deemed appropriate by park management. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management DENA-I-410).

C. Mitigation

N-362.321: Continue Caribou Behavioral Modification

Efforts would continue as necessary to eliminate the caribou habituation to humans at visitor use facilities such as the Eielson Visitor Center. An action plan would be developed to address public education, aversive conditioning techniques, implementation, monitoring, and evaluation. All efforts would be documented and evaluated for effectiveness.

D. Monitoring

N-362.331: Conduct Annual Caribou Survey

The park would support the acquisition of annual survey information through the ongoing research program. Survey efforts would be coordinated with ADF&G biologists. Data from surveys in federal registration permit areas within the park would be used by park managers, SRC, and FSB to evaluate subsistence harvest effects on caribou populations. Data would be used to manage federal subsistence caribou hunting.

N-362.332: Track Sport and Subsistence Use Harvest Data on Lands Adjacent to and Within the Park and Preserve

A data base would be developed and maintained of caribou harvest on lands adjacent to and within the new park additions and preserve. An effective dialogue would be established with ADF&G staff and subsistence users to ensure data quality and continuity.

N-362.333: Track Road and Railroad-Kill Numbers Within and Adjacent to the Park

A data base would be maintained of caribou killed by automobiles and trains on lands adjacent to and within the park. An effective dialogue would be established with Alaska Department of Fish and Game staff and Alaska State Troopers to ensure data quality and continuity.

E. Interpretation

N-362.341: Provide Public Information about Caribou

Park officials would cooperate with concerned groups, where possible, regarding the management and conservation of caribou and the development of public information plans and strategies. Park interpreters, researchers, and resource managers would work closely to ensure information accuracy. Education and interpretation about the realities of caribou management and preservation would be continually evolving rather than a one time effort.

F. Protection

N-362.351: Enforcement of Caribou Protection Regulations

Protection of caribou and their habitat would be enhanced by maintaining an adequate

level of regulation enforcement. Human disturbances near caribou use areas would be stopped when encountered by park rangers and resource personnel and the violations would be immediately reported to the Ranger Division. Aerial patrols would be conducted over the park, concentrating on caribou use areas. Aerial patrol routes will be mapped and reported in a consistent manner. The park would utilize the Alaska Department of Public Safety, Division of Fish and Wildlife Protection's Violation Reporting Program to encourage visitors to turn in individuals intentionally harassing or disturbing caribou.

STAFFING AND FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Caribou Management Plan		60.0/0.1	20.0/0.1	20.0/0.1	100.0/0.3
RESEARCH					
- Modify Monitoring Program			60.0/0.0	60.0/0.0	120.0/0.0
MITIGATION					
- Behavioral Modification	8.0/0.1	8.0/0.1	8.0/0.1		24.0/0.3
MONITORING					
- Annual Monitoring	30.0/0.1	30.0/0.1	30.0/0.1	30.0/0.1	120.0/0.4
INTERPRETATION					
- Public Information		10.0/0.2	10.0/0.2	10.0/0.2	30.0/0.6
PROTECTION					

-Enforcement		14.0/0.3	14.0/0.3	14.0/0.3	42.0/0.9
TOTALS	38.0/0.2	122.0/0.8	142.0/0.8	134.0/0.8	436.0/2.5

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Adams, L. G., B. Shults, and B. W. Dale. 1989. Comparisons of bear and wolf predation on caribou calves, Denali National Park and Preserve, Alaska. National Park Service, Anchorage, Alaska.

Adams, L. G., B. W. Dale, and B. Shults. 1989. Population status and calf mortality of the Denali caribou herd, Denali National Park and Preserve, Alaska - 1984-1988. National Park Service, Natural Resources Progress Report AR-89/13.

Adams, L. G., B. W. Dale, and F. J. Singer. 1988. Neonatal mortality in the Denali caribou herd. Proceedings of the 3rd North American Caribou Workshop, Alaska Department of Fish and Game, Wildlife Technical Bulletin No. 8.

Adams, L.G. and B.W. Dale. 1998. Timing and synchrony of parturition in Alaskan caribou. J. Mammal. In press.

Adams, L.G., F.J. Singer, and B.W. Dale. 1995. Caribou calf mortality in Denali National Park, Alaska. J. Wildl. Manage. 59:584-594.

Adams, L.G. and L.D. Mech. 1995. Population trends of wolves and caribou in Denali National Park, Alaska. in E.T. Laroe, G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac, eds. Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. U.S. Department of the Interior, NBS. Washington, DC. pp347-348.

Adams, L.G., B.W. Dale, and L.D. Mech. 1995. Wolf predation on caribou calves in Denali National Park, Alaska. in L.N. Carbyn, S.H. Fritts, and D.R. Seip, eds. Ecology and

conservation of wolves in a changing world - proceedings of the Second North American Symposium on Wolves. Canadian Circumpolar Institute Occasional Publication 35. University of Edmonton, Alberta, Canada. pp 245-260.

Boertje, R. D. 1981. Nutritional ecology of the Denali caribou herd. M.S. Thesis, University of Alaska, Fairbanks.

Buskirk, S. W. 1975. Memo to the Chief Ranger re: Caribou, Mount McKinley National Park.

Curatolo, J. A., and S. M. Murphy. 1986. The effects of pipelines, roads, and traffic on the movements of caribou, *Rangifer tarandus*. Canadian Field Naturalist 100(2): 218-224.

Davis, J. L., P.. Valkenburg, and M. E. McNay. 1987. Demography of the Delta caribou herd under varying rates of natural mortality and harvest by humans. Alaska Department of Fish and Game, Research Progress Report, Job 3.33R.

Duff, S., and F. J. Singer. 1982. Caribou use of the Cantwell calving grounds, Denali National Park and Preserve, Alaska. National Park Service, Research/Resource Management Report AR-1.

Hicks, M. V. 1995. Caribou: annual performance report of survey-inventory activities. AK. Dept. of Fish and Game.

Lieb, James W., W. Brad Cella, Robert W. Tobey. 1989. Population dynamics of the Mentasta caribou herd. Alaska Department of Fish and Game, Research Progress Report.

Mech, L. D., et al. 1991. Demography and distribution of wolves, Denali National Park and Preserve. Progress report. North Central Forest Experiment Station, St. Paul, MN.

Murie, A. 1944. The wolves of Mount McKinley. Fauna of the National Parks of the United States, Fauna Series No.5.

Shideler, R.T., et al. 1986. Impacts of human developments and land use on caribou: a literature review. Alaska Department of Fish and Game, Technical Report 86-2.

Shults, B., and L. G. Adams. 1989. Status and distribution of the Tonzona caribou herd - 1988 progress report. National Park Service, Natural Resources Progress Report AR-89-02.

Singer, F. J. 1986. History of caribou and wolves in Denali National Park and Preserve-Appendices. USNPS Research/Resource Management Report AR-11, Anchorage, AK.

Tracy, D. M. 1977. Reactions of wildlife to human activity along Mount McKinley National

Park road. M.S. Thesis, University of Alaska, Fairbanks.

FURBEARERS

PROJECT CODE: DENA-N-363

SERVICEWIDE ISSUES:
- N19 Loss of Park Resources Due to Consumptive Practices (Hunting and Trapping)
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
- N18 Visitor Use Impacts on Backcountry Park Resources

STATEMENT OF PROBLEM

Introduction

Mount McKinley National Park was established in 1917 to protect an outstanding assemblage of wildlife resources. While large mammalian species tend to receive a majority of the visitor interest and research and management attention, furbearers play an important role in the ecosystem of the park. Furbearer species inhabiting Denali are beaver (*Castor canadensis*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), lynx (*Lynx canadensis*), marten (*Martes americana*), mink (*Mustela vison*), ermine (*M. erminea*), weasal (*M. rixosa*), muskrat (*Ondatra zibethicus*), river otter (*Lutra canadensis*), red squirrel (*Tamiasciurus hudsonicus*), ground squirrel (*Spermophilus parryii*), marmot (*Marmota caligata*), wolf (*Canis lupus*) and wolverine (*Gulo gulo*). A great deal of attention has focussed on wolf research and management, to the extent that wolves are addressed in a separate project statement (Wolves DENA-N-364.1). This project statement will address furbearers residing in the park, with the exception of wolves.

The establishment of Mount McKinley National Park afforded protection of wildlife within its boundaries. Furbearers within the park continue to be naturally regulated although they are faced with a host of natural and anthropogenic influences with potential to affect population parameters and distribution. These include weather, predation, loss of habitat due to human development, and harvest. Park visitation has increased dramatically over the past two decades. Consequently, the potential for impacts to furbearer populations also increases as facility development expands and wildlife/human interactions increase. There is a need to understand the factors that influence furbearer population characteristics so that natural processes can be maintained and anthropogenic forces mitigated.

Furbearers are fully protected from harvest within the old Mount McKinley National Park boundary. Furbearers may be harvested under State and Federal regulations within the 1980 Alaska National Interests Lands Conservation Act (ANILCA) park and preserve additions to the park. Non-subsistence harvest regulations are developed by the Alaska Board of Game (BOG) while subsistence harvest regulations are developed by the Federal Subsistence Board (FSB). Limited harvest currently occurs, but at a level that would not likely affect population parameters. The difficulty in accessing these areas, and low fur prices, are expected to continue to limit interest in trapping. However, social and economic conditions could change quickly, which could result in greater interest in harvesting furbearers.

Present Condition

Very little is known about the furbearer populations of the park and preserve. Most wildlife research in Denali has focused on understanding large mammal predator-prey interactions and park management is currently unable to survey furbearers due to budget, personnel, and technical constraints. Interviews with local subsistence trappers have provided incidental information of furbearer abundance (Trapline Management DENA-N-368). Most furbearer population information is derived through furbearer harvest records. Additional information may also be derived through trapper interviews and questionnaires and pelt sealing records for species requiring sealing, such as lynx, river otter, wolverine and beaver. However, with trapping efforts declining, this rough index of local furbearer populations provides very little quantitative information.

Population information is very difficult to collect for most furbearer species. Furbearer population monitoring programs have proven to be extremely costly and have met with limited success. Examination of carcasses of trapped animals has been used to provide an index of population demography and productivity. However, this technique relies on consumptive practices, which are not allowed in the old park, and may not provide a large enough sample size in new park areas to determine population parameters during periods of low trapping effort.

Track surveys have been proposed for some species. The State has conducted research on the efficacy of utilizing aerial track surveys to analyze relative abundance. However, track deposition after adequate snowfalls has proven to be highly variable. Aerial track surveys may provide a relative index for some species (marten, lynx, and wolverine) but it is not likely to provide a population estimate with enough precision to track population numbers other than in a gross context.

Trapper questionnaires have provided some of the best information on furbearers to date. Beavers may be one of the few species that may be easily surveyed using other existing techniques. Cache surveys during fall, prior to freeze up, will provide a number of active

lodges. Caches are relatively easy to identify in most ponds, lakes, and streams. However, due to the remoteness of most beaver habitat, this work would require expensive aerial surveying of beaver occupied areas.

Current Management Actions and Results

Congress intended for customary and traditional use of wildlife resources by eligible local rural residents to continue within 1980 park additions by specifically addressing the issue through ANILCA. Congress also stated, in Section 1313 of ANILCA, that non-subsistence trapping and sport hunting could continue in preserve areas. Trapping of furbearers has been the mainstay for many early residents of the area. Marten were probably of greatest economic value to trappers. Trapping pressure and species sought usually varies with fur prices and weather conditions. High fur prices result in greater effort. The recent drop in fur prices along with the European Economic Communities' efforts to ban the use of furs from countries that utilize leg-hold traps have drastically reduced demand for furs and fur prices. The drop in fur prices has greatly reduced trapping effort throughout Alaska. Many pelts are now processed at home and crafted into clothing or other items.

Currently, the State relies on trapper questionnaires, sealing requirements, and opportunistic observations to acquire much of the information needed for management (Hicks 1995). However, if harvest increases due to increases in fur prices or other factors, a more regimented approach to monitoring furbearers may be necessary. Managers of some areas are conducting prey surveys to help predict furbearer population trends. A harvest tracking strategy has been implemented for lynx in some areas of the state. The harvest tracking strategy adjusts harvests by changing season lengths depending on whether the lynx/hare cycle is increasing or decreasing. During periods of declining population numbers, the season length is shortened to reduce harvest.

Anecdotal information suggests that densities of beavers may be increasing in portions of the park. Many streams that cross the park road have been dammed or partially blocked by beavers. Attempts have been made to ensure adequate drainage while allowing the beavers to reside in ponds near the park road.

Other park programs directed toward obtaining furbearer information include fox den monitoring. Fox den locations are documented annually and closure areas created to limit human activity near active dens. Habituation of foxes to human activity has become a concern of park managers. Foxes have approached humans in what appears to be attempts to acquire food. It may be necessary to experiment with aversive conditioning to deter fox habituation to humans and human food.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-363.001: Develop an In-Park Trapping Database to Track Harvest

The State maintains a harvest data base to track harvest of many species. The Wildlife Biologist should develop a similar data base to be maintained at Denali. The data base should incorporate spacial information when possible for use with the park's geographic information system. The park would work closely with the FSB and biologists from ADF&G to obtain harvest information specific to Denali and surrounding areas.

N-363.002: Develop an Interagency Furbearer Management Program

The park would work cooperatively with state and Federal management agencies as well as private citizens and corporations to develop an interagency working plan to manage furbearers in and adjacent to the park. The National Park Service, ADF&G, Denali Subsistence Resource Commission (SRC), FSB, and the BOG would develop and implement furbearer management strategies.

B. Research

N-363.011: Conduct Annual Interviews with Trappers Who Utilize Denali

Create and expand an oral history database to include annual interviews with local trappers. Denali currently does not have a cultural resource position to record oral history.

N-363.012: Develop a Furbearer Research and Monitoring Program

Develop techniques for long-term monitoring of furbearer populations. When fluctuations in furbearer populations occur, initiate projects to determine causation. Conduct baseline ecological studies on furbearers as warranted. Cooperate with other federal and state agencies on furbearer research when possible.

N-363.013: Coordinate With Ongoing Predator-Prey Research

Ongoing predator-prey research, conducted by US Geological Survey, Biological Resources Division scientists, would be supported by the park and encouraged to continue. An integrated systems approach would be taken to study resource interactions throughout the park. Furbearer population information would be included as a

component of ongoing work to the extent possible.

N-363.014: Recover Historic Data for Inclusion in Park Data Bases

Survey reports and individual observations from researchers, bus drivers, wildlife observation cards, case incident reports, and interviews would be used to develop a park database. Furbearer population dynamics, distributions, movements, and habitat use will be recorded. Efforts would be made to ensure that the data base is complete and up-to-date. Whenever possible these data would be incorporated into the park geographic information system.

N-363.015: Support Independently Funded Furbearer Research Projects

The Service would support independently funded furbearer monitoring and research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities when deemed appropriate by park management. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management DENA-I-410).

C. Mitigation

N-363.021 Modify Culverts to prevent Beaver Dam Blockage

Culverts with potential to be blocked by beaver cuttings will be modified to allow for proper water drainage, without permanently removing the beavers from the ponds.

D. Monitoring

N-363.031 Initiate A Monitoring Program For Furbearers

Implement a monitoring program in coordination with ADF&G once a monitoring protocol is developed (Long-Term Ecological Monitoring DENA-I-210).

E. Interpretation

N-363.041: Provide Public Information about Furbearers

Park officials would cooperate with groups concerned about the management and conservation of furbearers in the development of public information plans and strategies. Park interpreters, researchers, and resource managers would work closely to ensure accuracy of information. These educational efforts would be an ongoing aspect of a total

management scheme.

Furbearer displays at visitor contact stations, slide and videotape programs, wayside exhibits, and articles in the park newspaper would inform visitors about furbearer ecology. Interpretive programs about the realities of furbearer management would be maintained.

F. Protection

N-363.051: Enforcement of Trapping Regulations

See Trapping and Sport Hunting DENA-N-367.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Develop Database	5.0/0.1	5.0/0.1	5.0/0.1	5.0/0.1	20.0/0.4
RESEARCH					
- Annual Interviews	5.0/0.1	5.0/0.1	5.0/0.1	5.0/0.1	20.0/0.4
- Develop Research & Monitoring Program	50.0/0.5	50.0/0.5	50.0/0.5	50.0/0.5	200.0/2.0
MONITORING					
- Initiate Monitoring			20.0/0.5	20.0/0.5	40.0/1.0
MITIGATION					
- Modify Culverts	15.0/0.1	10.0/0.1	10.0/0.1	5.0/0.1	40.0/0.4

INTERPRETATION					
- Public Information		10.0/0.2	10.0/0.2	10.0/0.2	30.0/0.6
TOTALS	75.0/0.8	80.0/1.0	100.0/1.5	95.0/1.5	350.0/4.8

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Hicks, M. V. 1995. Furbearers. Annual performance report of survey-inventory activities - 1 July 1994-30 June 1995. Alaska Department of Fish and Game, Division of Wildlife Conservation.

N-364.1

WOLVES

PROJECT CODE: DENA-N-364.1

SERVICEWIDE ISSUES:

- N19 Loss of Park Resources Due to Consumptive Practices (Hunting and Trapping)
- N18 Visitor Use Impacts on Backcountry Park Resources
- N16 Biological Impacts of Near-Park Development on Populations of Animals
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Present Condition

Despite complete legal protection of grey wolves (*Canis lupus*) within the wilderness portion of Denali National Park and partial protection through harvest regulations in the new park and preserve additions, the wolf population of the park is susceptible to impact by human activities inside the park boundaries as well as throughout surrounding areas. Within the park, wolves must adapt their behavior to a variety of widely dispersed human recreational activities while some are even illegally killed (National Park Service Archives and Mech 1991). Of the fifteen or more wolf packs that utilize Denali, only three spend the majority of their time within the park's boundaries (Mech 1991). Wolves which venture into new park and preserve lands and lands adjacent to the park are subject to legal harvest and occasional state-sponsored predator control. All wolves within the park are subject to vehicle collisions and illegal hunting (Harbo and Dean 1983). In addition, parasites and diseases could potentially spread to wolves within the park from other wild canids and domestic pets.

Prehistorically, the grey wolf occupied most of the United States, Mexico, and Canada. Today, however, as a result of government and private wolf control measures as well as human intolerance and habitat destruction, the wolf has been eliminated from most of its former range. Alaska and northern Canada represent the last strong-hold of the wolf in North America.

Since market hunting of ungulates prevailed during the early 1900s, throughout much of interior Alaska, the early white settlers regarded wolves as competitors. The National Park Service

(NPS) felt the pressure to control wolves and, beginning in 1929, park staff occasionally killed wolves. Before control efforts ceased in 1952, about 69 wolves were killed (National Park Service archives, Superintendent-Been 1947, Singer 1986).

During the 1970s, the State of Alaska engaged in statewide wildlife management planning. Those efforts identified the former Mt. McKinley National Park as a primary area for wolf viewing. Concurrently, the state engaged in various wolf control efforts to meet other wildlife management objectives. In 1987, the state adopted regulations that permitted same-day airborne hunting of wolves. This regulation applied to eight National Preserves including Denali National Preserve. The NPS moved to establish temporary restrictions on this activity. By August, 1990, state regulations were amended to exclude National Preserves from such activities.

Today, wolf management in the state of Alaska remains controversial. In hopes of devising a wolf management plan with widespread public support, the state created the Alaska Wolf Management Planning Team in November 1990. That team developed a statewide wolf management plan (Alaska Department of Fish and Game 1992) that was adopted by the Alaska Board of Game (BOG) after extensive public involvement. During 1992, the Alaska Department of Fish and Game (ADF&G) prepared area specific plans tiered off of the statewide plan. Area specific plans were developed for Game Management Units (GMUs) 13 and 20 which incorporate portions of Denali National Park and Preserve. In 1993, controversy over the state's proposals came to a head and all plans were suspended. Subsequently, the BOG implemented an experimental ground-based wolf control program in the winter of 1993-1994 in the Alaska Range south of Fairbanks and east of the park. This program was suspended during the winter of 1994-1995 pending a National Academy of Sciences review of the efficacy of wolf control as a means to enhance prey populations. The review by the National Academy has subsequently been completed but no further action has been taken by the state as it pertains to Denali.

As visitor use in Denali continues to rise, the potential for conflict between wolves and people becomes greater. Wolf-human encounters can result in the loss of wild and free ranging wolves and could threaten pups, den structures and rendezvous sites. The continued monitoring of wolf activities and the establishment and enforcement of a temporary closure procedure is essential to long term wolf protection.

Increased visitor use of the park resulted in an increase in vehicular traffic on the park's primary artery. In an attempt to reduce the subsequent impact to wildlife, the park established the visitor transportation system in the early 1970's. This shuttle bus system is designed to minimize disturbance to wildlife and to maximize wildlife viewing opportunities. It is not clear what impact use of the visitor transportation system has had on wolf behavior along the road corridor. It is also impossible to establish biologically-sound use limits with our current level of knowledge.

Approximately 36% of the suitable wolf habitat of Denali National Park and Preserve lies within

the old park boundaries where wildlife receives total protection. New park lands, open to subsistence hunting, comprise 41% of the suitable wolf habitat, while preserve lands, open to both subsistence and sport hunting, determined by federal subsistence or state of Alaska Hunting regulations, comprise 23% (Mech et al. 1991).

Research to date indicates that legal harvest by subsistence and sport hunters has had no measurable biological impact to the wolf population within the park. However, as local demography continues to change, wolf utilization by residents may alter, creating a potential problem of legal wolf harvest within the 1980 Alaska National Interest Lands Conservation Act (ANILCA) additions and outside the park (Mech et al. 1991). Currently, new park lands are open to federal subsistence hunting by local, rural residents with "customary and traditional use rights" as defined in the subsistence management regulations for federal lands in Alaska (USFWS 1992). Bag limits and seasons are quite liberal (see the above listed document for details). The level of harvest that can be allowed without impacting the natural and healthy status of the wolf populations is not known.

Occasionally, wolves in Denali have suffered harassment from aircraft engaged in buzzing or photographing them at low altitudes. In the winter of 1984-85 eight wolves were found illegally shot from aircraft within the park. Such activities will probably not diminish without an adequate level of wildlife law enforcement.

The disease canine parvovirus has been implicated in the decline of the Isle Royale wolf population which occurred through the 1980's and into the early 1990's (R. O. Peterson, Michigan Technological University, pers. commun.). Conceivably, diseases such as distemper, rabies, hepatitis, and canine parvovirus could become limiting factors for some wolf populations in Alaska. Further discussion of this issue can be found in Project Statement Plant and Animal Disease Program DENA-N-560 (proposed as of 1998).

Current Management Actions and Results

The study of wolf ecology has been a priority of the NPS in Denali beginning with Adolph Murie's work in 1939. This broad based ecological work was continued by Haber beginning in 1966 (Haber 1977), who made numerous observations on wolf-prey interactions. Like Murie, Haber began documenting wolf territories and populations in Mount McKinley National Park.

From 1985 to 1993, the NPS conducted a comprehensive wolf research project, which was initiated due to concerns that activities in and adjacent to Denali National Park and Preserve may adversely affect the health of the current wolf population (Mech 1991). Research data revealed an estimated wolf population of 85-170 during 1986-1990. The results of this project have provided the following information necessary for reaching management decisions regarding wolf protection (Mech 1991):

1. The number of wolf packs in Denali
2. The number of wolves in each pack
3. The size and location of each pack's territory
4. The extent to which Denali's wolf population uses the different jurisdictional areas within the park and areas outside the park
5. Denning locations and rendezvous sites for each pack
6. Information on predator-prey population dynamics

When preserving populations of highly controversial species which are subjected to such a variety of influences, the ability to determine trends in population numbers and reproductive status is critical. With the conclusion of the intensive research program in 1993, less intensive research and monitoring efforts have continued to the present. Those efforts involve the maintenance of one or two radiocollars in each pack. This effort is necessary to consistently obtain up-to-date and accurate wolf population information for park management needs.

Management of wolves within Denali National Park should be based on sound scientific principles. Monitoring population dynamics, movements, and density of wolves, and the effects of hunter harvest and control measures, will provide information critical to the management of Denali National Park as a functioning ecosystem. Knowledge of population and behavioral change is needed to assist studies in progress on predator prey relationships and the effects of traffic on wildlife use of the road corridor.

RECOMMENDED ACTIONS

Under this alternative, wolf monitoring efforts will continue and will be evaluated to determine their ability to realize park management objectives. Data obtained will be used to assess wolf movements, mortality factors, behavior and population dynamics, and the effects of recreational activities inside and outside the park.

The influence of the present levels of human-caused mortality on wolf population dynamics would be assessed. If legal harvest of wolves outside and within the 1980 ANILCA additions of Denali proves detrimental to the park's wolf population, the NPS will present biological data and recommendations to the state of Alaska BOG and to the Federal Subsistence Board. The NPS will work with these groups, which manage the taking of wolves, to reduce the harvest pressure if biological evidence suggests the 'healthy and natural' population of wolves in the park is in jeopardy.

Wolf packs originating in the park, with potential to become involved in adjacent land wolf control programs, would be intensively monitored. A contingency plan would be developed with the ADF&G to ensure the protection of wolves that may originate from within the park and enter

these control areas.

Biologists would continue to locate and map actual and potential denning and rendezvous sites. All known denning and rendezvous sites within the park would receive strategic management plans regardless of activity status. Human use would be restricted in the vicinity of active wolf dens to minimize disturbance as well as around inactive den sites to prevent physical damage to the structures.

Efforts to inform visitors and park employees about minimizing chronic human disturbances to wolves would be expanded to include a public information strategy. Pets would continue to be prohibited outside the developed area. Visitors would continue to be encouraged to report wolf observations.

A. Program Administration and Planning

N-364.101: Prepare an Interagency Wolf Management Plan for the Park and Vicinity

The park would work cooperatively with state and federal management agencies as well as private citizens and corporations to develop an interagency management plan that protects wolves using the park. If monitoring shows wolf hunting and trapping on state managed lands in the vicinity of Denali National Park to be detrimental to the wolf population in Denali the BOG would be encouraged to reduce or eliminate the activity. The plan would encourage the agencies managing lands adjacent to Denali to maintain low road densities, increase wildlife law enforcement and expand public education efforts. Strategies would be developed to encourage the protection of wolves that may originate from within the park and enter potential control areas outside park boundaries.

The National Park Service will work cooperatively with the Federal Subsistence Board. If biological research indicates that subsistence hunting and trapping activities within the 1980 ANILCA Denali National Park and Preserve additions has an adverse impact on the wolf population within the park, the service will submit a proposal restricting subsistence use to the Federal Subsistence Board as described in Section 8 of ANILCA. The proposal will include the biological justification for any such limitation.

N-364.102: Implement Site Specific Management Plans

Implementation of these plans would counter harmful human disturbance of active wolf dens and rendezvous sites, prevent physical damage to inactive dens, and stop human activity from inhibiting the selection of dens or rendezvous sites by wolves. The management plans would address backcountry closures and wolf activity monitoring. A commitment to long term, extensive monitoring of den and rendezvous sites would be

essential to implementing this management action (DENA-N-364.131).

B. Research

N-364.112: Coordinate with Ongoing Predator-Prey Research

Ongoing predator-prey research, conducted by U.S. Geological Survey, Biological Resources Division scientists, would be supported by the park and encouraged to continue. Research efforts would be expanded to incorporate the role of all major predators and major prey species. A systems approach would be taken to studying resource interactions throughout the park.

N-364.113: Recover Historic Data for Inclusion in Park Data Bases

Census reports from National Park Service and other researchers, bus drivers, wildlife observation cards, case incident reports, and interviews would be used to develop a picture of past wolf population dynamics, distributions, and habitat use. Whenever possible these data would be included in current park data bases and into a GIS.

N-364.114: Investigate Road Use Disturbance to Wolf Populations

See Road Use Impacts to Natural Resources DENA-I-670.

N-364.115: Support Independently Funded Wolf Research Projects.

The service would support independently funded grey wolf monitoring and research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities when deemed appropriate by park management. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management DENA-I-410).

C. Monitoring

N-364.131: Implement a Year-Round Wolf Monitoring Program

Trends in wolf abundance, pack size, and reproduction would be monitored systematically each year. The monitoring program would focus on the need for managing human activities in order to minimize or eliminate adverse impacts on wolves and their critical habitats. Monitoring protocols would be developed through consultation with experts in the field. Protocols would be evaluated based on their ability to

accomplish park management objectives.

N-364.132: Monitor Wolf Prey Populations

See Dall Sheep DENA-N-362.1, Moose DENA-N-362.2, and Caribou DENA-N-362.3.

N-364.133: Implement Special Monitoring in Response to State Control Programs

Maintain monitoring programs for potentially affected wolf packs to determine population status with emphasis on periods when state wolf control actions are underway. Monitoring activities would be increased to provide information on pack locations during control efforts. Initially, radio collars would be maintained on potentially affected wolf packs until all proposed monitoring protocols are evaluated and an acceptable method is selected.

N-364.134: Track Sport and Subsistence Use Harvest Data on Lands Adjacent to and Within the Park and Preserve

A data base would be maintained of wolf harvest on lands adjacent to and within the new park additions and preserve. An effective dialogue would be established with ADF&G staff and subsistence users to ensure data quality and continuity.

N-364.135: Develop Data Base and Documentation Protocol for Predation Events

A parkwide system would be developed and implemented for gathering and recording data on predation events. Locations, species, condition, time of year, weather conditions, and other food availability would be included.

D. Interpretation

N-364.141: Provide Public Information about Wolves

Park officials would cooperate with groups concerned about the management and conservation of the grey wolf in the development of public information plans and strategies. Park interpreters, researchers, and resource managers could work closely with the local school districts and local interest groups to create effective environmental education programs about wolves for all ages. These educational efforts would be an ongoing aspect of a total management scheme rather than a one time effort.

A wolf pamphlet, displays at visitor contact stations, slide and videotape programs, wayside exhibits, and articles in the park newspaper could inform visitors about the

ecological and aesthetic values of this carnivore. Interpretive programs about the realities of wolf management and preservation could be increased. A program encouraging visitors to report sightings of wolves to park officials could facilitate the location of wolf use areas throughout the park. This information would be recorded and mapped annually.

E. Protection

N-364.151: Enforce Wolf-Protection Regulations

Protection of wolves and their habitat would be enhanced by increasing regulation enforcement. Human disturbances near wolf dens and rendezvous sites would be stopped when encountered by park rangers and resource personnel and the violations would be immediately reported to the Ranger Division. Regulations prohibiting aircraft or other motorized vehicles from harassing wolves within the park (CFR Title 36-2.2(a)(2)) would be widely publicized. Winter aerial patrols of the park concentrating on locating the park's wolf packs would be conducted several times per month. Aerial patrol routes will be mapped and reported in a consistent manner. The park would utilize the Alaska Department of Public Safety, Division of Fish and Wildlife Protection's Violation Reporting Program to encourage visitors to turn in individuals intentionally harassing or disturbing wolves and their prey. Information posters and pamphlets developed by the state for the Turn In Poachers program would be distributed in the park by NPS personnel. Educational efforts would be made to let the local community know that the NPS was intent on enforcing regulations within the park's boundaries.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM MANAGEMENT					
- Wolf Mgmt Plan		68.7/0.1	31.0/0.1	31.0/0.1	130.7/0.3
- Site Specific Plans	12.9/0.0				12.9/0.0
MONITORING					
- Year-round Monitoring	50.0/0.3	50.0/0.3	50.0/0.3	60.0/0.5	210.0/1.4
- Monitoring Response to Control	35.0/0.2	35.0/0.2	35.0/0.2		105.0/0.6

INTERPRETATION					
- Public Information		11.3/0.2	11.3/0.2	11.3/0.2	33.9/0.6
PROTECTION					
- Enforcement		14.0/0.3	14.0/0.3	14.0/0.3	42.0/0.9
TOTALS	97.9/0.5	179.0/1.1	141.3/1.1	116.3/1.1	534.5/3.8

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Adams, L.G. and L.D. Mech. 1995. Population trends of wolves and caribou in Denali National Park, Alaska. in E.T. Laroe, G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac, eds. Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. U.S. Department of the Interior, NBS. Washington, DC. pp347-348.

Adams, L.G., B.W. Dale, and L.D. Mech. 1995. Wolf predation on caribou calves in Denali National Park, Alaska. in L.N. Carbyn, S.H. Fritts, and D.R. Seip, eds. Ecology and conservation of wolves in a changing world - proceedings of the Second North American Symposium on Wolves. Canadian Circumpolar Institute Occasional Publication 35. University of Edmonton, Alberta, Canada. pp 245-260.

Anonymous. 1992. Subsistence management regulations for federal public lands in Alaska. U.S. Fish and Wildlife Service, Anchorage Alaska.

Carbyn, L. N. 1983. Incidence of disease and its potential in the population dynamics of wolves in Riding Mountain National Park, Manitoba. In: Wolves of the World. Harrington, F.H. and P.C. Paguet, eds. Noyes Publishers, Park Ridge NJ pp. 106-116.

Chapman, R. C. 1977. The effects of human disturbance on wolves. Masters Thesis, Alaska

Cooperative Park Studies Unit, University of Alaska, Fairbanks Alaska.

Chapman, R. C. 1979. Human disturbance at wolf dens-a management problem. In Proceedings of the first conference on Scientific Research in the National Parks. pp. 323-328.

Fuller,T. K., and W. J. Snow. 1988. Estimating winter wolf densities using radio telemetry data. Wildlife Society Bulletin 16(4):367-370.

Haber, G. C. 1977. Socio-Ecological dynamics of wolves and prey in a subarctic ecosystem. Ph.D. Thesis, Univ. of British Columbia, Vancouver, Canada.

Lehman, N., P. Clarkson, L.D. Mech, T.J. Meier, and R.K. Wayne. 1992. A study of the genetic relationships within and among wolf packs using DNA fingerprinting and mitochondrial DNA. Behav. Ecol. and Sociobiology. 30:83-94.

Mech, L. D. 1970. The wolf: the ecology and behavior of an endangered species. University of Minnesota Press, Minneapolis.

Mech, L. D. 1985. Presence and effect of the dog louse trichodectes canis (*Mallophaga trichodectidae*) on wolves and coyotes from Minnesota and Wisconsin. The American Midland Naturalist 114(2):404-405.

Mech, L.D. 1993. Resistance of young wolf pups to inclement weather. J. Mammal. 74:485-486.

Mech, L.D., L.G. Adams, T.J. Meier, J.W. Burch, and B.W. Dale. 1998. The wolves of Denali. University of Minnesota Press. In press.

Mech, L.D., S. H. Fritts, G. L. Radde, and W. J. Paul. 1988. Wolf distribution and road density in Minnesota. Wildlife Society Bulletin 16:85-87.

Mech, L.D., T.J. Meier, and J.W. Burch. 1991. Denali Park wolf studies: implications for Yellowstone. Transactions of the North American Wildlife and Natural Resources Conference. 56:86-90.

Mech, L.D., T.J. Meier, J.W. Burch, and L.G. Adams. 1995. Patterns of prey selection by wolves in Denali National Park, Alaska. in L.N. Carbyn, S.H. Fritts, and D.R. Seip, eds. Ecology and conservation of wolves in a changing world - proceedings of the Second North American Symposium on Wolves. Canadian Circumpolar Institute Occasional Publication 35. University of Edmonton, Alberta, Canada. pp 231-243.

Mech. L.D., T.J. Meier, J.W. Burch, and L.G. Adams. 1996. Demography and distribution of

wolves, Denali National Park and Preserve, Alaska. Draft Final Report.

Mech, L.D. et al. 1991. Demography and distribution of wolves, Denali National Park and Preserve. Progress report. North Central Forest Experiment Station, St. Paul, MN.

Meier, T.J., J.W. Burch, L.D. Mech, and L.G. Adams. 1995. Pack structure and genetic relatedness among wolf packs in a naturally regulated population. in L.N. Carbyn, S.H. Fritts, and D.R. Seip, eds. Ecology and conservation of wolves in a changing world - proceedings of the Second North American Symposium on Wolves. Canadian Circumpolar Institute Occasional Publication 35. University of Edmonton, Alberta, Canada. pp 293-302.

Murie, A. 1944. The Wolves of Mount McKinley. Fauna National Parks U.S. Fauna Series No.5.

Peterson, R. O. 1976. Wolf survey In Voyageurs National Park. Final Report, Department of Biological Sciences, Michigan Tech. University, Houghton.

Peterson, R. O. 1977. Management implications of wolf-moose research, Isle Royale National Park, Michigan. Final Report, Department of Biological Sciences, Michigan Technological University, Houghton.

Singer, F. 1986. History of caribou and wolves in Denali National Park and Preserve. USNPS, Anchorage, Alaska.

Smith, D., T. Meier, E. Geffen, L.D. Mech, J.W. Burch, L.G. Adams, and R. K. Wayne. 1997. Is incest common in gray wolf packs?. Behavioral Ecology 8(3):384-391.

Stephenson, R. O. et al. 1982. Serologic survey for canine distemper and infectious hepatitis in wolves in Alaska. Alaska Department of Fish and Game.

Thiel, R. P. 1985. Relationship between road densities and wolf habitat suitability in Wisconsin. The American Midlands Naturalist 113(2): 404-407.

Zarnke, R. 1990. Serologic survey for microbial pathogens. Alaska Department of Fish and Game.

N-364.2

GRIZZLY AND BLACK BEARS

PROJECT CODE: DENA-N-364.2

SERVICEWIDE ISSUES:

- N18 Visitor Use Impacts on Backcountry Park Resources
- N24 Human Impacts Within and Adjacent to Park
- N16 Biological Impacts of Near-Park Development on Populations of Animals
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Present Condition

Denali National Park and Preserve currently receives over 600,000 person days of visitor use per year in an area with grizzly bear (*Ursus arctos*) densities as high as 32 bears/1000km^2 (Dean 1987, Keay unpublished data). As visitation to Denali continues to increase, so will the potential for impacts to bear populations. Grizzly bears and black bears (*U. americanus*) are unpredictable animals that can seriously threaten human safety (Herrero 1985). In Denali National Park, many people have the opportunity to observe grizzly bears in their natural environment. In 1989, 95% of park visitors using the visitor transportation system were able to observe grizzly bears along the park road (Machlis 1990). The park provides a valuable opportunity for the public to foster an appreciation and understanding of bears. This appreciation and public support could enhance efforts to conserve threatened bear populations in other areas.

Despite the legal protection of grizzly and black bears within the wilderness portion of the park, the bear population continues to face impacts from human activities inside park boundaries and throughout surrounding areas. Within and adjacent to the park, bears must adapt their behavior to a variety of widely dispersed human influences. These influences include garbage dumps, garbage incinerators, food caches, human developments, frontcountry hiking and camping, backcountry hiking and camping, existing and proposed road use, development, and legal and illegal harvest. These influences have potential to impact movements of bears, bear behavior, and population sex and age structure resulting in an unnatural bear population.

Visitor use in Denali continues to rise. Consequently, the potential for conflict between bears and people is a major concern. Bear-human conflicts result in loss of wild and free ranging bears and could threaten human safety. Bear behavior and ecology is strongly influenced by the motivation to obtain high energy sources of food. The availability of human foods increases as visitor numbers increase. Availability of human food and garbage at campsites, campgrounds, and other areas of human use may attract both black and grizzly bears. Habituation of bears to people by food rewards is the primary factor associated with bear-human conflicts in national parks (Herrero 1985, Herrero and Fleck 1989). Food-conditioned bears may behave aggressively toward people in order to obtain food. Although no human fatalities have occurred in the park and injuries are few, the number of bear-human incidents and encounters is high. In 1996, over 240 bear-human interactions were reported. Incidents involving property damage are an annual occurrence. Factors affecting bear-human conflicts must be investigated. The continued experimental development and implementation of a bear-human conflict management program, by professional biologists and highly trained technicians, is essential to visitor safety and resource protection.

The increase in visitor use over the years has resulted in an increase in vehicular traffic on the park's primary artery. In an attempt to reduce the impact to bears from increased vehicle use, the park established the visitor transportation system in the early 1970's. This is a shuttle bus system, designed to minimize disturbance to wildlife and to maximize wildlife viewing opportunities. It is not clear what impact use of the visitor transportation system has had on bear behavior along the road corridor. It is also impossible to establish biologically-sound use limits with our current level of knowledge.

In addition to the consequences associated with increased visitor use, bears are subject to harvest by subsistence and sport hunters within the 1980 new park additions and outside the park. A great deal of this harvest activity occurs on preserve lands and on state lands immediately adjacent to the park on the south side of the Alaska Range. National Park Service presence in this area prior to 1980 was minimal. Subsequently, the bear activities, population status, and extent of impact from this harvest is not well known.

When dealing with harvested populations, the ability to determine trends in population numbers and reproductive status is critical. Numerous efforts have been made to quantify the bear population within Denali National Park. Currently no method exists for management to readily and consistently obtain up-to-date and accurate numbers.

Current Management Actions and Results

Denali park staff have developed a bear-human conflict management program for the park (Stahlnecker 1994). This program has been the result of over a decade of experience, research, and consultation with other bear biologists. The goals of this program are based on management policies of the National Park Service and legislation which applies specifically to Denali. Specific

goals are to (1) maintain the natural processes affecting the genetic integrity, distribution, abundance, and behavior of black and brown bear populations; (2) provide visitor safety by minimizing bear-human conflicts and the resulting personal injuries and property damage; (3) provide opportunities for visitors to understand, observe, and appreciate black and brown bears as part of an intact ecosystem; and (4) minimize management actions considered intrusive to bears. Currently bear management policy meets these goals by stressing preventive management as the first step toward problem resolution. Efforts are focused on identifying and resolving the causes of bear-human conflict through appropriate research, management, and public education.

Research, conducted by a U.S. Geological Survey-Biological Resources Division (USGS-BRD) research biologist, is underway to determine the status and trend of grizzly bears in the park and the primary factors affecting grizzly bear population dynamics. The research will also investigate an effective method to monitor populations throughout the park. Results of this research will assist in answering management questions concerning bear densities and population characteristics. Radiocollars are used in this research.

Management of bears and people in Denali National Park should be based on sound scientific principles. Seasonal habitat selection, availability of natural foods, and distribution affect population dynamics and patterns of bear-human interactions. Scientific research is necessary to understand the relationship between bears and humans within the park and formulate management strategies to minimize conflicts. Monitoring population dynamics, movements, and density of black and brown bears, and the effects of hunter harvest, will provide information critical to the management of Denali National Park as a functioning ecosystem. Knowledge of population and behavioral change is needed to assist studies in progress on bear ecology, predator prey relationships, and the effects of traffic on wildlife use of the road corridor.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-364.201: Convert the Seasonal Wildlife Management Technician Positions to Permanent (Subject to Furlough) and Create an Additional Position

Extended seasons, from four months to seven months, for the wildlife technicians would facilitate end of season data entry and analysis, equipment repair and ordering, and report writing. Bear resistant food containers (BRFCs) would be adequately maintained. The extension of these positions would provide time for monitoring bear-human interactions on the south side of the Alaska Range during the spring snowmachine season, maintenance of a wildlife harvest data base for land adjacent to the park, and conducting bear education programs at local schools. Structuring these positions in such a way

would provide continuity, facilitate positive relationships with inholders and local government agencies, and decrease the need to continually train new personnel in a highly complex and technical operation.

As visitor use activities continue to increase on the south side of the Alaska Range, one additional wildlife management technician will be needed to deal with the added bear-human conflicts that may occur.

N-364.202: Develop Cooperative Planning Agreement With Local Government Agencies

Contacts and agreements will be developed with the Denali Borough, Department of Transportation, Denali State Park personnel, and state regulatory agencies to implement food and garbage handling regulations and ordinances in areas outside the park and on private lands within the park. All regulations would be established to ensure no impact to the natural behavior of bears residing in the park. Methods would be developed to share information on the location and nature of bear problems and bear human interactions. If biological research indicates that subsistence or sport hunting activities within the 1980 park or preserve additions or on state lands adjacent to the park have an adverse impact on the bear population within the park, the Federal Subsistence Board or Alaska Board of Game would be encouraged to modify bear hunting regulations and bag limits on lands within and surrounding the park.

N-364.203: Maintain Adequate Training for the Wildlife Management Personnel

Bear control actions would be enhanced by the availability of sufficiently trained personnel and properly maintained equipment to safely and efficiently handle problem bears. Wildlife management personnel will be knowledgeable of bear behavior, shotgun qualified, and trained in the use of aversive conditioning techniques. They will be proficient in chemical immobilization and handling of bears. This will be accomplished by sending personnel to training with other parks or agencies as necessary. The park will coordinate with USGS-BRD research to maintain one permanent employee at a fully-trained park practitioner level. Personnel with adequate training and authorization to immobilize bears must be available at all times to respond to bear incidents. A quick response to problem bear situations is critical to a successful management program.

N-364.204: Update the Bear-Human Conflict Management Plan Annually

The bear-human conflict management plan would be reviewed annually and updated as necessary to reflect areas of concern and current bear management situations. The plan would address evolving issues such as increasing activity and development on the south slope of the Alaska Range. Planning would encompass methods to determine and

measure wildlife harassment by snowmachine users. The implementation of closures around critical areas such as den and kill sites would also be addressed on a parkwide basis.

N-364.205: Publish Summary of Bear/Human Conflict Program

Park staff has gained important experience and data on bear-human conflicts. This information should be synthesized and published to assist others with bear management programs.

B. Research

N-364.211: Coordinate Black and Brown Bear Research Program

Ongoing grizzly and black bear research will be supported by the park and encouraged to continue. Research efforts would be expanded to develop a park-wide, comprehensive, problem-oriented research program to provide management with knowledge of black and grizzly bear population characteristics. Emphasis would be placed on studying distribution and movements, behavior, human-bear interrelationships, and the impacts of management programs on the bear population within the park. Specific information will include seasonal habitat selection by bears in areas along the park road, in the backcountry, and south of the Alaska Range and the identification of areas with a high potential for bear-human conflicts. A habitat model would be developed to provide a more detailed picture of bear use and potential habitat. Some specific research problems include:

1. Integrate bear research with ongoing predator-prey studies and incorporate the role of all major predators and major prey species, taking a community approach to studying resource interactions throughout the park.

2. Determine what effect human activity, including garbage management, consumptive use, and backcountry hiking, is having on the bear population and movement patterns.

3. Model predator-prey and predator-predator interactions.

4. Determine the appropriateness, impacts to the bear population, and potential safety hazards associated with proposed in-park and near-park development.

N-364.212: Develop Bear Monitoring Protocols

Develop a monitoring protocol for evaluating bear population status and trend along the road corridor, the Stampede area, the south district, and in the preserve.

N-364.213: Recover Historic Data for Inclusion in Park Data Bases

Historic records from Murie, Dean, other researchers, bus drivers, wildlife observation cards, case incident reports, and interviews would be used to develop a picture of past wildlife population dynamics and distributions, and habitat use, along the road corridor. Whenever possible these data would be incorporated into park data bases and the park geographic information system (GIS). A document would also be prepared compiling the historic records

N-364.214: Investigate Road Use Disturbance to Bear Populations

See Road Use Impacts to Natural Resources DENA-I-670.

N-364.215: Develop Aversive Conditioning Techniques

A technique for delivering a capsicum-based spray, triggered by remote control, would be developed with professional-level oversight and direction by a Wildlife Biologist. Additional techniques will be developed and/or evaluated as opportunities occur.

N-364.216: Investigate Habitat Use and Population Status of Bears Occupying the South Side of Denali

In cooperation with the Alaska Department of Fish and Game and Denali State Park, habitat use and population status of grizzly and black bears on the south side of Denali would be investigated.

N-364.217: Support Independently Funded Bear Research Projects

The service will support independently funded bear research projects in Denali National Park by private and public organizations, agencies, and universities. The park would provide temporary housing and logistical support for field and laboratory work (Research Administration and Management DENA-I-410).

C. Mitigation

N-364.221: Remove Human Foods

The availability of BRFCs would be maintained to insure an adequate supply for all backcountry units. A BRFC program would be developed on the south side of the Alaska Range as the need arises due to increased visitor use. New BRFCs would be purchased each year to maintain a high quality stock. Bear-proof lockers would be maintained in developed campgrounds. Bear-proof food storage would be required at all

NPS field camps. A proactive effort would be made to encourage local businesses inside and outside the park to conform with state regulations regarding food and garbage storage. Technical assistance would be provided to inholders and local businesses in developing secure food and garbage handling practices.

N-364.222: Implement Closure Procedure as Required in Bear-Human Conflict Management Plan

Based on procedures outlined in the bear-human conflict management plan and on monitoring results, closures would be implemented around den and kill sites as necessary. Implementation of necessary closures would counter harmful human disturbance of active bear dens and stop human activity from interfering with active kill sites. A commitment to long term, extensive monitoring of bear activity and den sites would be essential to implementing this mitigation action (DENA-N-364.205, DENA-N-364.231, and DENA-N-364.232).

N-364.223: Continue Current Experimental Aversive Conditioning

The wildlife management technicians would continue to aggressively use experimental aversive conditioning techniques under the oversight of a professional Wildlife Biologist. New techniques would be developed with professional-level oversight, evaluation, and direction (DENA-N-364.215). All actions would be carefully documented and evaluated to determine their effectiveness.

N-364.224: Develop Interagency Habitat Linkages

Denali National Park and Preserve biologists would coordinate with ADF&G and other adjacent land management agencies toward developing habitat linkages which would ensure a large, healthy, contiguous population of grizzly bears and black bears into the future.

D. Monitoring

N-364.231: Maintain Adequate Parkwide Monitoring of Human-Bear Encounters and Incidents

All visitors would be encouraged to report any bear incident to a uniformed National Park Service employee. Uniformed employees would interview the witness/victim and complete a bear information management system (BIMS) form used to monitor individual bears, bear activity, and bear management actions. The wildlife management technicians would provide training to NPS staff on the use of these forms. A computerized bear information and management system would be maintained to aid in the analysis and

evaluation of the park's bear management program.

A monitoring system would be implemented to begin evaluating the effect of snowmachine use on wildlife during March and April on the south side of the Alaska Range. Efforts would also be made to obtain bear-human interaction data from the south district.

The wildlife technicians would record the locations of bear-human encounters and incidents as universal transverse mercator (UTM) coordinates suitable for entry in the park GIS.

N-364.232: Implement Annual Bear Monitoring Program

A technique would be developed (DENA-N-364.212) and conducted on a regular basis to gain information on bear population status and trends including densities, numbers, distribution, composition, age class, and productivity. Attempts would be made to duplicate previous survey efforts to allow comparability of data. Survey efforts would be coordinated with ADF&G Biologists to ensure complete and accurate reporting of population status within and adjacent to the park.

Data from surveys in the preserve lands would be used by park managers to evaluate sport harvest effects on bear populations. Data may be used to support changes in annual season and bag limit regulations as necessary.

N-364.233: Update Bear Information Management System Data Base

The suitability of data from the late 1970's to 1992 would be evaluated and added to the BIMS data base if appropriate. Where possible, the locations of past bear interactions would be recorded as UTM coordinates suitable for entry in the park GIS.

N-364.234: Track Alaska Dept. of Fish and Game (ADF&G) and US Fish and Wildlife Service Bear Management Decisions and Harvest Data on Adjacent Lands and in the Preserve

All bear management decisions would be monitored and input would be provided as appropriate. A data base would be maintained of wildlife harvest on lands adjacent to the park and in the preserve. An effective dialogue would be established with ADF&G staff and users to ensure data quality and continuity.

N-364.235: Gather Known Bear Data for South District

The wildlife technicians would monitor and gather data on den locations, concentrations

of wildlife, and kill sites in the south district. The information sources would include local residents and users, and historic records and reports.

N-364.236: Implement Monitoring Protocol for Predation Events

N-364.237: Implement Berry Production Monitoring Protocol

N-364.238: Monitor Human Use Patterns

Human use activities, particularly backcountry use, would be tracked and analyzed on a regular basis to assist in determining areas with high potential for bear-human interactions.

E. Interpretation

N-364.241: Maintain Adequate Level of Public Information

Information about black and grizzly bears would be distributed throughout the park. All visitors obtaining campground permits or backcountry use permits will be given verbal and written warnings about black and grizzly bears. Adequate staff would be available at the visitor access center backcountry desk to provide information and record reports of bear-human interactions. An informative article about bear behavior and bear-human interactions will be published in the Denali Alpenglow. Interpretive activities will emphasize the potential hazards of bear-human interactions in a uniform fashion. The wildlife management technicians will provide training to the interpreters on disseminating the 'bear warnings'. Signs posted at developed campgrounds will advise campers about proper food and garbage storage. Special training about bear ecology and behavior will be required for all NPS and concession employees. As the wildlife technician function continues to evolve, their ability to assist with these duties will diminish. Funding is needed to provide seasonal interpretive support to accomplish these tasks.

F. Protection

N-364.251: Maintain Adequate Level of Regulation and Closure Enforcement

Protection of bears, their habitat, and public safety would be enhanced by evening campsite and overnight backcountry patrols in areas characteristic of frequent bear-human interactions. Campsites and backcountry areas that experience bear problems would be temporarily closed to protect visitors and minimize the need to manipulate bears. Closure signs would be constructed during the winter so supplies are always available. Protection of bears and their habitat would be enhanced by regulation enforcement throughout the park and preserve. Human disturbances near bear activity sites would be

stopped when encountered by park rangers and resource personnel and the violations would be immediately reported to the Ranger Division. The park would utilize the Alaska Department of Public Safety, Division of Fish and Wildlife Protection's Violation Reporting Program to encourage visitors to turn in individuals intentionally harassing or disturbing bears and their prey. Information posters and pamphlets developed by the state for the Turn In Poachers program would be distributed in the park by NPS personnel. As the wildlife technician function continues to evolve, their ability to assist with these duties will diminish. Funding is needed to provide seasonal law enforcement support to accomplish these tasks.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Inter-Agency Planning		50.0/0.1	25.0/0.1	25.0/0.1	100.0/0.3
- Training	10.0/0.0	10.0/0.0	10.0/0.0	10.0/0.0	40.0/0.0
RESEARCH					
- Coordinate Research	50.0/0.2	100.0/1.0	100.0/1.0	100.0/1.0	350.0/3.2
- Develop Monitoring Procedures	200.0/0.7	200.0/0.7	200.0/0.7		600.0/2.1
- Recover Historic Data	10.0/0.2				10.0/0.2
- Develop Aversive Conditioning	50.0/0.0	50.0/0.0			100.0/0.0
MITIGATION					
- Remove Artificial Foods	8.0/0.0	8.0/0.0	8.0/0.0	8.0/0.0	32.0/0.0
MONITORING					
- Monitor Bear/Human Interactions	60.0/1.2	60.0/1.2	60.0/1.2	60.0/1.2	240.0/4.8
- Monitor Bear Population		30.0/0.1	30.0/0.1	30.0/0.1	90.0/0.3
- Monitor Predation	10.0/0.2	5.0/0.0	5.0/0.0	5.0/0.0	25.0/0.2

- Monitor Berry Production	15.0/0.2	5.0/0.1	5.0/0.1	5.0/0.1	30.0/0.5
INTERPRETATION					
- Public Information	11.3/0.2	11.3/0.2	11.3/0.2	11.3/0.2	45.2/0.8
PROTECTION					
- Enforcement	14.0/0.3	14.0/0.3	14.0/0.3	14.0/0.3	56.0/1.2
TOTALS	438.3/3.7	543.3/3.7	468.3/3.7	268.3/3.0	1718.2/13.6

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Bunnell, F. L., and D. E. N. Tait. 1978. Bears in models and in reality-implications to management.

Herrero, S. 1985. Bear attacks: their causes and avoidance. N. Lyons Books/ Winchester Press, Piscataway, N.J. 287pp.

Herrero, S. 1989. The role of learning in some fatal grizzly bear attacks on people. Pages 9-14 in M. Bromley, ed. Bear-People Conflicts: Proceedings of a Symposium on Management Strategies. Northwest Territory, Department of Renewable Resources, Yellowknife.

Herrero, S., and F. Fleck. 1989. Injury to people inflicted by black, grizzly, and polar bears: recent trends and new insights. International Conference on Bear Research and Management, 8:25-35.

Jope, K. L. 1985. Implications of grizzly bear habituation to hikers. Wildlife Society Bulletin, 13:32-37.

Machlis. 1990. Denali National Park Visitor survey. Idaho State University, Moscow, ID.

Mattson, D. J. 1989. Human impacts on bear habitat use. International Conference on Bear Research and Management, 8:33-56.

Mattson, D. J., R. R. Knight, and B. M. Blanchard. 1987. The effects of developments and primary roads on grizzly bear habitat use in Yellowstone National Park, Wyoming. International Conference on Bear Research and Management, 7:259-273.

McLellan, B. N., and D. M. Shackleton. 1989. Immediate reactions of grizzly bears to human activities. Wildlife Society Bulletin, 17:269-274.

Meagher, M. and Phillips. 1983. Restoration of natural populations of grizzly and black bears in Yellowstone National Park. International Conference on Bear Research and Management, 5:152-158.

Stahlnecker, K.E. 1994. Bear-human conflict management action plan, Denali National Park and Preserve. Unpublished Draft. U.S. Department of the Interior, NPS, Denali National Park and Preserve. Denali Park, Alaska. 45+pp.

TRAPPING AND SPORT HUNTING

PROJECT CODE: DENA-N-367

SERVICEWIDE ISSUES:
- N19 Loss of Park Resources Due to Consumptive Practices (Hunting and Trapping)
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Introduction

Denali National Park is comprised of park and preserve units which allow varying degrees of consumptive uses. Fishing is the only consumptive use of wildlife allowed within the boundaries of the original Mount McKinley National Park (Sport Fishing DENA-N-251 [in preparation]). Passage of the Alaska National Interest Lands Conservation Act (ANILCA) in 1980, added approximately 1.6 million hectares (4 million acres) to the original park. Congress intended for the customary and traditional use of wildlife resources by eligible local rural residents to continue on lands added in 1980 under the National Park designation. Furthermore, Sections 1313 and 203 of ANILCA explicitly permits continued sport and subsistence harvest of wildlife on lands added under the National Preserve designation. This project statement is meant to address issues related to trapping (by other than eligible subsistence users) and sport hunting.

Furbearer species inhabiting Denali which are subject to trapping include beaver (*Castor canadensis*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), lynx (*Lynx canadensis*), marten (*Martes americana*), mink (*Mustela vison*), ermine (*M. erminea*), weasel (*M. rixosa*), muskrat (*Ondatra zibethicus*), river otter (*Lutra canadensis*), red squirrel (*Tamiasciurus hudsonicus*), ground squirrel (*Spermophilus parryii*), marmot (*Marmota caligata*), wolf (*Canis lupis*), and wolverine (*Gulo gulo*).

Moose (*Alces alces*), Dall sheep (*Ovis dalli*), black bears (*Ursus americanus*), grizzly bears (*Ursus arctos*), wolves, wolverine, Spruce Grouse (*Dendragapus canadensis*), Ruffed Grouse (*Bonasa umbellus*), Willow Ptarmigan (*Lagopus lagopus*), Rock Ptarmigan (*Lagopus mutus*), White-tailed Ptarmigan (*Lagopus leucurus*), snowshoe hares (*Lepus americanus*), and fur animals including coyote, red fox, lynx, and squirrel are subject to sport hunting on preserve lands.

Moose are an important subsistence species, and, like most species listed above, are harvested under both subsistence and sport regulations. When wildlife resources are limited and not able to sustain both subsistence and sport harvest, ANILCA provides a preference for eligible subsistence users.

Present Condition

ANILCA requires that "healthy" wildlife populations be maintained while allowing sport and subsistence harvest to occur in preserve areas. Since the term "healthy" is not defined in ANILCA, considerable debate is necessary to understand what this term means in regards to management of wildlife resources on preserve lands. ANILCA specifically allows the superintendent to temporarily close preserve areas to the taking of wildlife for reasons of public safety, administrative purposes, or to maintain the health and viability of wildlife populations. Such closures can only occur after consultation with the State and adequate public notice and a public hearing has occurred. The enactment of a closure must be based on sound scientific information.

The complexity of this harvest management scheme requires accurate and timely information on wildlife populations and harvest levels. Population information, such as abundance, sex and age composition, productivity, critical habitat, and seasonal distribution and movements is critical for proper management. A routine monitoring program is necessary to provide management with current population information.

The Alaska Board of Game (BOG) regulates non-subsistence trapping and sport hunting and establishes harvest levels and season lengths for preserve lands within Denali (see Tables 10 and 11). Hunting and trapping regulations are published annually (Alaska Department of Fish and Game 1996, 1996a). The BOG meets regularly to receive comments and proposals from the public and local fish and game advisory committees to change state hunting and trapping regulations. The National Park Service (NPS) participates in the state regulatory process by submitting proposals to the BOG when a need for regulatory change is identified. The Service also submits comments on proposals that effect game management units encompassing land areas managed by the NPS.

While the NPS adopts state law to the fullest extent possible in the management of fish and wildlife, there are situations in which there is a conflict between state law and Congressional mandates for federal areas. One such situation involves same-day-airborne hunting and trapping regulations. This practice threatens to violate the separate and distinct Federal mandates established for NPS areas. Furthermore, changes in the state rule for same-day-airborne taking of wildlife resulted in a great deal of public confusion regarding the applicability of State hunting and trapping laws to NPS areas. As a result, in 1995 the NPS issued a final rule, through the federal register process, prohibiting hunting in NPS areas in Alaska on the same day in which a hunter has flown in an aircraft.

A second situation involves the use of a firearm to take free-ranging wildlife under a trapping license. Federal regulations (36 CFR Part 13) limit trapping in NPS areas in Alaska to taking by snares, traps, mesh, or other implements designed to entrap animals. State regulation permits the taking of free-ranging furbearers with a firearm. While the practice is explicitly prohibited in NPS areas, clarification of the prohibition is deemed necessary due to State action to allow the taking of certain wildlife by same-day-airborne land and shoot trapping. In 1994, the NPS issued a proposed rule, through the Federal Register public comment process, seeking the necessary clarification. Public comment was so varied that the NPS has tabled any further rule making on the issue, until further notice.

Current Management Actions and Results

Park staff periodically conduct wildlife censuses and monitoring studies for large mammals which are frequently hunted, such as moose, bear and sheep. Wildlife populations are surveyed within the old park area as well as in the preserve additions. Whenever possible, park staff work cooperatively with the ADF&G and USFWS on wildlife census and monitoring projects.

Park managers currently rely on anecdotal information and incidental observation as an indication of the status of small game species such as ptarmigan, grouse (Ptarmigan and Grouse DENA-N-361.5), and hares. No systematic program is currently in place to track the abundance or population dynamics of these species.

Similarly, very little is known about the furbearer populations of the park and preserve (Furbearers DENA-N-363). Interviews with local trappers who use furbearers for subsistence purposed have provided incidental information of furbearer abundance. Most furbearer population information is derived through furbearer harvest records. Additional information may also be derived through trapper interviews, questionnaires, and pelt sealing records for species requiring sealing, such as lynx, river otter, wolverine and beaver. However, at current trapping levels, this rough index of local furbearer populations provides very little quantitative information.

The state of Alaska is divided into 26 Game Management Units (GMUs). Hunting and trapping regulations, harvest reporting requirements, and game management practices are designed specific to each GMU. GMUs are further divided into subunits and Uniform Coding Units (UCUs) which represent major drainages. The boundaries of UCUs rarely conform to political land designations. The state maintains a harvest data base in which is entered the location of harvest according to UCU. Because UCUs do not follow political land designations, it is difficult to determine whether harvests occurred within the boundaries of the preserve.

Information on sport harvest is obtained through harvest reports or sealing records. The current harvest reporting system for several large mammals, such as moose and sheep, require hunters to return a harvest report by mail. Harvest reports are species-specific and request information

on hunting effort, success, and location by GMU and drainage or mountain range. Harvest reports must be returned whether or not an animal was harvested. Present sport harvest levels and hunter harvest reporting rates in preserve areas varies by species. The lowest reporting rates occur in remote villages and outlying settlements which harvest more traditional subsistence species. Hunters from urban areas have higher reporting rates than their rural counterparts. Grizzly bears, wolves, wolverine, and many of the other furbearers require sealing. Hunters and trappers report to a sealing agent who gathers information on harvest locale, methods, and means. In many GMUs, the sealing of black bears is not required; therefore the harvest is not reported. Harvest and sealing records represent the minimum take of a hunted species.

Two big game guides operate within preserve boundaries under the authority of concession permits issued by the NPS. In addition to state harvest reporting requirements, these guides are required to report hunting and harvest activities directly to the park.

Sport harvest and other data are tabulated by the state and input into a computer database. Harvest statistics are usually summed by GMUs or subunits. Harvest statistics are published and available from the state (Keyes 1995). The harvest database has also been available from the state, usually prior to the beginning of the next hunting season. Factoring in the limitations associated with the existing reporting system, current reported harvest levels for most species in the preserve units have been low and probably have not affected the biological parameters of harvested populations. Illegal taking of wildlife is also estimated to be low and does not have a measurable affect on populations at this time. The remoteness and difficulty in access excludes most people from utilizing preserve wildlife resources.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-367.001: Develop a Harvest Report that Identifies Land Management Agency

NPS would assist ADF&G and the Federal Subsistence Board (FSB) with the collection and management of harvest data to further improve its efficiency and usefulness. The establishment of a harvest monitoring strategy that enables the identification of harvest locales by management designation would provide additional information to resource managers. A harvest report allowing the identification of the managing agency as state or federal would allow managers to further delineate harvest locale.

N-367.002: Develop an Interagency Harvest Management Strategy

The park would work cooperatively with state and federal management agencies as well as private citizens and corporations to develop an interagency working plan to manage

harvest in and adjacent to the park. The NPS, ADF&G, FSB, Denali Subsistence Resource Commission (SRC), and BOG would develop and implement harvest management strategies.

N-367.003: Enhance Inter-Divisional Exchange of Harvest Data from Licensed Guides

Procedures will be improved to ensure thorough and timely exchange of hunting activity and harvest data, obtained from NPS concession permit holders, between park divisions. The physical location of commercial guide areas will be digitized in a format suitable for the park geographic information system.

N-367.004: Create a Biological Technician (GS-7) Position to Assist with Program Development

A biological technician position will be created. Tasks associated with harvest management, including database development and wildlife population monitoring will be overseen by the wildlife biologist with assistance from the biological technician.

N-367.005: Develop Criteria for the term "Healthy"

Park staff will continue to work with the task group assigned to define what is meant by the term "healthy" in preserve areas. See also Subsistence Hunting DENA-N-369.

B. Research

N-367.011: Develop Furbearer Survey Techniques

See Furbearers DENA-N-363.

N-367.012: Recover Historic Data for Inclusion in Park Data Bases

Harvest reports, individual observations from park users, case incident reports, and interviews would be used to develop a park database which provides a complete record of wildlife harvest. Efforts would be made to ensure that the data base is complete and up-to-date. Whenever possible these data would be incorporated into the park geographic information system.

N-367.013: Support Independently Funded Research Projects Involving Harvested Species

The service would support independently funded monitoring and research projects in

Denali National Park and Preserve, which focus on species subject to sport harvest. Entities including private and public organizations, agencies, and universities would be supported when deemed appropriate by park management. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management DENA-I-410).

C. Monitoring

N-367.031: Design and Initiate A Long-Term Monitoring Program To Track Wildlife Population Trends

NPS would develop a long-term monitoring plan for each harvested species using standard methodologies where they exist. Species of immediate concern are moose, sheep, bears, and wolves. The long-term monitoring plan will include the monitoring frequency and schedules, data management techniques, methodologies, and data analysis techniques.

The park would develop monitoring plans in consultation with Wildlife Biologists from Alaska Department of Fish and Game, United States Geological Survey Biological Research Division, and U.S. Fish and Wildlife Service. A Biological Technician (GS-7) would assist with database management. (Long-Term Ecological Monitoring DENA-I-210).

N-367.032: Design and Maintain A Wildlife Harvest Database To Track Consumptive Uses

The wildlife biologist and the park public information specialist would design a data base system to maintain harvest information in a easily accessible and user friendly format. The database would be updated on a yearly basis when the previous year's data becomes available.

N-367.033: Initiate a Monitoring Program for Furbearers

See Furbearers DENA-N-363.

D. Interpretation

N-367.041: Provide Public Information about Wildlife Harvest

Park officials would cooperate with groups concerned about the management of wildlife harvest in the development of public information plans and strategies. Park interpreters, researchers, and resource managers would work closely to ensure accuracy of

information. These educational efforts would be an ongoing aspect of a total management scheme.

Interpretive programs and displays explaining the role and management of hunting and trapping within the preserve could be established and maintained.

E. Protection

N-367.051: Enforcement of Hunting and Trapping Regulations

An adequate level of hunting and trapping regulation enforcement would be maintained. Hunting and trapping violations would be stopped when encountered by park rangers and resource personnel and would be immediately reported to the Ranger Activities Division. Aerial patrols would be conducted over the park to detect illegal hunting and trapping activity. Aerial patrol routes will be mapped and reported in a consistent manner. The park would utilize the Alaska Department of Public Safety, Division of Fish and Wildlife Protection's Violation Reporting Program to encourage visitors to turn in individuals intentionally violating hunting and trapping regulations.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Database Management	22.0/0.7	22.0/0.7	22.0/0.7	22.0/0.7	88.0/2.8
MONITORING					
- Long-term Monitoring Plan Development	25.0/0.5	25.0/0.5			50.0/1.0
INTERPRETATION					
- Public Information		10.0/0.2	10.0/0.2	10.0/0.2	30.0/0.6
PROTECTION					
- Enforcement	14.0/0.3	14.0/0.3	14.0/0.3	14.0/0.3	56.0/1.2

TOTALS	61.0/1.5	71.0/1.7	46.0/1.2	46.0/1.2	224.0/5.6

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Alaska Department of Fish and Game. 1996. Alaska state hunting regulations. No. 37. ADF&G.

Alaska Department of Fish and Game. 1996a. Trapping regulations. No.37. ADF&G.

Keyes, Enid. 1995. Alaska wildlife harvest summary. Division of Wildlife Conservation, Alaska Department of Fish and Game. 517pp.

Office of the Federal Register. 1995. Code of Federal Regulations, Title 36. US Government Printing Office.

United States Congress. 1980. Alaska National Interest Lands Conservation Act. Public Law 96-487, 96th Congress.

USNPS. 1986. Final general management plan, land protection plan. USNPS, Denali NP&P. 231pp.

TABLE 9.

ALASKA HUNTING SEASONS AND BAG LIMITS FOR GMUs ENCOMPASSING DENALI NATIONAL PRESERVE JULY 1, 1997-JUNE 30, 1998

SPECIES AND BAG LIMITS	TICKET OR PERMIT	OPEN SEASON
BEAR, BLACK		
Units 16, 19 and 20: Residents & Nonresidents: Three Bears		No closed season
BEAR, BROWN/GRIZZLY		
Unit 16: Residents & Nonresidents: One bear every four regulatory years		Sept. 1-May 25
Units 19C, 19D and 20C: Residents & Nonresidents: One bear every four regulatory years		Sept. 1-May 31
CARIBOU		
Units 16 and 19C: Residents & Nonresidents: One bull	Harvest	Aug. 10-Oct. 10
Unit 19D: Residents: One caribou Nonresidents: One caribou	Harvest Harvest	Aug. 10-Sept. 30 OR Nov. 1-Jan. 31 Aug. 10-Sept. 30
Unit 20C:		No open season
MOOSE		
Unit 16B: Residents: One bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on at least one side, or One bull by permit Nonresidents: One bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on at least one side	Harvest Tier II Harvest	Aug. 20-Sept. 30 OR Nov. 1-Feb. 15 Aug. 20-Sept. 30
Unit 19C: Residents: One bull, of One bull by permit Nonresidents: One bull with 50-inch antlers or with 4 or more brow tines on at least one side	Harvest Registration Harvest	Sept. 1-Sept. 25 Jan. 15-Feb. 15 Sept. 1-Sept. 25
Unit 19D: Residents: One bull Nonresidents: One bull with 50-inch antlers or with 4 or more brow tines on at least one side	Harvest Harvest Harvest	Sept. 1-Sept. 25 OR Dec. 1-Dec. 31 Sept. 1-Sept. 25
Unit 20C: Residents: One bull Nonresidents: One bull	Harvest Harvest	Sept. 1-Sept. 20 Sept. 5-Sept. 15
SHEEP		

Units 16, 19 and 20C: Residents & Nonresidents: One ram with full curl horn or larger	Harvest	Aug. 10-Sept. 20
WOLF		
Units 16, 19 and 20: Residents & Nonresidents: Five wolves		Aug. 10-Apr. 30
WOLVERINE		
Units 16B, 19 and 20: Residents & Nonresidents: One wolverine		Sept. 1-Mar. 31
COYOTE		
Units 16, 19 and 20: Residents & Nonresidents: Two coyotes		Sept. 1-Apr. 30
FOX, RED		
Unit 16: Residents & Nonresidents: Two foxes		Sept. 1-Feb. 15
Units 19 and 20: Residents & Nonresidents: Ten foxes, however no more than 2 foxes may be taken before Oct. 1		Sept. 1-Mar. 15
LYNX		
Unit 16: Residents & Nonresidents: Two lynx		Dec. 15-Jan. 15
Unit 19: Residents & Nonresidents: Two lynx		Nov. 1-Feb. 28
Unit 20C: Residents & Nonresidents: Two lynx		Dec. 1-Jan. 31
SQUIRREL		
Units 16, 19, 20: Residents & Nonresidents: No limit		No closed season
GROUSE		
Unit 16: Residents & Nonresidents: Fifteen per day, 30 in possession of which not more than 2 per day and 4 in possession may be ruffed grouse		Aug. 10-Mar. 31
Unit 19: Residents & Nonresidents: Fifteen per day, 30 in possession		Aug. 10-Apr. 30
Unit 20C: Residents & Nonresidents: Fifteen per day, 30 in possession		Aug. 10-Mar. 31
HARE		
Units 16, 19, 20: Residents & Nonresidents: No limit		No closed season
PTARMIGAN		
Unit 16: Residents & Nonresidents: Ten per day, 20 in possession		Aug. 10-Mar. 31

Units 19 and 20C: Residents & Nonresidents: Twenty per day, 40 in possession		Aug. 10-Apr. 30

TABLE 10.

ALASKA FURBEARER TRAPPING SEASONS AND BAG LIMITS FOR GMUs ENCOMPASSING DENALI NATIONAL PRESERVE JULY 1, 1997 THRU JUNE 30, 1998

SPECIES AND UNITS	BAG LIMITS	OPEN SEASONS
BEAVER		
Unit 16:	No limit	Nov. 10-May 15
Unit 19:	No limit	Nov. 1-Jun. 10
Unit 20C:	25	Nov. 1-Apr. 15
COYOTE		
Unit 16:	No limit	Nov. 10-Mar. 31
Units 19 and 20C:	No limit	Nov. 1-Mar. 31
FOX, RED		
Unit 16:	No limit	Nov. 10-Feb. 28
Unit 19:	No limit	Nov. 1-Mar. 31
Unit 20:	No limit	Nov. 1-Feb. 28
LYNX		
Unit 16:	No limit	Dec. 15-Jan.15
Unit 19:	No limit	Nov. 1-Feb. 28
Unit 20:	No limit	Nov. 1-Feb. 28
MARTEN		
Unit 16B:	No limit	Nov. 10-Jan. 31
Units 19 and 20:	No limit	Nov. 1-Feb. 28
MINK & WEASELS		
Unit 16:	No limit	Nov. 10-Jan. 31
Units 19 and 20:	No limit	Nov. 1-Feb. 28
MUSKRAT		
Unit 16:	No limit	Nov. 10-Jun. 10

Units 19 and 20C:	No limit	Nov. 1-Jun. 10
OTTER		
Unit 16:	No limit	Nov. 10-Mar. 31
Units 19 and 20:	No limit	Nov. 1-Apr. 15
SQUIRRELS & MARMOTS		
Units 16, 19 and 20:	No limit	No closed season
WOLF		
Unit 16:	No limit	Nov. 10-Mar. 31
Units 19 and 20C:	No limit	Nov. 1-Apr. 30
WOLVERINE		
Unit 16B:	No limit	Nov. 10-Feb. 28
Unit 19:	No limit	Nov. 1-Mar. 31
Unit 20:	No limit	Nov. 1-Feb. 28

SUBSISTENCE TRAPLINE MANAGEMENT

PROJECT CODE: DENA-N-368

SERVICEWIDE ISSUES:
- N19 Loss of Park Resources Due to Consumptive Practices
- N20 Lack of Basic Data

STATEMENT OF PROBLEM

Introduction

Trapping and bartering of furbearing mammals for subsistence purposes has long been a customary and traditional activity for Native Alaskans and other park area residents. After Russian and American contact, trapping, trading and selling of furbearers became a significant socio-economic activity for both native and non-native subsistence users. ANILCA provides for the continuance of personal or family use, bartering, sharing and customary trade of subsistence wildlife resources.

Customary trade is not explicitly defined in ANILCA. However, the legislative history (Senate Report 96-413) states that customary trade is not intended to be or become a significant commercial enterprise beyond its traditional role as part of the subsistence regime.

Subsistence trapping is allowed in the ANILCA additions to Denali National Park and Preserve by eligible local rural residents. Trapping is the predominant subsistence activity occurring on Denali National Park and Preserve lands. Trapping activities commence in November and continue through March, constituting approximately six months of activity which is significantly longer and more intensive than any other type of subsistence use. Winter travel in pursuit of furbearers can be extensive and is generally supported by a network of winter trails, shelters and cabins, which are accessed by the use of dog teams or snowmachines.

The customs and traditions involved in trapping differ from region to region within Alaska, and may differ between communities within a particular region of Alaska. For example, in the northern regions of Denali National Park and Preserve, traplines and winter travel in pursuit of furbearers can be extensive in distance and duration which generally necessitates use of shelters, caches and maintenance of winter trails. Traplines in the southern region tend to be more proximate to communities and operate without the network of trails and shelters typical in the

north. These customs and traditional practices must be understood in order to protect and manage the activities associated with trapping.

In recent years trapping in general, and use of humane traps in particular, has been receiving a significant amount of scrutiny by the public and special interest groups.

In order to ensure the continued opportunity for traditional subsistence use, park managers need reliable information regarding traditional land uses and practices.

Present Condition

Eligible subsistence trappers utilizing Denali National Park and Preserve are permanent residents from Denali's resident zone communities of Nikolai, Telida, Lake Minchumina and Cantwell. In addition, several individuals from Healy, Nenana, Tanana and Broad Pass area have subsistence use permits.

Trappers are active in all regions of Denali, but the intensity of effort and extent of traplines are greatest on the north side of the Alaska Range. Marten, mink, red fox, wolf, lynx, weasel, wolverine, land otter, beaver, muskrat, and coyote are important fur animal resources. Trapping seasons generally open in early November and continue through February for most species. Beaver, muskrat and otter are typically trapped during early spring. With the exception of beaver, most furbearer species have no harvest limits.

As is the case elsewhere in Alaska, trapping in Denali's northern region operates on the basis of formal and informal agreements between individuals since there is no recognized legal guarantee that extends ownership or property rights to a trapline or the public lands where the trapping occurs. In recent years, this system of social norms and peer pressure has been threatened by increasing numbers of users. On occasion, the NPS and the courts have been asked to settle disputes between trappers who could not reach agreement between themselves regarding the claims to and use of traplines.

Marten continue to be the most sought after furbearer species by trappers in interior Alaska due to their abundance, ease of capture, and high pelt prices (eg. $100 average price). Marten are the primary furbearer species for trapper utilizing the north side of Denali National Park and Preserve.

Since 1930 the marten seasons have opened and closed irregularly with essentially the same pattern, large harvests following a closed season, followed by a period of significantly declining harvest, and then a closed season again. In the past regulations have been inconsistent and overtly reactive due to a lack of biological information upon which to base a better program (Lensink 1953).

Marten research is needed to help managers and subsistence users maintain a healthy furbearer (marten) populations in the park and preserve. Quantitative data is needed to evaluate the effects of harvest on marten distribution and numbers and to develop guidelines which individual trappers can use to determine the optimal annual marten harvest on each trapline to insure the resource is not overexploited.

Denali's Subsistence Resource Commission is concerned about increasing rural populations and competition for trapping resources due to BLM and the state of Alaska's land disposals near the resident zone community of Minchumina. As a result, the boundaries for the Lake Minchumina resident zone have been established to exclude these developing areas from the resident zone eligibility. The current belief is that there is very little unappropriated trapping resource areas available.

Trappers have expressed concerns about the need for buffer zones between traplines, fearing that new trappers to the area may be infringing upon current active traplines or those sections of their traplines current users are leaving fallow for a year or two for management purposes.

Trapping of wolves near Denali National Park became a significant political issue after a wolf was illegally trapped near the park's eastern boundary. A proposal to close State lands adjacent to the park's boundary was submitted to the state Board of Game, and numerous letters were sent to the park superintendent asking that the park be closed to subsistence trapping.

Denali has received several requests from subsistence users to re-roof and/or reconstruct subsistence use cabins associated with traplines. Three cabin reconstruction permits have been issued in the past and two requests are pending. The National Park Service needs to assess what are the subsistence trappers current needs and what are the customs and traditions that have governed trapping activities and the use of cabins.

Current Management Actions and Results

In an effort to understand the land uses of the north additions to Denali National Park and Preserve, park managers have undertaken several subsistence related studies. In 1978, a "Subsistence Resource Use in the Proposed North Additions to Mt. McKinley National Park" study was conducted to document current and recent subsistence use in the proposed north additions to the park (Bishop 1978).

In 1984, a "Land Use in the North Additions of Denali National Park and Preserve and Preserve: An Historical Perspective" study was conducted to complement the earlier work of Richard Bishop and provide park managers with additional information for understanding the land uses of the north additions. This report identifies and describes significant places and trapping areas within and areas near the park and preserve (USNPS 1984).

Between 1986 and 1993 the park sponsored an extensive wolf research project including the areas north of the Alaska Range. This has been the only significant furbearer study that the park has conducted.

In 1994, a subsistence cabin study was initiated to document the historical and contemporary use of cabins and structures associated with subsistence use activities in the north additions to Denali National Park and Preserve.

Some initial marten harvest data has been cooperatively collected from Denali subsistence users. Data from the ADF&G furbearer harvest and sealing records has been acquired and incorporated into the park's data base. Information from the state's community profile data base for selected communities associated with the Denali area has been acquired.

The issues regarding subsistence trapping such as trapline cabin use, season and bag limits for certain furbearers, clarification of NPS trapping regulations, harvest reports for wolves, proposals to the ADF&G to create trapping buffer zones around Denali, and petitions to the superintendent to close park lands to trapping have been brought before the Denali Subsistence Commission for review and comment.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-368.001: Develop Trapline Management Program

After completing the research studies identified below, park staff will work cooperatively with the Denali Subsistence Resource Commission and subsistence trappers to develop a trapline management plan for the park and preserve. The plan would address ownership and exchange of traplines, the need to register or provide protection for established traplines, use of trapline cabins and maintenance programs, cooperative furbearer harvest monitoring programs, trapline management strategies such as rotation or fallow practices for sections of their traplines, trapline dispute resolution, trail brushing and maintenance practices, utilization of humane trapping practices, criteria to more clearly define what is meant by customary trade, and work to clarify National Park Service trapping regulations and definitions.

B. Research

N-368.011: Customs and Traditions Governing Subsistence Trapping

This study would focus on the contemporary use of traplines and the associated support activities of subsistence and commercial trappers in both the northern and southern regions of Denali. Documentation would be made of the customs and traditions currently used to govern ownership, exchange and use of traplines. Also documented will be the construction and brushing of trapping trails, and the construction and use of winter base camp cabins and trapline cabins defining their size, type and spacing along trails. The practices and need for reconstruction of cabins or the use of other alternatives will be assessed. The study would review means of accessing both the trapping area and the trapline itself, the frequency a line is trapped and the extent of buffer zones between traplines. The study would identify past and current trapping techniques and trapline management practices. The study would investigate traditional knowledge of furbearers by elders and seek ways to incorporate such knowledge into management strategies. Information on the species trapped and the approximate amounts of harvest would be collected. Documentation would be made of how trappers settled trapline disputes and when a trapline is considered abandoned. Adverse impacts associated with trapping activities will be assessed such as fuel transport and storage, trash disposal, timber harvest and food cache management. Ways to mitigate these concerns would be evaluated.

N-368.012: Conduct Marten Trapping Study

After consulting with subsistence trappers and Denali's Subsistence Resource Commission, park staff would propose that the NPS enter a cooperative agreement with several local trappers and the Alaska Department of Fish and Game to conduct a marten study within the Lake Minchumina area and the north additions to Denali National Park and Preserve. Of particular interest would be an assessment of the affects upon marten population dynamics and demography resulting from "3-year trapping/3-year fallow" management practices utilized on some traplines compared to annual age class and composition trapping management practices used on others.

Information developed from the these work elements would be used to design guidelines and management strategies which individual trappers could use to determine optimal marten harvest while maintaining healthy marten populations.

N-368.013: Denali Subsistence Cabin Use Study

See Subsistence Program Management DENA-S-100.012.

C. Monitoring

N-368.031: Initiate A Furbearer Harvest Monitoring Program

Park staff and the Subsistence Resource Commission will work with local trappers and the state to establish a furbearer harvest monitoring program. Information will be obtained from the ADF&G and the USFWS data bases on furbearer population monitoring studies and harvest data information. Data will be organized and where appropriate entered into the park's computerize data base. Data will be evaluated to identify gaps in furbearer information and prepare proposals for future population monitoring studies. Staff will work with the ADF&G, USFWS, Subsistence Resource Commission, and local subsistence users to develop harvest reports for furbearers that are more specific in identifying harvest that occur from park or preserve lands.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Develop Trapline Management Program			30.0/0.5	2.0/0.2	32.0/0.7
RESEARCH					
- Trapline Customs and Traditions	80.0/1.0	80.0/1.0			160.0/2.0
- Conduct Marten Study	82.0/1.0	82.0/1.0	82.0/1.0	82.0/1.0	328.0/4.0
MONITORING					
- Furbearer Harvest Monitoring	6.0/0.3	6.0/0.3	6.0/0.3	6.0/0.3	24.0/1.2
TOTALS	168.0/2.3	168.0/2.3	118.0/1.8	90.0/1.5	544.0/8.9

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before

initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Alaska National Interest Lands Conservation Act. Public Law 96-487, 96th Congress.

Archibald, W.R. and R.H. Jessup. 1984. Population dynamics of the Pine marten (Martes americana) in the Yukon Territory. Pages 81-91 in R. Olson, R. Hastings, and F. Geddes, eds. Northern ecology and resource management. The Univ. Alberta Press, Edmonton.

Bishop, R. 1978. Subsistence Resource Use in the Proposed North Addition to Mt. McKinley National Park. Occasional Paper No. 17. 115 pp.

Code of Federal Regulations. 36 CFR Part 13. 1995.

Lensink, C. J. 1953. An investigation of the martin in interior Alaska. M.S. Thesis, University of Alaska, Fairbanks.

Magoun, A.J., R.M. Gronquist, AND D.J. Reed. 1988. Development of a field technique for sexing and aging marten. Final Rep. Coop. study Alas. Dep. Fish and Game and Nowitna Natl. Refuge. 33pp.

Shults, B.S. 1991. Research proposal, Population dynamics of harvested marten population in interior Alaska. 20pp.

Strickland, M.A. and C.W. Douglas. 1987. Marten. Pages 531-546 in M. Novak, J.A. Baker, M.E. Obbard, and B. Malloch, eds. Wild furbearer management and conservation in North America. Ontario Trapper Assoc., North Bay, Ont., Canada. 1150pp.

Report of the Committee on Energy and Natural Resources, United States Senate, 1979. Report Number 96-413, 96th Congress.

USNPS, 1984. Land Use in the North Additions of Denali National Park and Preserve: An Historical Perspective. National Park Service, Alaska Region, Research/Resources Management Report AR-9. 91pp.

USNPS, 1986. Final General Management Plan, Land Protection Plan. National Park Service, Denali National Park and Preserve. 231pp.

USNPS, 1996. Use of Cabins and Other Shelters Associated with Subsistence Activities in Selected Areas of the North Additions to Denali National Park and Preserve. Draft Cabin Study Report. On File at Denali National Park and Preserve, Division of Research and Resource Preservation.

SUBSISTENCE HUNTING PROGRAMS

PROJECT CODE: DENA-N-369

SERVICEWIDE ISSUES: N19 Loss of Park Resources Due to Consumptive Uses
N20 Lack of Basic Data

STATEMENT OF PROBLEM

Introduction

ANILCA provides for the continuation of consumptive subsistence practices in the new additions to Denali National Park and Preserve by local rural residents as long as fish and wildlife populations remain "healthy" in preserve areas and "natural and healthy" in the park areas. Since ANILCA did not define these terms, considerable debate will be necessary to understand what these terms mean in regards to management of wildlife resources on park and preserve lands.

In authorizing subsistence uses within Denali National Park and Preserve, Congress intended that certain traditional National Park Service values and management practices be maintained and that the agency should strive to maintain the natural abundance, behavior, diversity, and ecological integrity of native animals as part of their ecosystem. The National Park Service recognizes that subsistence uses by local rural residents have been, and are now, a natural part of the ecosystem serving as a primary consumer in the natural food chain.

Accordingly, Congress expects the NPS to take appropriate steps when necessary to insure that consumptive uses of fish and wildlife not be allow to disrupt or drive the natural balance which has been evolving for thousands of years.

In addition, ANILCA provides a preference for local rural residents over other consumptive users should a shortage of subsistence resources occur and allocation of harvests becomes necessary. This is particularly important for national preserves where state sport hunting and trapping are allowed in addition to federal subsistence hunting and trapping.

The state of Alaska managed statewide subsistence harvests until 1989 when the Alaska Supreme Court ruled that rural residency preference required by federal law violated the Alaska

Constitution. As a result, in 1990 the federal government established a federal subsistence management program to manage subsistence take of fish and wildlife on federal public lands in Alaska.

The federal and state programs each operate under separate legislation and regulations. The Federal Subsistence Board oversees subsistence harvests on all federal public lands in Alaska including park and preserve lands. In national preserves where sport hunting and trapping are allowed, the Alaska Board of Game oversees the general and sport wildlife harvest. Alaska's dual wildlife management programs for state and federal hunting and trapping activities are the most complex in the nation.

The management and conservation of renewable resources requires considerable knowledge of the populations levels, compositions, age class structures, productivity, critical habitat and ranges, seasonal distributions and movements, and harvest levels by sport and subsistence users. Many wildlife species have large home ranges which extend well beyond the park and preserve boundaries onto state and native lands. Management of these wildlife resources will require cooperative efforts with neighboring agencies and land owners. Dual advisory programs and regulatory processes require a significant amount of time and commitment by the public and agencies.

Present Condition

In 1985, the Denali Subsistence Resource Commission was formed to advise the park Superintendent, the Governor of the state of Alaska, and the Secretary of the Interior regarding a subsistence hunting program for the park. The commission continues to meet at least twice a year to provide recommendations on the park's subsistence hunting program, and to advise the recently established Federal Regional Subsistence Advisory Councils and the Federal Subsistence Board regarding Denali's subsistence users needs.

As a result of recent court cases which have increased management responsibilities regarding subsistence use of fish and wildlife resources on federal public lands in Alaska, a full time position has been established at Denali to administer the park and preserve hunting programs. The subsistence specialist is dedicated to coordinating and participating in both natural and cultural research activities related to subsistence use, coordinating activities with public advisory groups and regulatory boards, and performing the administrative duties required by ANILCA and federal regulations.

In 1992, nine Federal Regional Subsistence Advisory Councils were established to advise and make recommendations to the Federal Subsistence Board regarding subsistence use of fish and wildlife on federal public lands in Alaska. The regional councils meet twice a year to receive public comments and review proposals to change federal subsistence regulations. The Federal Subsistence Board meets annually to decide on changes to seasons, harvest limits, methods and

means, and customary and traditional use determinations related to taking of fish and wildlife on federal public lands.

In a similar manner, the state of Alaska through the Department of Fish and Game, manages subsistence resources on nonfederal lands and sport hunting on certain federal lands where authorized by ANILCA. The Board of Game meets regularly to receive comments and proposals to change state hunting regulations from the public and local fish and game advisory committees.

The main subsistence species hunted in Denali are moose, caribou, ptarmigan, spruce grouse, and hare. In general, black and grizzly bears are not actively hunted, but are taken when they pose a threat to life for property, incidental to other hunting, or when other meat is not available. Large mammals account for 70% of the resources used and are typically hunted in the fall or in early winter. Some furbearers (coyote, fox, lynx, wolf and wolverine) also have established hunting seasons and harvest limits.

Current Management Actions and Results

Park staff periodically conduct wildlife censuses and monitoring studies for large mammals which are frequently hunted such as moose, caribou, bear and sheep. Wildlife populations are surveyed within both the old park area, which is not open to consumptive uses, as well as in the new park and preserve additions. Whenever possible, park staff work cooperatively with the ADF&G and USFWS on wildlife census and monitoring projects.

Park staff prepare and review proposals for changes in hunting and trapping regulations to both the state and the federal regulatory processes. Park staff will occasionally take the lead in preparing and presenting a detailed staff analysis for a proposed regulatory change which directly affects Denali resources or its users. Park staff frequently consult with USFWS staff regarding wildlife proposals, status of wildlife resources, and subsistence use activity.

Biological data, harvest information, and community use data are shared with other wildlife management agencies. Some harvest report statistics and community profile databases for the Denali area have been acquired from the ADF&G and the USFWS.

A National Park Service workgroup has been formed to begin work on clarifying what is meant by the terms "healthy" and "natural and healthy" as they apply to preserves and parks.

There are three federal registration permit subsistence hunts authorized within the current subsistence hunting regulations. Because of the special eligibility requirements for subsistence hunting on NPS lands, Denali National Park staff are responsible for issuing the annual permits for moose and caribou hunting in Wildlife Unit 13E and moose in Wildlife Unit 16B. Park staff

travel to Cantwell and Skwentna to facilitate issuance of registration permits. Permits are also issued throughout the hunting season from park headquarters.

Due to concerns for visitor health and safety in the developed area of Kantishna, a temporary closure to the discharge of firearms during a portion of the hunting season when the commercial facilities are in operation is implemented. The closure encompasses an area of approximately ten square miles along the Kantishna road from the Kantishna airstrip to the old Mt. McKinley National Park boundary.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-369.001: Acquire Past Wildlife Population and Harvest Data

Resource management staff will make a coordinated effort to obtain population monitoring and harvest data for the Denali National Park and Preserve region from the ADF&G and USFWS. Data will be organized and filed, and where appropriate, entered into a computerized data base. Staff will evaluate existent data for consistency, identifying gaps and seek cooperative agreements and funding to accomplish needed population censuses and monitoring. Park staff will work with ADF&G and local subsistence users to obtain harvest reports that are more specific to NPS lands and represent local subsistence uses.

N-369.002: Develop Cooperative Management Plans

Park staff will seek to develop cooperative management plans with other agencies and/or organizations for wildlife species that are dependant upon habitat both within and adjacent to the park and preserve. Cooperative opportunities exist for management of moose, black bear and grizzly bears along the southside of Denali National Park and Preserve; Dall sheep in the southern preserve; wolf management areas along the exterior eastern boundaries of the park; and water fowl in the lakes region the northern park and preserve. Where appropriate, the park will seek partners with adjoining land management agencies such as the Denali State Park, Alaska Department of Fish and Game, U.S. Fish and Wildlife Service, and the Ahtna and CIRI Regional Native Corporations.

S-369.003: Denali SRC Subsistence Hunting Plan

As directed by Section 808 of ANILCA, park staff will continue to assist Denali's SRC in developing a comprehensive subsistence hunting plan for the park, and where appropriate, for subsistence hunting in the preserve. Components of this plan should include recommendations regarding eligibility for the park and if necessary the preserve; subsistence access; educational and interpretation needs for subsistence users and the general public; subsistence harvest monitoring programs for hunting and trapping; review of annual harvest regulations and proposals and coordination with the Federal Regional Subsistence Advisory Councils and Federal Subsistence Board; and identification of subsistence research needs.

Park staff will provide technical information and other pertinent data from field studies or investigations to assist the commission in formulation of the plan. The park will assist by providing administrative support for developing hunting plan recommendations and facilitating the consultation process with local advisory committees and regional advisory councils. As stated in Denali's GMP, the approved hunting program of the subsistence resource commission will be a primary component of the subsistence management plan.

N-369.004: Criteria for the Terms "Healthy" and "Natural and Healthy"

Park staff will continue to work with task group assigned to define what is meant by the terms "healthy" in preserve areas and "natural and healthy" in the park areas mean.

B. Mitigation

N-369.021: Manage Federal Registration Permit Hunt Program and Kantishna Firearms Closure

Park staff will continue to manage the federal registration permit hunts for moose and caribou in Wildlife Management Unit 13 and moose in Wildlife Management Unit 16B as authorized in the federal hunting regulations. Additional National Park Service regulations regarding eligibility requirements will guide issuance of permits for park lands. For non-park federal lands, Denali staff will continue to issue registration permits to rural residents that meet the general Federal requirements for moose or caribou hunting on other federal lands in Wildlife Unit 13, but are not qualified for use of park lands.

Park staff will work to promulgate a special regulation to establish a reoccurring annual closure to the discharge of firearms in the developed area of Kantishna during periods of high visitor use activity. In the interim, park staff will instigate a temporary firearms closure during the period of high recreational visitor use activity and hunting season.

Park staff will continue to work with the Denali Subsistence Resource Commission to address this public health and safety issue and potential conflict with visitor use and subsistence hunting opportunities.

C. Monitoring

N-369.031: Initiate A Cooperative Harvest Monitoring Program

Park staff and the Denali Subsistence Resource Commission will work with local hunters and trappers to establish a harvest monitoring program. Information will be obtained from the ADF&G and the USFWS data bases on wildlife population monitoring studies and harvest data information. Data will be organized and where appropriate entered into the park's computerize data base. Data will be evaluated to identify gaps in wildlife information and prepare proposals for future population monitoring studies. Staff will work with the ADF&G, USFWS, the Denali Subsistence Resource Commission, and local subsistence users to develop harvest reports for wildlife that are more specific in identifying harvest that occur from park or preserve lands.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Acquire Harvest Data	3.0/0.2	1.0/0.1	1.0/0.1	1.0/0.1	6.0/0.5
- Cooperative Mgmt Plans		10.0/0.5		10.0/0.5	20.0/1.0
- Define Natural and Natural and Healthy	4.0/0.3				4.0/0.3
MITIGATION					
- Manage Permit Hunts	2.0/0.2	2.0/0.2	2.0/0.2	2.0/0.2	8.0/0.6
MONITORING					
- Cooperative Harvest Program	5.0/0.4	5.0/0.4	5.0/0.4	5.0/0.4	20.0/1.6
TOTALS	15.0/1.1	40.0/1.8	8.0/0.7	18.0/1.2	78.0/4.0

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Alaska National Interest Lands Conservation Act. Public Law 96-487, 96th Congress.

Bishop, R. 1978. Subsistence Resource Use in the Proposed North Addition to Mt. McKinley National Park. Occasional Paper No. 17. 115 pp.

Code of Federal Regulations. 36 CFR Part 13. 1995.

Report of the Committee on Energy and Natural Resources, United States Senate, 1979. Report Number 96-413, 96th Congress.

USNPS, 1984. Land Use in the North Additions of Denali National Park and Preserve: An Historical Perspective. National Park Service, Alaska Region, Research/Resources Management Report AR-9. 91pp.

USNPS, 1986. Final General Management Plan, Land Protection Plan. National Park Service, Denali National Park and Preserve. 231pp.

N-400

PALEONTOLOGY

PROJECT CODE: DENA-N-400

SERVICEWIDE ISSUES:
- N20 Lack of Basic Data: Insufficient Understanding of Park Ecosystems and Threats to Them
- N24 Other Issues: Threats to Public Health and Safety by Geological Processes

STATEMENT OF PROBLEM

Introduction

Paleontological resources are those resources that represent or give evidence to the existence of past life and/or past conditions. These resources can range from microscopic plant materials (i.e. diatoms, fungal spores, pollen etc.) and animal materials (i.e. connodonts, radiolarians, foramenifera, etc.), to large plant or animal remains, such as stem or leaf imprints, mollusk remains, or dinosaur skeletons. They can also be trace fossils, which are the evidence of past activity such as tracks, root traces, coprolites, nests, burrows, and other features.

The management and protection of paleontologic resources is addressed in the National Park Service Management Policies (4:19):

> o Paleontological resources, including both organic and mineralized remains in body or trace form, will be protected, preserved, and developed for public enjoyment, interpretation, and scientific research in accordance with park management objectives and approved resource management plans.
>
> o Paleontological research by the academic community will be encouraged and facilitated...
>
> o Management actions will be taken to prevent illegal collecting and to prevent damage...
>
> o localities and settings will be adequately documented...

In some cases, paleontological resources can occur in an archeological context, in which case

the management and protection of these resources are also protected by the Archaeological Resources Protection Act (1979), and some interpretations of the Antiquities Act have included protection considerations for paleontological resources.

In the Paleontological Resources Management section of the National Park Service Natural Resource Guidelines (NPS 77), it is suggested that efforts be made to identify resources through: literature surveys, collection (permit) surveys, identification of significant or sensitive areas, and paleontological surveys (inventory).

Additionally, this section of NPS 77 identifies management concerns which include:

- site significance determinations
- protection or preservation options
- collecting permit procedures
- research standards
- repository or curatorial obligations

Paleontological resources are intimately tied to geologic resources. As described in the Geology Project Statement (DENA-N-311), most of the geologic data or information on Denali is either of a cursory reconnaissance level, is limited to small site-specific areas, or is entirely lacking. Paleontological resource data, which is usually obtained as an accessory to geologic mapping and research, is additionally limited in Denali because fossil data are only one part of geologic mapping efforts.

Paleontological discoveries rarely get the attention to detail (species, variety, ecological context) when they are found during geologic mapping projects. This problem is due partially to the lack of involvement of paleontologists, whose specialty is frequently overlooked or underplayed when assembling geologic field mapping parties. Thus, the field recognition, collection, and sometimes even the determination of age and paleo-ecological setting of fossil-bearing horizons, is relegated to geologists, who frequently do not have the expertise for such applications and assignments.

This discrepancy, or lack of paleontological involvement, has resulted in many data limitations about the stratigraphy, fossil content and tectonic setting of Denali and Central Alaskan geology as a whole. Large segments of Paleozoic and Mesozoic rocks, and even some Tertiary age rocks are poorly understood or controlled, in regards to paleontological data. Current tectonic models, often based on lithologic and stratigraphic evidence alone, lack the age control that can be afforded by the systematic assessment of paleontologic resources by qualified paleontologists.

Additionally, paleoclimatic conditions, which are partially deciphered through paleoinvertebrates, are poorly understood within Denali and central Alaska. This results from very limited efforts in Quaternary and Late Tertiary research in the area. Current emphasis on global warming, resources inventory and ecological monitoring would suggest a need for additional data regarding

past climates and environments.

Present Condition

As mentioned above, geologic data on the park is still in reconnaissance status, and paleontological resources similarly remain unknown and unprotected, due to this associated data deficiency. Additionally, little information is available for assessing depositional or stratigraphic histories, tectonic evolution, or even the rudiments of earth history in the park or central Alaska.

The bulk of the known paleontologic resources within Denali consists of marine macro and micro fossil invertebrates which are found in Paleozoic and Mesozoic marine sedimentary units. Currently, 1068 fossil records are known to exist in 276 localities as referenced in 46 journal articles, government documents, and other sources. No doubt numerous marine fossil localities from within the park are reported in more obscure publications, and many additional park fossil sites have gone unpublished or unreported.

Although the above citations suggest some 276 fossil sites within the six million acres of the park, few of these sites have been systematically sampled, nor have attempts been made to maintain detailed stratigraphic control or to evaluate the depositional histories related to their burial or emplacement. Essentially, these sites represent brief reconnaissance sampling that, at best, would give basic time signatures to large, undifferentiated rock units. In most cases, even relative time brackets for these undivided or undifferentiated units are grossly lacking.

Reports from adjacent areas are frequently the best source of data regarding expected or likely paleontological resources and their associated depositional and tectonic implications within the park. Recent work in an area to the southwest of the park on Frasnian (lower Upper Devonian) megafauna correlates with in-park fauna in the Shellabarger Pass area to further substantiate a depositional sequence interpretation of the Dillinger and Mystic terranes (Blodgett and Gilbert 1992). Additional work at Shellabarger Pass will help confirm or deny a lateral equivalence with several terranes and further refine a Frasnian Central Alaska carbonate platform-type depositional history.

Pre-Tertiary floras are not known to occur within the park, with the exception of a Permian broadleaf (*Zamiopteris* sp.) found within the "Mt. Dall Conglomerate". These are the only known Permian flora of this type in North America north of the Dunkard Basin of Eastern Pennsylvania (Mamay and Reed in Coonrad and Elliot, 1981). More recent fossil botanical specimens (*Metasequoia*, *Populus arctica*, and *Ginko*, to name a few), are found abundantly in the Paleocene to Cretaceous Cantwell Formation (Wolfe and Wahrhaftig 1970), and near present-day plant assemblages are found slightly less abundantly in the Mid to Late Tertiary Coal Bearing Group (Wolfe in Hawley and Clark 1974, Mullen in Csejtey 1992).

Vertebrate paleontological resource finds are especially rare within the boundaries of the park. The only known occurrences are probable Pleistocene vertebrate remains (possibly bison)

reportedly eroding out of a bank on the Bearpaw River in the northwesterly portion of Denali (Howell 1987). Older (Pre-Tertiary) vertebrate evidence might be exceptionally difficult to find due to the accretionary tectonic history of much of the park (potentially long transport distances and moderate to extensive alteration), and many potential fossil bearing strata are indeed unlikely to have retained their specimens in recognizable form.

However, due to the reconnaissance level of knowledge about most of the bedrock geology, the possibility for vertebrate specimens should not be ruled out. For example, recent palynologic evidence from the Cantwell Formation, an autochthonous continental/fresh-water sedimentary unit, verifies a Cretaceous lower limit for the unit, which was previously thought to be no older than Paleocene (Trop & Ridgeway pers. comm. 1994). This may have implications for the potential discovery of Late Mesozoic vertebrates (dinosaurs) and/or other Cretaceous-Tertiary (K-T) boundary physical or biological phenomenon.

Late Tertiary and Quaternary flora and fauna finds are surprisingly rare within the boundaries of the park. Extensive glaciation, permafrost, and eolian processes, although frequently providing excellent preservation conditions, also do much to destroy or conceal the fossil potential landscape. Furthermore, the lack of development or construction within the park does well to keep paleontological materials undiscovered. Other locations within the state of similar age and similar types of deposition, have furnished many significant finds of Pliocene to recent specimens, and a reasonable potential exists in Denali for fossils of this age bracket.

Future additional fossil locality finds are always in high probability in areas where only cursory reconnaissance level geologic mapping has occurred. The potential for Paleozoic and Mesozoic macro and micro fauna is excellent. Extensive marine sediments, of both deep and shallow water affinities, are largely unmapped and are often lumped with igneous or metamorphic rocks in undifferentiated units, requiring, as a next step, detailed stratigraphic description and age control. Known fossil bearing strata or lithologies are not precision mapped for their surface extent, where additional fossil localities are likely to be found. Geologic mapping and structural relationships at a regional scale (1:250,000) do not provide the detail to systematically expand a paleontological inventory in many locations of the park.

Current Management Actions and Results

Program Administration - An unofficial bibliography of geologic and paleontologic references is kept by the park Geologist. Additionally, over 200 journal articles, bulletins, and other documents are in residence in the park's libraries.

Current cooperation with other agencies, institutions, and individuals regarding paleontologic data acquisition is mostly under research or collection permit conditions. Efforts are ongoing to establish or update cooperative agreements, memoranda of understanding (MOUs) and project specific documents, particularly when large or long-term projects are anticipated. Potential cooperating partners may include the US Geological Survey (USGS), Alaska State Division of

Geophysical and Geological Survey (ADGGS), Soil Conservation Service (SCS), US Forest Service (USFS), University of Alaska, Fairbanks (UAF), UAF Geophysical Institute, and many others. A memorandum of understanding between the USGS and NPS for the purposes of collaborative research, inventories, monitoring, and data exchange in geological sciences, including paleontology, has been finalized. Additional efforts should be made to formally establish relationships with other agencies and institutions.

Research - Recent projects regarding paleontological research within Denali have been mostly minor efforts associated with geologic mapping. Attempts are ongoing to update the 1:250,000 Mt. McKinley Quadrangle Geologic map in partnership with USGS. This effort has resulted in several micro fossil finds that may revise some time-unit thinking. Additional efforts are planned, with a paleontology emphasis, to investigate macro and micro flora and fauna in the Shellabarger Pass area, and at certain points with the Cantwell Formation.

Mitigation/Interpretation - There are no attempts by the NPS to identify, or otherwise call attention to any known paleontological site or locality within the park for interpretive purposes. Additionally, the NPS has not established a need to formally protect or monitor known paleontological sites, nor has there been a need to mitigate any existing natural or human caused threats or damage to known sites.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-400.001: Coordinate Paleontology Programs with Other Agencies and Institutions

Establish contacts, memoranda of understanding, and cooperative agreements regarding inventory, research, interpretation and protection of paleontologic resources, and enhance the availability of paleo data. Encourage and enhance park personnel participation in outside research and other data collection endeavors.

N-400.002: Involve PFT Geologists or Physical Scientist in Recognition and Evaluation of Paleontologic Resources

See DENA-N-311, DENA-N-312, DENA-N-314, and DENA-N-320.

N-400.003: Create Dedicated Temporary Seasonal Physical Science Position

A physical science technician would provide program assistance, field support, and data manipulation for many branch operations. A dedicated seasonal position would greatly enhance the resource knowledge by accomplishing literature searches, developing paleo bibliographies and databases, assessing field inventory targets and needs, and

participating in field data collections (DENA-N-311, DENA-N-314, and DENA-N-320).

B. Research

N-400.011: Inventory and Map Park Paleontology Resources

Determine areas (bedrock or surficial deposits) of known vertebrate and invertebrate fossil occurrences, and evaluate additional data needs. Evaluate these depositional unit(s) in areas where fossils are not known to exist to establish target search areas. Type areas, species and other pertinent physical features should be photodocumented with annotations or full reports describing the particulars of each site, strata, or occurrence. Microfossil data should similarly be cataloged as to sites of occurrence, (strata or horizon) and other pertinent data. Detailed geologic mapping should be considered for each site on an as needed basis to further characterize the horizontal and vertical extent of the fossil occupance, and the depositional environment (DENA-N-400-014 below).

N-400.012: Initiate NPS and Cooperative Special Studies

The NPS would address special topics, features or problem areas by initiating research projects independently or cooperatively with other agencies. Projects could include known site refinements & recollections, inventories on target rock units, refinement of stratigraphic controls, data improvement on stratigraphic relationships, or any of many unanswered paleo/geologic dilemmas within the park. Coordination and cooperation with specialists in other agencies or institutes would be encouraged. Listed below are a few potential special study areas:

Shellabarger Pass-Refine lithology and paleontology
Chulitna terrane-Refine unique stratigraphy in park
Windy/Foggy Pass-Stratigraphic and paleontologic inventory
Savage-Toklat Limestone-Inventory/evaluate Devonian-Ordorvician unit
Dillinger River-Map and photodocument Ordovician units.

N-400.013: Support Independently Funded Paleontologic and Palynologic Projects

The service would support independently funded paleontologic research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities, when deemed appropriate by park management. The park would provide temporary housing and logistical support for field and laboratory work, if possible (Research Administration and Management DENA-I-410).

N-400.014: Coordinate and Enhance Paleontological Resource Personnel and Data Collection Efforts in all Geologic and Geoscience Research Efforts

Insure that paleontologic components exist in all research geoscience project proposals where appropriate, and encourage the participation of qualified paleontologists in those projects.

C. Mitigation

N-400.021: Provide for the Protection of Known or Newly Discovered Paleontological Sites as Necessary

D. Monitoring

N-400.031: Periodically Visit and Evaluate Paleontological Sites for Current Condition and Protection Needs

E. Interpretation

N-400.041: Encourage Public Awareness of Paleo-Resources

Develop public displays, provide books, monograms, brochures, slides and or videos, and encourage interpretive programs regarding the paleontologic wonders of Denali. (Geology Project Statement DENA-N-311)

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- GIS Paleontologic Database			1.5/0.0	1.5/0.0	3.0/0.0
- Seasonal Temp.	6.0/0.3	6.0/0.3	6.5/0.3	6.5/0.3	25.0/1.2
RESEARCH					

- Paleontologic Inventory (helicopter)	25.0/0.0	25.0/0.0	50.0/0.0	50.0/0.0	150.0/0.0
- Special Studies (helicopter)	2.5/0.0	2.5/0.0	3.5/0.0	3.5/0.0	12.0/0.0
- Independent Studies	1.5/0.0	1.5/0.0	1.5/0.0	2.5/0.0	7.0/0.0
MITIGATION AND MONITORING					
- Site Protection	0.0/0.0	1.0/0.0	2.0/0.0	3.0/0.0	6.0/0.0
INTERPRETATION					
- Geologic Guide	1.5/0.0	3.5/0.0	1.5/0.0	0.0/0.0	6.5/0.0
- Geologic Monograms	1.0/0.0	1.0/0.0	1.0/0.0	1.0/0.0	4.0/0.0
- Geologic Video		5.0/0.0	20.0/0.0	20.0/0.0	45.0/0.0
- Geologic Slides	0.5/0.0	0.5/0.0	0.5/0.0	0.5/0.0	2.0/0.0
- Rock Catalogue	0.5/0.0	0.5/0.0	0.5/0.0	0.5/0.0	2.0/0.0
TOTALS	40.0/0.3	50.0/0.3	97.0/0.3	93.5/0.3	281.0/1.2

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Blodgett, R. B., and W. G. Gilbert. 1992. Upper devonian shallow-marine siliciclastic strata and associated fauna and flora, Lime Hills Quadrangle, Southwest Alaska. in USGS Bull. 2041.

Brooks, A. H. 1911. The Mt. McKinley region, Alaska. USGS Professional Paper #70.

Capps, S. R. 1940. Geology of Alaska Railroad region. USGS Bull. 907.

Csejtey, B. Jr., et al. 1992. Geology and geochronology of the Healy quadrangle, Alaska. USGS Misc. Invest. Series.

Mamay, S. H. and B. L. Reed. 1981. Permian plant megafossils from the conglomerate of Mt. Dall, central Alaska range, in Coonrad, W.L. and Elliot, R.L., The United States Geological Survey in Alaska: accomplishments during 1981. USGS Circular 868.

Moxham, R. M. et al. 1953. Geology and cement raw materials in the Windy Creek area, Alaska. USGS Open File Report, 1953.

NPS - Howell, W. et al. 1987. Mining compliance site inventory form. AHRS No. MMK - 088, Field Site No. DENA-87-015.

Reed, B. L. and S. W. Nelson. 1980. Geologic map of the Talkeetna quadrangle, Alaska. USGS Misc. Invest. Series Map I-1174.

Reed, J. C. 1961. Geology of the Mt. McKinley quadrangle, Alaska. USGS Bulletin 1108A.

Ridgeway, K. D. 1993. Tectono-stratigraphic analysis of the Cantwell basin, Alaska range, Alaska. Project proposal to NPS Denali. 11 pp.

Wolfe, J. A. 1974. In Hawley, C. C, and A. L. Clark. Geology and mineral deposits of the upper Chulitna district, Alaska: USGS Professional Paper 758-B.

Wolfe, J. A., and C. Wahrhaftig. 1970. The Cantwell formation of the central Alaska range. In Cohee, G. V. et al. Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1968: USGS Bulletin 1294-A.

N-500

Natural Resource Program Management

PROJECT CODE: DENA-N-500

SERVICEWIDE ISSUES: N24 Other

STATEMENT OF PROBLEM

Denali National Park and Preserve contains significant atmospheric, aquatic, geologic, soil, paleontological, and terrestrial biotic resources. These natural resources are highly dynamic ecologically. Denali is one of the premier protected areas in the world. The Park is also a complex management environment for natural resources that are difficult to access, and are vulnerable to the pressures of development, growing visitation, and, in some cases, subject to harvest.

Present Condition

Denali has been fortunate to have had a steady stream of biologists on staff or closely affiliated with the Park since early in this century. However, up until the beginning of the last decade, the number of biologists has been limited to a handful. Recently staffing has increased in number and disciplinary scope. At present, the Division of Research and Resource Preservation includes nine professional, four technical, and approximately nine seasonal technical staff members (numbers exclude employees engaged in administrative, compliance, information management, and subsistence functions). The division includes a Program Management Group, a Branch of Wildlife and Vegetation as well as a Branch of Water, Air, Geology, and Soils that have primary focus on natural resources or oversight responsibilities related to natural resources. Growth to this size has been in response to many significant resource issues such as wolf preservation, mining operations, and air quality threats. Some growth has stemmed from program initiatives such as global climate change and resource inventory and monitoring.

Funding increases and operational support (vehicles, computers and other equipment, supplies) have also occurred concurrent with staffing growth.

Early staffing and funding committed to resource management were targeted at specific, high profile resource issues (i.e., predator management). This pattern has continued until relatively

recently. As a result, the park's resources management program and the body of scientific information about park resources tends to be unbalanced. These shortcomings have been recognized and some measures have been taken to correct them. Rapid growth and changing workloads have, however, outstripped the ability of the service to keep up and many deficiencies still exist.

Current Management Actions and Results

The following Table lists all ongoing and funded natural resource management activities that are supported by the park.

Table 13.

CURRENT RESOURCE MANAGEMENT ACTIONS - FULLY OR PARTIALLY FUNDED

RMP Project Statements	Action Items
I-210 Long Term Ecological Monitoring	.002 Cooperative Programs .006 Report Preparation .012 Integrate Data
I-220 Resource Inventory	.002 Data Standards .004 GIS Plan .012 Complete Inventories .013 Digitization .023 Operate GIS/AutoCAD .031 Document Monitoring
I-300 Curatorial Management	.003 Cataloging .005-.007 Collection Planning
N-110 Air Quality	.001 Document/Permit Review .013 Road Dust Assessment .021 HCCP Mitigation .031 AQ Station Operations .033 Regional Network .034 DISPro
N-120 Meteorology	.035 Station Operations
N-210 Water Resources Management	.032 LTEM Program
N-311 Geologic Resources	.011 McKinley Quad Mapping .013 Special Studies .015 Engineering Support
N-312 Geologic Hazards Management	.032 Monitoring

N-313 Minerals Management	.003 Plans of Operation .032 Monitoring Operations .033 Hazmat Recertifications .034 Monitoring Reclaimed Areas
N-314 Glacial Resources	.011 Glacial Surge Investigations .031 Monitoring .036 Index Stations
N-320 Soil Resources	.011 Parkwide Soils Inventory .033 Monitoring
N-330 Terrestrial Vegetation	.005 Vegetation/Landcover Map .031 Monitoring
N-361.1 Passerines	.131 Breeding Bird Surveys .132 MAPS .133 Point Counts
N-361.4 Raptor Management	.411 Golden Eagle Study .431 Nest Monitoring
N-362.1 Dall Sheep Management	.131 Monitoring
N-362.2 Moose Management	.231 Moose Census
N-362.3 Caribou Management	.331 Annual Census
N-364.1 Wolf Management	.131 Monitoring .133 Monitor State Control .141 Public Information
N-364.2 Bear Management	.203 Training .204 Update Plan .205 Include in Planning .211 Bear Research .222 Implement Closure Procedures ,223 Implement Aversive Conditioning .224 Interagency Links .231 Monitor Conflicts .233 Update BIMS .241 Public Information .251 Regulation Enforcement
N-400 Paleontological Resources	.011 Inventory
N-510 Integrated Pest Management	.001 Program Management
N-520 Wildland Fire	.001 Fire Program Management .002 Fuel Reduction Planning .031 Wildfire Surveillance
N-530 Ecological Restoration	.022 Reclamation

Expansion of park natural resources programs has not been without problems. Significant deficiencies in each of several program areas are described below.

Planning, Staffing/Funding, and Facilities

Deficiencies in each of these categories and proposed actions to correct them are described in individual project statements that largely preceded this project statement.

Specific natural resource staffing recommendations include restoration of the Plant Ecologist position to manage vegetation programs and assist with restoration/reclamation, creation of an Ornithologist position to manage avian programs including the variety of monitoring efforts that are currently underway, and creation of a physical science position to manage meteorology, glaciology, and various other physical science programs. These core positions would be augmented by seasonal and permanent technicians. See individual project statements for details.

Information Management

Many of the project statements located throughout this document point to the need for improvements in information management. Such things as collection of reference materials and preparation of bibliographies, greater use of the Internet, and expansion of the park's geographic information system are all examples of those proposals. While these needs apply to the subsistence and cultural resources disciplines, they are particularly acute in the biological and physical sciences.

Interagency and NGO Cooperation

A number of project statements call for improved relationships with other agencies. The U.S. Geological Survey and the Alaska Department of Fish and Game are the most frequently cited. The division needs to take specific efforts to work with other agencies and organizations to improve the exchange of technical information and to improve working relationships. Potential candidates would include the Geophysical Institute, UAF, The Nature Conservancy, the Environmental Protection Agency, the Water Resources Division, USGS, Alaska Department of Natural Resources, and so forth.

RECOMMENDED ACTIONS

A. Program Administration and Planning

N-500.001: Build Park Natural Resources Bibliography

Incomplete and irregular format bibliographies would be updated and standardized to current resource database requirements. Coordination with other agencies and individuals regarding published and unpublished data and formal, informal or unknown collections is required to fulfill this project. Weak topics in the park technical area include paleontology, aquatic invertebrates, geology, glaciology, floristics, autecology, and plant ecology.

N-500.002: Improve Information Gathering System

Improve system for gathering wildlife observation information. Much natural history information can be gained from interested individuals through the reporting of wildlife observations. Such a system has been in effect in Denali for some years but needs much refinement. If properly publicized and handled this system can be useful for providing information on species with little or no intensive research.

N-240.003: Develop GIS Applications

Implement a program to manage all data in such a way that it is compatible and readily accessible for use in making sound planning and management decisions. A geographic information system (GIS) is a tool that will allow managers to store, manipulate and analyze data, and produce and display mapped information. It has direct use in research as well as resource management and planning (Resource Inventory and Mapping DENA-I-220).

N-500.004: Provide Avenues for Information Exchange

Foster the exchange of information on raptor, waterfowl, shorebird, passerine research, conservation, and management, and technical assistance among National Park Service units, and other federal, state, local, educational, international, and private agencies. Provide a park representative to the Boreal Partners in Flight working group.

N-500.005: Provide Interagency Coordination

Coordinate and cooperate with efforts of the USFWS, Endangered Species Office, to

comply with the Endangered Species Act of 1973, as amended, and to support additional programs which give appropriate attention to candidate, sensitive, and other unlisted species.

N-500.006: Enhance Cooperation with Other Agencies

Staff would commit a percentage of their time to improving relationships with personnel from other agencies and non-governmental organizations. Some travel time may be required for office visits.

N-500.007: Provide Training and Professional Development Opportunities

Opportunities to attend formal training courses, regional workshops, and conferences would be supported to assure professional development of all natural resource staff. Opportunities would also be developed for greater involvement of Resource Apprenticeship and Cooperative Education Programs.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Natural Resources Bibliography	2.0	2.0	2.0	2.0	8.0
- GIS Applications	20.0	20.0	20.0	20.0	80.0
- Interagency Cooperation	5.0	5.0	5.0	5.0	20.0
- Training	10.0	10.0	10.0	10.0	40.0
TOTALS	37.0	37.0	37.0	37.0	148.0

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

INTEGRATED PEST MANAGEMENT

PROJECT CODE: DENA-N-510

SERVICEWIDE ISSUES:	N05	Degradation of Park Resources Due to Non-Native Plants
	N20	Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
	N24	Human Impacts Within and Adjacent to Park

STATEMENT OF PROBLEM

Present Condition

The National Park Service identifies pests as "animal or plant populations that interfere with the purposes of a park." Exotic species clearly fall within the scope of this definition. Many fungi, diseases, plants, and animals, that are native components of the ecosystem may fall within the scope to the servicewide definition of pests as well. Within Denali National Park and Preserve, all exotic pests will be controlled or eradicated but native pests will be allowed to function unimpeded except where resource values or land management practices necessitate control to prevent the loss of host species from the ecosystem, to prevent pest outbreaks from spreading outside the park, to protect threatened, endangered, or unique species or communities, to preserve the historical integrity of cultural resources, to conserve species in developed zones where they have identified cultural values, and to manage a human health and safety hazard. Park philosophy is that extreme caution will be used in determining whether or not a native species will be manipulated or treated as a pest.

Since the late 1970's, a number of pests or, more often, situations wherein resource manipulation was necessary, have been documented in Denali National Park. Prior to this date, no records are available which indicate any pest management problems except for one instance where DDT was used to control mosquitoes (1947) in the headquarters area. The impact of DDT was obviously not known at that time. Over the past twenty-five years, managers at Denali have identified twenty distinct situations involving plants, animals and insects and determined that mitigation measures were necessary to assure protection of various park values or purposes. Following is a brief description of those situations:

Swallows have nested on the eaves of Eielson Visitor Center and at the residential cabins of the Wonder Lake Ranger Station. These swallows are considered pests. The robin that nests on the eaves of the picnic shelter of Eielson Visitor Center has been considered a pest due to it's close proximity to visitor activities in the picnic shelter. The airborne dust from the dried nesting material at these locations pose a health concern to those residents and visitors with allergies. The unsightliness of droppings is also a concern in areas of high visitor use.

A raven at Toklat has fed on the rubber of windshield wipers from government and private vehicles. Several new cabin window and door screens were replaced because of damage by the same raven. This raven began causing problems in the summer of 1993.

Two species of woodpeckers, identified as the three toed and the common flicker, have damaged the exterior of historic buildings in the headquarters area. The extent of this type of structural damage on a parkwide basis is unknown.

A red fox in the headquarters area first appeared in 1990 and is still sighted on occasion. This fox began approaching people in the headquarters area causing a health and safety concern. Residents, employees, and visitors approaching too closely are subject to potential rabies infection if bitten. It is suspected the fox may be showing signs of habituation to humans as a result of being hand fed in the past.

Beavers along the park road west of Eielson have become pests as they tend to block culverts when building dams. Periodic problems have occurred since the late 1970's. The situation was especially troublesome during 1992, when the Maintenance Division's roads and trails crew spent considerable time clearing culverts.

During the late 1980's, caribou started using the shade of the Eielson Visitor Center during sunny summer days. This created a safety hazard to park visitors and diverted the limited interpretive staff from normal interpretive work to deal with safety management.

Porcupines have eaten wood siding from buildings ranging from the Savage Check Station, to the ranger cabins at the Toklat Road Camp, to the Wonder Lake bus station. This problem has not been thoroughly documented but has cost the maintenance staff extra time and funding for materials.

Squirrels in the headquarters area have taken small amounts of insulation for nest construction from numerous buildings over the past twenty years. This activity continues on occasion and impacts the buildings with the loss of insulating material, requiring additional funding and effort for repair.

Grizzly bears that become habituated to humans in the park are considered pests (Grizzly and Black Bears DENA-N-364.2). Habituation to humans occurs when the bear obtains human food

that was improperly stored. Management actions may result in destruction of the bear if aversive conditioning is unsuccessful.

Bees and wasps have threatened workers and residents in the headquarters area, Toklat Road Camp, Wonder Lake Ranger Station, and backcountry patrol cabins. Nests are constructed in housing structures and in the ground near the work and play environments of staff and residents.

Mosquito Control was carried out in the headquarters area through the application of DDT in 1947. Mosquitoes have been identified as a nuisance and do not pose a health and safety concern. As a result, no further management action has been taken. An independent researcher from Yale University collected mosquito samples in the park in 1993. He attempted to identify viral infection in these mosquitoes but the results indicate that none were present.

German cockroaches were imported in 1982 or 1983 into headquarter's apartment complex (building #51). Six apartments and the headquarters recreation hall have been treated with traps and boric acid and remodeling has occurred. This has served to greatly reduce, if not eliminate, the roach population. Monitoring should continue.

Willows and dwarf birch in the east end of Denali have been infested by a blotch leaf miner and a geometrid caterpillar causing a large scale defoliation which was first noted in 1992. The U.S. Forest Service and the University of Idaho is studying the insect defoliation and, if found to be a natural occurrence, no control actions will be taken.

Willow species at the sewer lagoon near the park entrance are considered pests. They were manually cleared to create a sterile environment immediately along the contour of the lagoon in order to maintain the lagoon structure. Management actions were taken with the herbicide treatment of Rodeo to limit growth and kill the vegetation. Treatment began in the late 1970's and has continued sporadically. The last herbicide request was dated for application in 1986.

Other situations include exotic plants identified in Denali's Exotic Plant Management project statement (DENA-N-342.0). They include dandelion, brome grass, sweet clover and lambsquarters. These non-native plants present a potential disruption of natural ecosystems in Denali National Park.

Current Management Actions and Results

Management action has been taken on a case by case basis for identified conflicting situations as indicated in the exotic plant and the grizzly and black bear project statements (DENA-N-342.0, DENA-N-364.0). Most of the circumstances do not have an action plan as a guide for management actions. Following is a table which illustrates management actions taken for identified situation:

Situation	Treatment
Swallows	Visqueen/wood boards on eaves
Robin	Nixalite
Raven	None
Red fox	Hazing
German Cockroach Roach	Control bait trays
Willow	Rodeo
Woodpeckers	None
Exotic Plants	Manual Eradication
Beavers	Cages on Culverts
Caribou	Hazing
Porcupines	Chew Stop
Squirrels	None
Bees/Wasps Nests	Wasp Freeze
Grizzly Bears	Aversive Conditioning
Blotch Leaf Miner/ Geometrid Caterpillar	None

RECOMMENDED ACTIONS

In accordance with NPS Management Policies, integrated pest management (IPM) policies will be used to determine when to control pests and whether to use mechanical, physical, chemical, cultural or biological means. Guidelines need to be developed to describe the operational aspects as well as interdivisional relationships within the park related to pest management. A park IPM plan will be developed to describe the overall pest management problems and devise a program

to deal with them.

A. Program Administration and Planning

N-510.001: Develop an Integrated Pest Management Directive

The park will formally develop a directive to implement a parkwide IPM program. This IPM program would establish and implement guidelines for the roles and responsibilities of park managers and staff members related to pest management on an interdivisional basis.

Native or exotic species which could damage park resources will be identified. Pest species and their abundance or importance will be documented. Literature and information will be collected on those specific pests of concern.

Management of pest species will be aimed at a level which ensures resource protection, while reducing economic, ecologic, and social injury. It will encourage the non-chemical management of pests and provide alternatives which include prevention, biological, mechanical, physical, and cultural methods before utilizing chemical practices.

NPS and park specific policy will be spelled out to ensure safety, certification, approval, ordering, storage, documentation, and training for necessary staff members. The use of the IPM objectives and guidelines for the park will be referenced as a management tool.

N-510.002: Develop Pest Management Action Plans

An action plan will be developed for each major pest. The basic principles and guidelines of the parkwide IPM program will be applied directly to individual pest problems in the park. Information about pests will include description, biology, an action threshold, a monitoring program, documentation, and selective management tactics based on preventative strategies and an evaluation of alternative management techniques. As new pest problems arise, action plans addressing each problem will be developed.

N-510.003: Provide Necessary Training

A minimum of one employee in the park will be required to be certified as a commercial pesticide applicator from the state of Alaska and have completed the service's 40 hour IPM course. All staff members involved in pesticide applications will be informed of the parkwide IPM program and with the pesticide use policy as discussed in DENA-N-510.002. The application of any pesticide must be supervised by an employee who is state certified at the commercial applicators' level. This will ensure proper handling procedures, safety equipment, storage, and disposal to avoid hazards.

N-510.004: Consider Pest Management in All Facility Construction Activities

Park staff involved in the design and maintenance of facilities should be aware of the parkwide pest management program. Preventative measures should be taken during design and repair to limit pest damage to new and existing facilities.

B. Research

N-510.011: Develop an Inventory of Pest Species

Studies would be initiated to inventory all pests in the park. Action plans would be developed to address each pest as discussed in DENA-N-510.003. This inventory would include all pests discussed above as well as pests referred to in the Exotic Plant Management Project Statement (DENA-N-342.0). Currently Denali National Park does not have a complete inventory of the resources (pests) it is managing. Until the pest species inventory and action plan are complete, we will continue to manage pests as they arise.

N-510.012: Research Impacts of Pest Species

Based on the results of the pest species inventory mentioned in DENA-N-510.001, threats to humans and adjacent forests, from pests originating in the park, will be studied. This work will be coordinated with several other program actions. Refer to the Plant and Animal Diseases DENA-N-560.0 (in preparation), Terrestrial Invertebrates DENA-N-350.0 (in preparation), and Aquatic Invertebrates DENA-N-240.0.

C. Mitigation

N-510.021: Implement Action Plans

Comprehensive management actions would be implemented for each major pest after evaluating alternative management techniques. In the meantime, current actions on the identified pests will be managed on a case by case basis, following the NPS IPM approach.

D. Monitoring

N-510.031: Maintain Adequate Pest Monitoring Program

Organisms identified as pests that occur in Denali National Park will be systematically monitored. Monitoring and documentation of pest populations and injury levels will be used to carefully and thoroughly assess each pest problem. Monitoring will be conducted

before and after management actions are taken to evaluate program success.

E. Interpretation

N-510.041: Maintain Adequate Public Information about Pests

On occasion, concession tour bus drivers and visitors ask about the early fall colors in the east end of the park. The source of this early color is the blotch leaf miner that has infested the willow and caused the discoloration. This blotch leaf miner was documented in 1992 and may have been occurring in previous years.

Another source of questions stem from the caribou at the Eielson Visitor Center. Although these caribou pose a safety threat to the visitor and staff members at Eielson, the interpretive opportunities cannot be avoided as long as the caribou are in the area.

The park's interpretive, ranger, and resources management personnel would cooperatively develop and implement programs aimed at informing park visitors, neighbors, and employees about existing pest problems.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Integrated Pest Mgmt Directive	10.0/0.1	10.0/0.1			20.0/0.2
- Develop Action Plans	8.0/0.1	8.0/0.1	8.0/0.1	8.0/0.1	32.0/0.4
- Training	4.0/0.0	4.0/0.0	4.0/0.0	4.0/0.0	16.0/0.0
MITIGATION					
- Implement Action Plans	20.0/0.1	10.0/0.1	10.0/0.1	10.0/0.1	50.0/0.4
MONITORING					
- Monitor Pest Mgmt Programs	8.0/0.1	8.0/0.1	8.0/0.1	8.0/0.1	32.0/0.4
INTERPRETATION					
- Public Information		4.0/0.1	4.0/0.1	4.0/0.1	12.0/0.3

TOTALS	52.0/0.5	44.0/0.5	34.0/0.4	34.0/0.4	164.0/1.7

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

USNPS. 1988. NPS Management policies, Management of the National Park System. 4:13-14.

USNPS. 1984. NPS Integrated pest management, Washington D.C.

USNPS. 1991. NPS-77, Natural resources management guideline. National Park Service, Washington D.C. 219 pp.

FIRE MANAGEMENT

PROJECT CODE: DENA-N-520

SERVICEWIDE ISSUES:
- N07 Disruption of Natural Fire Regimes
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Present Condition

Fire is one of the most dynamic and influential environmental processes in tundra and taiga ecosystems. The complex interactions of fire, weather, and the terrestrial environment are readily apparent in the complex form of the vegetative mosaic and habitat diversity at Denali.

Until the 1950's, fire suppression was not common except along the park road and railroad corridors. It is difficult to demonstrate the degree to which suppression activities may have adversely affected the natural fire regime or altered ecosystem dynamics in these areas.

Within the developed areas of the Savage Subdistrict, on the eastern end of the park, fire is being excluded from a ecosystem that is fire dependent. Fuel loads around structures are such that there is no defensible space for firefighters to safely protect buildings from wildland fires. This same situation makes it impossible to safely allow natural fire in the developed areas or to reintroduce fire with prescribed burning. The last big fire in this area was in 1924, when considerably less fuel was present.

In general, interior Alaska fuel types, including Denali's, respond to moisture changes quickly, and predicting fire behavior can be difficult. Extensive continuous fine fuels and a lack of significant natural barriers in many places add to the difficulty of managing fire.

In 1992, Alaska made the transition from the National Fire Danger Rating System to the Canadian Fire Danger Rating System (CFDRS). There is no validation that the indices produced by the CFDRS are accurately predicting fire danger for Denali's fuel types. Fire weather stations are being used to produce indices for a large geographical area which is not necessarily represented by the location of the station.

Current Management Actions and Results

The Bureau of Land Management, Alaska Fire Service (BLM-AFS) is mandated to provide wildfire protection for the state. It has divided the state into three zones and delegated the authority for protection in two of those threes zones to the Alaska Department of Natural Resources (AKDNR) and the USDA Forest Service. Denali falls under the management of the BLM-AFS. The agency responsible for suppression outside the boundary from Cantwell south is the AKDNR. Currently all agencies are working under the 1993 Operational draft Alaska Consolidated Interagency Fire Management Plan.

As the land manager of Denali, NPS has identified values at risk and selected fire suppression options for all lands within the park and preserve. The management options are selected from four categories: Critical, Full, Modified and Limited. These options provide guidelines from which the fire suppression organizations determine their initial attack actions. By selecting Critical or Full options, NPS is, in fact, creating fire exclusion zones unless prescribed fire is used. The map atlas, created by the park with input from BLM-AFS depicting fire protection zones is reviewed annually and updated as necessary. There are 37,517.71 hectares (92,705 acres) in full suppression zones, 290.78 hectares (718.5 acres) in modified, and 2,106,659.3 hectares (5,205,484 acres) in limited. In the park/preserve, there are 28,403.46 hectares (70,184 acres) of inholdings and 972 kilometers (604 miles) of external boundary to protect, which complicates fire management. Along the boundary is a narrow band of modified suppression zones which may have an adverse effect on the natural fire regime. This band is there to protect early season fires from leaving the park and burning onto private lands.

During wildfire activities, NPS and BLM-AFS work closely together discussing the fire behavior and the suppression tactics. NPS has conducted surveillance activities on the fires collecting data on fire behavior, fire weather and fire growth. Information gathered on fires has not been standardized; therefore, the data is not compatible and can not be analyzed.

Our ability to predict fire behavior, danger ratings, and resistance to control is hampered by lack of basic information on weather, fuel types and effectiveness of natural barriers. The fire history of Denali is very incomplete; records have been kept since 1940 but many small fires have gone unreported. A flood in the BLM warehouse in Fairbanks in July 1995 destroyed historical records of wildfires in Denali. Fire weather records are also very poor.

Backcountry cabin identification and wildland fuel assessments of buildings began in 1993 and continues today. Buildings are located in the natural fuels throughout the park and preserve. The majority of the cabins do not have any defensible space for firefighters to safely conduct burnout operations should a wildland fire threatened them. Structures were also assigned a protection status from wildfire according to their current use or cultural importance.

Since 1982, FIREPRO has funded fire management activities in the Alaska Region. These activities include (1) surveillance of fire behavior, fire growth and environmental conditions of ongoing wildland fires in the park; (2) assistance with interagency suppression activities; (3) fire management training for NPS employees; (4) collection of data on fire behavior, fire history, and vegetation communities for GIS vegetation/fuels map layers; (5) location of structures and sensitive resources; and (6) establish paired plots for assessment of fire effects.

In 1994, fuels assessment began on sites in the frontcountry of the Savage Subdistrict. Vegetation clearing for fire protection has not historically been conducted at these sites. Denali is beginning to develop a hazard removal program and a long term cyclic program to keep a defensible space around structures.

In 1996 a review and update was done of Denali's staff and their current red card qualifications. A Fire Management position was added and funded by FIREPRO for .5 FTE. The other half of the FTE is also being funded by FIREPRO, but is dedicated to National level technology transfer. Denali also participated in inter-agency training to maintain skill levels and to keep current with national standards.

RECOMMENDED ACTIONS

In 1994, the National Park Service released a document (USNPS 1994) that outlines the importance of fire to ecosystem health and made a series of recommendations aimed at improving the understanding of this relationship and at correcting fire management practices that detract from ecosystem health. The recommendations listed below fully support the fire and ecosystem health program.

A. Program Administration and Planning

N-520.001: Develop a Fire Management Plan

The fire management program goal is to protect human life, property and significant resources while allowing fire to fulfill its role in the ecosystem. An integrated fire management plan, which includes the existing interagency suppression program, park specific suppression capability, and prescribed fire objectives, needs to be developed.

A complex fire management plan will include (a) protocols for surveillance activities on wildfires; yearly schedule of readiness to include annual review of fire suppression boundaries with staff as well as suppression agencies; (b) fire training requirements and needs; (c) step-up procedures for fire danger, readiness and presuppression plans for full protection zones; (d) fire notification procedures both for in-park personnel and with other agencies, along with out of park call out procedures for interagency support; and

(e) a comprehensive hazard fuel program.

The plan should be reviewed annually and updated every five years.

N-520.002: Hazard Fuel Reduction Program for the Frontcountry

Develop as an amendment to the fire management plan a long-term hazard fuel reduction program to alleviate the artificial fuel loads in developed areas due to fire suppression activities (USNPS 1995). The program may incorporate both mechanical removal of fuel loads along with prescribed burning. The program will also be involved in the planning of any new development with regards to developing fuel breaks and complying with the National Fire Protection Association (NFPA) standards.

N-520.003: Hazard Fuel Reduction Program for Values of Concern in the Backcountry

A hazard fuel program needs to be developed to protect backcountry values (cabins, archeological sites, etc.) from fire. This program may incorporate a combination of mechanical and prescribed burning to accomplish this protection. Due to the location of most of these features, the response time for any suppression or protection activities may be several hours. These features should have a defensible boundary so that fire may play its natural role without destruction of the resource.

An inventory of values at risk from wildfires has begun. The list needs to be continually updated. Once a value has been identified a fire protection determination must be made and updated on the master maps.

N-520.004: Qualification and Training

The service will maintain the park records of red carded employees, both permanent and seasonal, and administer yearly fitness tests to ensure that only qualified firefighters are placed on a fire line. Annual firefighter refresher courses, and national standards for qualifications will be maintained.

N-520.005: Fire Records/FIREPRO data base

The service will maintain accurate and current data input into the National Interagency Fire Center (NIFC) computer. Fire reports (Form 1202) need to be entered within 10 days of a fire being declared out. Situation reports need to be updated daily when a fire is active and periodic updates during inactive periods until the fire is declared out. The basic data on Denali's wildland fire assessment has to be completed in the NIFC computer. Information stored in the computer is used for the FIREPRO analysis and

determines yearly funding. Historical fire records will be entered into the computer by AKSO staff while current records will be entered by the park staff.

N-520.006: Interagency Cooperation

The service will maintain interagency cooperation through an annual review of fire suppression boundaries. Interagency cooperation will also continue with training and providing suppression personnel as needed by other agencies. It is important that all suppression agencies and NPS maintain a good working relationship and that the suppression agencies understand the NPS mission during any in-park suppression actions.

B. Research

N-520.011: Natural Fire Regimes

Natural fire regimes in the Denali ecosystem would be identified. Emphasis would be placed on studying the diversity and location of fuel complexes, especially in the eastern portion of the park. Past management actions would be reviewed to see if they have altered natural fire regimes.

N-520.012: Evaluation of Historical Data Collected for Fire Effects

In the 1980's, FIREPRO funded projects in which fire effects data were collected during wildfires. The data is stored at the Alaska Support office, but has not been analyzed. A review of this material is needed to determine if existing permanent plots are adequate for data collection needs.

N-520.013: Effects of Mechanical Removal of Fuels in Conjunction With Hazard Fuel Program

Determine the effects on fire regime in areas where mechanical removal of fuels has been completed.

N-520.014: Development of Fire Effects Monitoring Program

In coordination with the Long-Term Ecological Monitoring (LTEM) program, develop a fire effects monitoring program.

N-520.015: Support Independently Funded Fire Research Projects

The service would support independently funded fire monitoring and research projects in Denali National Park and Preserve by private and public organizations, agencies, and

universities when deemed appropriate by park management. The park would provide temporary housing and logistical support for field and laboratory work if possible (Research Administration and Management DENA-I-410).

N-520.016: Fire Weather and Fire Indices

Validation of the Canadian Fire Danger Indices. Live fuel and soil samples taken along the fire perimeters and near fire weather stations would be use to validate the drought codes and fire behavior predictions in the Canadian Fire Danger System.

C. Mitigation

N-520.021: Frontcountry Hazard Fuel Program

Implement a hazard fuel program in areas where fire suppression activities have disturbed the natural fire regimes. Implementation would include a combination of mechanical removal of fuels to reduce the loads to a more natural state, with a follow-up treatment of prescribed burns.

N-520.022: Backcountry Hazard Fuel Program

Implement a hazard fuel program in areas where fire suppression activities have disturbed the natural fire regime. Implementation may include the introduction of prescribed fire to create fuel breaks to allow a natural fire regime to return. Due to the development of the area, a natural fire regime may be introduced with management ignited fire under prescriptions developed from fire effects research.

N-520.023: Evaluation of Fire Suppression Zones

Amend fire suppression zones as necessary to allow natural fire. If fire research shows that there is not enough fire in conditional zones, modification of these boundaries may need to be done on a yearly basis. Cooperation with BLM-AFS is essential.

D. Monitoring

N-520.031: Wildfire Surveillance Activities

Fire information would continue to be collected. Fire perimeter maps would document fire growth; on-site weather observations and fire behavior would be documented on all fires. Data collection standards need to be developed.

N-520.032: Implementation of Fire Effects Monitoring Program

In coordination with the LTEM program, the service would implement a fire effects monitoring program.

E. Interpretation

N-520.041: Provide Information on Fire Management Practices to Denali Staff

The park staff would be educated on fire management activities and practices. The fire staff would participate in seasonal training to update employees on fire management in the park. Park staff would be provided information on fire in the ecosystem, fire activity and fire management activities. Interpretative activities will be conducted as requested.

N-520.042: Develop Outreach and Fire Management and Prevention Activities

The service would provide information to the community and public on fire management. Activities may include public displays, lectures or articles. NPS would develop a cooperative relationship with the local volunteer departments in the rural-interface. Community prevention programs and activities would be conducted. Local volunteers would be invited to attend wildfire training.

F. Protection

N-520.051: Fire Cause Determination

Investigate fire starts in developed areas and suspicious starts elsewhere to determine cause. Fire starts of a suspicious nature should be investigated by a qualified wildfire arson investigator from NPS or a cooperating agency. Prosecution of violators would be conducted to deter future incidents.

N-520.052: Implementation of Statewide Burning Regulations

The service would enforce statewide burning regulations and temporary bans during high fire danger. Campground patrols would increase, and bulletin boards and visitor contact stations would contain posted notices to educate the public of the situation.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Develop fire management plan	15.0/0.2	77.0/0.8	77.0/0.8	77.0/0.8	301.0/2.6
- Fuel mitigation	44.0/1.5	60.0/1.5	30.0/0.7	30.0/0.7	164.0/4.4
RESEARCH					
- Natural fire regimes	20.0/0.0	30.0/0.0	30.0/0.0	10.0/0.0	90.0/0.0
MONITORING					
- Wildfire surveillance	20.0/0.5	20.0/0.5	60.0/1.5	60.0/1.5	160.0/4.0
INTERPRETATION					
- Outreach activities	5.0/0.1	0.0/0.1	0.0/0.1	0.0/0.1	5.0/0.4
TOTALS	159.0/2.3	187.0/2.2	197.0/3.1	177.0/3.1	570.0/11.4

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Anon. 1993. Operational Draft, 1993 Fire Season, Alaska Consolidated Interagency Fire Management Plan. Alaska Fire Service, BLM, Fairbanks, AK.

U.S. Department of the Interior/U.S. Department of Agriculture. 1995. Federal Wildland Fire Management Policy and Program review Final Report.

U. S. Department of the Interior/U.S. Department of Agriculture. 1996. Federal Wildland Fire Management Policy and Program Review Implementation Action Plan Report.

USNPS. 1990. NPS 18, Wildland Fire Management Guideline. U.S. Department of the Interior, Washington, DC.

USNPS. 1993. Branch of Fire & Aviation Management, NPS Fire Management Compendium. USNPS Branch of Fire and Aviation, Boise, ID.

USNPS. 1994. Fire management and ecosystem health in the National Park System. Branch of Fire and Aviation Management. Boise, ID.

USNPS. 1995. Forest fuel reduction/firewood management plan - Stehekin Valley. Lake Chelan National Recreation Area, WA.

ECOLOGICAL RESTORATION

PROJECT CODE: DENA-N-530

SERVICEWIDE ISSUES:

- N10 Disruption of Park Resources Due to Mineral Extraction Activities
- N11 Degradation of Park Water Quality Due to External Activities
- N20 Lack of Basic Data: Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Present Condition

While most of Denali National Park and Preserve can be classified as pristine wilderness, there are significant disturbed areas that require active restoration efforts to again become part of naturally functioning ecosystems. Reclamation does not replace natural processes or systems, but it does enhance the stabilization of an area and the restoration of a functioning system. This is particularly important in Alaska's northern latitudes where natural restoration of a barren area is very slow compared to similar disturbances farther south. Contributing to slow re-establishment of natural conditions are such items as: short, cool growing seasons, permafrost, aufeis deposits, lack of annual plant species and the resulting dependency on asexual vegetation reproduction, the need for deep pools for wintering fish, and glacially formed streams. Reclamation will slow or stop degradation of unstable areas and reestablish natural processes in the area.

Many disturbed areas in the park's "frontcountry" have been, and must continue to be, re-vegetated and carefully managed. These areas include the main park road from George Parks Highway to Kantishna and developments along the road corridor, including the entrance area and headquarters complex, the Toklat Road Camp, Eielson Visitor Center, Wonder Lake Ranger Station, and Kantishna area lodges and inholdings. Disturbance has occurred throughout the park's history because of building and road construction, changes in visitor needs and use patterns, and other improvements to park utilities and infrastructure. Maintaining 87 miles of the park road to Kantishna has resulted in several gravel pits along the road system, two of

which are still used. Some affected areas have recovered over time, and some have been reclaimed and restored to resemble original conditions. Still others, such as trails, bus stops, and campgrounds, need prompt management attention to reestablish natural ecological conditions.

Historically, mining and access activities in national parks have resulted in major surface disturbance and environmental damage, with minimal or no reclamation. The result is about 1500 of acres of barren gravel tailings from placer and lode mines, about 75 miles of trails and roads and tens of miles of disrupted stream channels and floodplains. Recently, increasing public awareness of the importance of natural processes and the need for reclamation of disturbed lands in our environment has developed. It is this awareness which partially fostered the lawsuits against the National Park Service and other agencies regarding the cumulative impacts of mining on public lands. The plaintiffs in the 1985 lawsuit were especially concerned that reclamation of disturbed areas and remediation of hazardous materials sites be accomplished.

Besides the Kantishna Hills and the immediate Kantishna developed area, the Dunkle Mine in the West Fork Chulitna River watershed will require restoration efforts, as will a few other mined areas on the south slope of the Alaska Range. There are also several small, isolated mined areas on the north side of the range outside the Kantishna Hills area such as the Slippery Creek mine, where more restoration work might be considered.

The National Park Service has the mandate to "preserve and protect" for future generations. According to this mandate and the Mining in the Parks Act of 1976, the NPS regulations at 36 CFR Part 9 (A) require reclamation by a mining operator to "restore natural conditions and processes" and to "return the area to a condition equivalent to its pristine beauty."

Reclamation of disturbed areas in Denali National Park and Preserve will include techniques tailored for each area. Considerations include type and severity of disturbance, current condition, history, and management objectives for the unit. Reclamation actions will stabilize stream banks, reestablish floodplains, reduce permafrost erosion, reshape tailing piles, and revegetate barren areas. This facilitates the natural processes of stream channel creation, reduces erosion and non-point source pollution, initiates vegetation succession, and reestablishes habitat for fish, wildlife and park visitors.

Park visitors will benefit from reclamation of disturbed lands in several ways. Visitor understanding and appreciation of the natural environment, and recreational opportunities in that environment increase with the reestablishment of habitats and populations of fish, birds and wildlife. Historic structures and landscapes can be interpreted and compared with natural disturbances such as wildfires and floods.

Current Management Actions and Results

Since the Final Environmental Impact Statement on the Cumulative Impacts of Mining in Denali was completed in 1990, management action has been directed at acquiring all mining claims while processing mining plans of operations as necessary. Part of the acquisition process is to assist claim owners in relocating personal property according to the Uniform Relocation Assistance and Real Property Acquisition Act of 1970. Claim owners are also encouraged to mitigate any hazardous materials problems on their claims to avoid being assessed clean up costs by the NPS. Both relocation of personal property and mitigation of hazardous substances are precursors to National Park Service reclamation and restoration projects. However, since claims have been acquired by the NPS through different means ranging from abandonment to direct purchase, conditions of the newly acquired land vary considerably. Abandoned property and debris removal as well as hazardous substance mitigation becomes a National Park Service responsibility in cases of claim abandonment, void claims, or alternative purchase arrangements (a claimant's hazardous substance mitigation responsibility may be waived with Secretary of Interior approval).

The Glen Creek reclamation project was initiated in 1988 to reclaim a stream segment in the Kantishna Hills that was significantly disturbed by placer mining. Project results include advanced knowledge of reclamation techniques and restoration of natural processes on lower Glen Creek. Similar projects are needed in many other watersheds, although a broad range of intervention levels will be necessary. For example, some watersheds may require as much effort as lower Glen Creek while others may need only minimal attention.

The park has benefitted from several projects recently initiated by the Alaska Region of the NPS, including research on lower Glen Creek, drum and barrel removal from claims in the Kantishna Hills, and general clean up of mining claims such as Red Top on lower Friday Creek and newly acquired properties on Eureka Creek. Relocation projects affecting Slate, Eldorado, Glacier, and Caribou Creeks were completed in 1995. While personal property will remain on Glen, Rainy, and Spruce Creeks pending current litigation and title problems, other mined areas in the Kantishna Hills are ready for any hazardous materials mitigation necessary and subsequent restoration efforts. Disturbed lands elsewhere in the park are already in this category.

Several reclamation and restoration projects have been conducted in areas other than the Kantishna Hills, particularly along the road corridor. An area on Stony Creek at mile 59.7 of the Park Road was used as a gravel source and crushing operations site for major road rehabilitation in the Thorofare Pass area for three years, 1983-1985. The site was reclaimed in 1992. Major re-vegetation projects have been conducted near the park entrance, at the Teklanika campground/rest stop area, along Polychrome Pass, and in the Wonder Lake campground.

To date there have been two major emphases for disturbed lands reclamation and restoration:

1. Complete Glen Creek Restoration Study:

Research on revegetation is continuing on Lower Glen Creek, where a major reclamation project was completed in 1992. Stream channel characteristics are being monitored to further refine techniques for establishing a stable channel in a floodplain. As additional reclamation projects are completed, park minerals management staff plan to monitor key physical and biological resources affected by minerals extraction and reclamation to identify additional restoration work necessary and to further refine reclamation methods.

2. Complete Disturbed Lands Reclamation/Restoration Plan:

A plan for restoration of disturbed areas throughout the park was drafted in 1994. This plan identifies the level of restoration required, documents the level and type of management intervention needed to protect cultural resources, and sets priorities on restoration projects. Based on this plan, specific site plans can be completed and implemented. National Environmental Policy Act compliance would be done concurrently with site planning.

RECOMMENDED ACTIONS

The park will work with Alaska Support Office staff to develop and implement a disturbed lands restoration program and to continue refining restoration methods based on research and monitoring efforts.

A. Program Administration and Planning

N-530.001: Complete Plan for Reclamation and Restoration of Disturbed Lands Throughout Denali National Park and Preserve

The final version of this plan should incorporate comments received during a review period in 1995. The draft plan includes site inventory, priorities for reclamation and restoration needs, a discussion of methodology, and an explanation of the roles of the system support office and park staff. Specific site plans would be developed from this plan with concurrent National Environmental Policy Act compliance. The reclamation and restoration plan also identifies cultural resources protection priorities on disturbed lands.

N-530.002: Develop Standard Operating Procedures for Restoration Component of all Construction, Research, and Other Park Operations

Standard operating procedures would be developed to require all compliance documents to outline reclamation and restoration upon project completion. Environmental assessments for proposed mining plans of operation include reclamation requirements,

and this same principle should be applied to all other ground-disturbing actions in the park. Reclamation and restoration would then be planned in advance for implementation immediately after project completion.

A written policy for reclamation and restoration should also include discussion of techniques to be used and funding requirements. In some cases additional investigation may be required to determine the best methods to use.

N-530.003: Construct a Greenhouse/Nursery/Seed Bank Facility for Park Revegetation Projects

The park would construct this facility in the headquarters area as called for in the Entrance Area and Road Corridor Development Concept Plan (USNPS 1997) so that plants would be readily available for revegetation projects and to assist in research efforts. This facility would greatly enhance the efficiency of revegetation projects, which will most likely continue to be a major program within the Research and Resource Preservation Division. There are considerable restoration needs in the park, and most projects will need to be either directly accomplished or at least supervised by park personnel.

N-530.004: Develop GIS for Reclamation/Restoration Planning

Information from the reclamation/restoration site inventory conducted for the 1994 draft plan should be digitized and added as a separate GIS data layer. This information would then be readily available for management needs and would assist with decision-making, establishing priorities for funding, and continuing planning and research efforts.

N-530.005: Re-establish Plant Ecologist/Botanist Position

See Terrestrial Vegetation Management, DENA-N-330 Project Statement.

B. Research

N-530.011: Complete Literature Review of Reclamation and Restoration Projects

Several research projects on reclamation and restoration methods have been conducted in Denali National Park and Preserve. These should be reviewed and collected in one bibliography to provide a summary of work that has already been conducted in the park. There may also be studies from other similar areas that can be applied to reclamation and restoration techniques at Denali.

N-530.012: Conduct Research on Methods to Enhance Riparian Zone Ecosystem Recovery in Watersheds Disturbed by Placer Mining

Research has been conducted since 1988 in the Glen Creek watershed. The NPS would continue to conduct a comprehensive research program which would address the development of techniques for stabilization and rehabilitation of stream channels and floodplains disturbed by placer mining activities. Physical, chemical, and biological parameters of the main study site and control site would continue to be monitored intensively each field season (DENA-N-313).

N-530.013: Work with NPS Geologic Resources Division (GRD) to Characterize Mine Tailings and Acid Mine Drainage Problems

The NPS would work with the NPS-GRD in conducting research on mined lands within the park. The current emphasis of this research is to identify hazards on abandoned mine lands to both human safety and the environment. Recommendations on mitigating these hazards have also been made. Park and system support office staff will continue to review project proposals and assist with field work logistics.

N-530.014: Encourage Independent Investigators to Conduct Research on Reclamation and Restoration Processes

Most research to date on reclamation and restoration processes and needs has been conducted by NPS investigators. The park would continue to update reclamation and restoration techniques with new knowledge. In addition, independent investigators would be encouraged by providing information on research needs in the park. Because of the variety of restoration needs and the diversity of sites, there are substantial opportunities for mutual benefit.

C. Mitigation

N-530.021: Eliminate Safety Hazards from Abandoned Mines

Abandoned mine lands can present safety hazards such as weak or collapsed structures and open shafts in addition to the hazardous materials and water pollution problems discussed separately. These hazards should be identified and marked and potential visitors should be warned accordingly. Hazardous conditions will be eliminated as part of the mined areas restoration plan (DENA-I-700).

N-530.022: Reclaim Previously Disturbed Areas

As the NPS purchases mining claims, major reclamation projects and perhaps hazardous waste mitigation will be necessary. Most claims in the Kantishna area lie outside the former Mount McKinley National Park boundaries and were mined before being incorporated into Denali National Park and Preserve in 1980. There was minimal regulation and reclamation efforts were negligible in many cases.

All mining claims purchased to date in the Kantishna area have either been free of hazardous substances or clean up arrangements have been made. In cases where substantial contaminant problems have been identified, it is necessary for the seller to clean up the problems before title can be conveyed to the United States unless mutually satisfactory clean up arrangements can be agreed upon. In some cases this may mean a lower purchase price and subsequent clean up efforts by the NPS.

Restoration/reclamation actions should follow the disturbed lands restoration/reclamation plan mentioned above. The plan must be updated as projects are completed and as new methods are developed based on continuing monitoring and research.

D. Monitoring

N-530.031: Monitor Previously Reclaimed Areas

Research on revegetation is continuing on Lower Glen Creek, where a major reclamation project was completed in 1992. Stream channel characteristics should be monitored to further refine techniques for establishing a stable channel in a floodplain (Water Resources DENA-N-210). As additional reclamation projects are completed, park minerals management staff will monitor key physical and biological resources affected by minerals extraction and reclamation to identify additional restoration work necessary and to further refine reclamation methods. Seasonal technician positions would be established and filled to accomplish these tasks.

N-530.032: Monitor Construction, Research, and Operations to Determine Reclamation and Restoration Needs

Upon completion of standard operating procedures for the reclamation component of all compliance documents, a procedure should be established for ensuring that requirements are met. Standards should be established to determine responsible personnel. These individuals would also monitor visitor use and park operations areas to determine revegetation needs.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Restoration Plan	25.0/0.5	25.0/0.5	0.0/0.0	0.0/0.0	50.0/1.0
- SOP - Restoration	11.0/0.3	11.0/0.3	0.0/0.0	0.0/0.0	22.0/0.6
- Construct Greenhouse	0.0/0.0	100.0/2.5	100.0/2.0	100.0/2.0	300.0/6.5
- Develop GIS	5.0/0.1	5.0/0.1	5.0/0.1	0.0/0.0	15.0/0.3
- Plant Ecologist	See DENA-N-330				
RESEARCH					
- Literature Review	5.0/0.1	5.0/0.1	0.0/0.0	0.0/0.0	10.0/0.2
- Riparian Zones	60.0/0.5	30.0/0.4	30.0/0.4	30.0/0.4	150.0/1.7
- B.O.M. Studies	20.0/0.0	0.0/0.0	0.0/0.0	0.0/0.0	20.0/0.0
- Independent Investig.	5.0/0.1	5.0/0.1	5.0/0.1	5.0/0.1	20.0/0.4
MITIGATION					
- Reclaim Mined Areas	60.0/1.0	50.0/0.5	50.0/0.5	50.0/0.4	210.0/2.4
- Safety Hazards	30.0/0.3	30.0/0.3	0.0/0.0	0.0/0.0	60.0/0.6
MONITORING					
- Reclaimed Areas	11.0/0.3	11.0/0.3	11.0/0.3	11.0/0.3	44.0/1.2
- Construction	11.0/0.3	11.0/0.3	11.0/0.3	11.0/0.3	44.0/1.2
TOTALS	243.0/3.5	383.0/5.4	212.0/3.7	237.0/3.5	945.0/16.1

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiating any project and will be maintained on file at Denali National Park and Preserve headquarters.

Applicable compliance documents already completed include the following:

1. Final Environmental Impact Statement, Cumulative Impacts of Mining, Denali National Park and Preserve, 1990: meets all National Environmental Policy Act, National Historic Preservation Act and Alaska National Interest Lands Conservation Act Section 810 requirements for implementation of a minerals management program.

2. Environmental Assessment: Mining Claim Acquisition Program, Denali National Park and Preserve, 1993: This document meets compliance requirements for most land acquisition, validity examination, cultural resources monitoring, and related activities in the Kantishna Hills. It does not cover unusual projects or those with special requirements.

3. Entrance Area and Road Corridor Development Concept Plan and Environmental Impact Statement, 1996: This document meets compliance requirements for new development and resource protection throughout the frontcountry of Denali. Some detailed site plans that have not yet been developed will be subject to additional compliance, such as tiering an environmental assessment from the EIS. However, in several cases the DCP/EIS meets compliance requirements for initiating reclamation and restoration projects. Examples include restoring the Horseshoe Lake area; reclaiming the former sites for the post office, park hotel, and airstrip; relocating the Toklat gravel crusher and restoring the site; and restoring the Wonder Lake outlet area.

REFERENCES

Alaska Department of Fish and Game. 1979. Placer mining and water quality. State of Alaska, Juneau, Alaska.

USNPS. 1990. Final environmental impact statement, cumulative impacts of mining. Volume 1. Alaska Regional Office.

USNPS. 1994. Status of the mineral examination program in Denali National Park and Preserve. USNPS, Alaska Regional Office (unpublished memo).

USNPS. 1994. Draft restoration and reclamation plan for disturbed lands of Denali National Park and Preserve. USNPS, Denali NP&P.

USNPS. 1997. Entrance area and road corridor development concept plan and environmental impact statement, Denali National Park and Preserve. USNPS, Denver Service Center.

CULTURAL RESOURCE PROGRAM MANAGEMENT

PROJECT CODE: DENA-C-100

SERVICEWIDE ISSUES:

C39	Heritage Education
C57	Special Studies (Themes)
C83	Cultural Resource Management Staff
C72	Resource Protection and Security
C91	Archives Management Training
C93	Cultural Resources Management Training
C94	Cultural Landscape Preservation Maintenance
C96	Law Enforcement, Protection Training
C97	Museum Management Training
C99	Structure Preservation Maintenance Training

STATEMENT OF PROBLEM

Present Condition

Denali National Park and Preserve contains significant cultural resources in each of the subdisciplines of cultural resources; archeology, history, historical archeology, ethnography, and cultural landscapes. Specialists in each of these fields agree that as research continues, additional resources will continue to be located. The park is also a complex management environment for cultural resources, including resources that are difficult to access, require intensive maintenance, and are vulnerable to the pressures of development, growing visitation, age, the environment, and current use.

Despite the presence of significant resources and complex management needs, Denali did not have a cultural resource specialist on staff. As a result, resource planning, research, budgeting, administration, and compliance were coordinated by park staff and individual specialists in the cultural resource disciplines at the Alaska Support Office (AKSO). This approach generally addressed short term management needs but the lack of an in-park cultural resource management specialist prevented development of a cohesive, interdisciplinary cultural resource management program that balanced the needs of the different types of resources. Such a program would meet broader long term program needs. These include identifying and implementing long term research and resource protection goals, developing local partnerships that support preservation of park resources, and integrating cultural resources into all park programs, planning, and

maintenance.

Timing was appropriate for adding a cultural resource management specialist to the park staff. Recent servicewide trends, as illustrated by reorganization of the Alaska Support Office, are increasing park level autonomy and responsibility for cultural resource management. These changes have not been matched by the addition of specialized staff. One example is increased involvement in setting priorities for the Cultural Resource Preservation Program (CRPP) budget process which creates the need for park staff to establish clear and specific cultural resource goals that reflect park priorities. Another example is the Section 106 review process, the means by which park managers evaluate and obtain approval for undertakings that have potential to impact resources. Prior to reorganization, review was coordinated between the park, AKSO and the State Historic Preservation Office (SHPO). Now a designated in-park 106 coordinator deals directly with the SHPO for clearance of park projects, calling on expertise at the AKSO for technical assistance (for example, to have an archeologist survey a proposed project area).

All aspects of the Denali cultural resource program, research, management, compliance and stewardship, would benefit from the development of a comprehensive interdisciplinary program. Key to meeting this goal is the addition of a full time professional level cultural resource program manager acting as an advocate for all park cultural resources and programs.

Current Management Actions and Results

Up until the fall of 1997, cultural resources management responsibilities where shared between the Chief of Subsistence and Cultural Resources Branch and the Chief of the Division of Research and Resource Preservation. This arrangement failed to provide sufficient time to address all cultural resource needs. Inclusion of cultural resource consideration in planning and development, and development of a cultural resource preservation and research program was inadequate. In 1997, a cultural resources specialist was added to the park staff. This individual has assumed primary responsibility for cultural resource activities.

The following table displays all current cultural resources or closely allied activities that are underway at Denali.

Table 14.

CURRENT RESOURCE MANAGEMENT ACTIONS - FULLY OR PARTIALLY FUNDED

RMP Project Statements	Action Items
I-220 Resource Inventory	.002 Data Standards .004 GIS Plan .012 Complete Inventories .013 Digitization .023 Operate GIS/AutoCAD .031 Document Monitoring
I-300 Curatorial Management	.003 Cataloging .005-.007 Collection Planning
I-410 Research Administration	.004 Administrative Guide .008 Library .041 Tattler Publication
C-100 Cultural Program Management	.006 Thematic Framework
C-200 Archeology	.011 Improve Data .014 Native Place Names
C-300 Ethnography	.011 Overview and Assessment .014 Oral History - Miners .016 Oral History - Park Employees
C-400 Cultural Landscapes	.011 Landscape Inventory .013 Headquarters Landscape .015 Road Corridor Landscape
C-500 Park History	.011 Administrative History
C-600 Historic Structures	.002 NR Nomination - Stampede .021 HQ Structure Rehab. .027 Cabin Preservation .031 Structure Monitoring
S-110 Traditional Use Patterns	.001 Use Zone Identification

RECOMMENDED ACTIONS

Project Statement I-100 outlines a series of actions that apply universally to all resource programs in the area of strategic planning, coordination and consultation, facilities, information

management, and publications programs. Actions listed below are unique to cultural resource programs.

A. Program Administration and Planning

C-100.002: Cultural Resource/Historic Preservation Planning

Identify and integrate long term research, preservation and resource protection goals in all park planning efforts, including updates of the general management plan (GMP), resource management plan (RMP), interpretive prospectus (IP), statement for management (SFM), and development concept plans (DCPs).

C-100.003: Develop a Working Relationship with Alaska Office of History and Archeology

Park staff will establish a dialogue with personnel in the Office of History and Archeology to improve information sharing, program coordination, and to expand expertise.

C-100.004: Resource Apprentice Program

Provide funding to support a Resource Apprenticeship Student (RAP) with the intent of including cultural resource training opportunities. Program would be designed for a local high school age student interested in resource management opportunities with the national park service.

C-100.005: Historic Preservation Partnerships

Develop partnerships with inholders, local Native groups and park neighbors interested in collaborating on management and interpretation of culturally significant sites. Areas such as the Kantishna historic district, the Golden Zone Mine and the Dunkle Mine would benefit from development of a historic preservation planning partnership. Identify ways in which the park can provide technical assistance and support for historic preservation planning and cultural resource interpretation.

As noted elsewhere, there is a need to develop consultation networks with the Native groups who use the park. This need is defined in federal cultural resource legislation and NPS policy. (Ethnographic Resources Project Statement - DENA-C-300)

C-100.006: Special Study - Develop Thematic Framework

One need that transcends cultural resource categories is the identification and

development of contexts (themes) that are illustrated by the park's cultural resources (sites, landscapes and cultural systems). Themes provide for meaningful and understandable interpretation of resources and, more importantly, they facilitate the legally mandated process for evaluating cultural resources; assessing eligibility for the National Register of Historic Places. Past management reports have noted the usefulness of themes in determining and interpreting cultural resources, but have stopped short of identifying and describing them. The NPS provides a framework of very broad themes to aid in addressing national register significance. The current version of this framework offers some very broad universal themes but a formal thematic framework relating these to Denali's unique resources and history has not been formulated. Working with appropriate existing historical, archeological, and ethnographic sources, a thematic framework for understanding and interpreting the cultural history of Denali National Park and Preserve would be prepared. This framework must include the NPS thematic framework as well as themes in Alaska state history, as included in the Alaska comprehensive historic preservation plan. Where appropriate, national register thematic nominations that relate to Denali and the surrounding region would be addressed. Recommendations for thematic nominations would be provided. The project should include a narrative description with sufficient historical background to clearly define each theme, and identify recorded cultural resource sites, historical districts and cultural landscapes that illustrate the theme. A bibliography of sources relating to each theme and supplementary materials such as photographs, maps and other sources of historical documentation would be included to fully illustrate each theme.

C-100.007: Cultural Resource Training

In addition to cultural resource staff, care of cultural resources is integrated into most other areas of park operation. In order to provide an optimal system of care, specialized training for staff who regularly are involved in cultural resource management is needed. Develop annual prioritized training goals for staff. Provide funding for training. This training should include Archeological Resources Protection Act (ARPA) for law enforcement staff; Native American Graves, Protection, and Repatriation Act (NAGPRA) training, archival management training, and object conservation training for curatorial staff; and training in management of cultural landscapes and techniques of historic structure conservation for maintenance staff. Include cultural resources (history, archeology, preservation) in orientation programs for seasonal rangers and interpretive staff.

C-100.008: Geographic Information System (GIS) for Cultural Resources

Management of archeological resources, cultural landscapes, and historic districts requires access to many related sources of information; site location, significance, land status, land use, threats and disturbances, survey coverage, vegetation type and cover,

soils, topography, distribution of wildlife populations, paleolandforms and paleoenvironmental factors. Without computer support, data retrieval is inefficient, analysis is limited, and it is difficult to respond rapidly to requests for resource assessments or other management needs.

This project proposes to develop and apply GIS capabilities for Denali cultural resources with the goal of meeting critical cultural resource management and research needs. Once the data entry is complete, relatively rapid and low cost maps can be produced showing selected data overlays. Prehistoric land use systems can be modeled and simulation studies of climate and landform changes relevant to site distribution can be conducted. All appropriate GIS quality standards will be met. Once the data layers are created, special applications will be developed to model prehistoric and historic settlement patterns, understand the known distribution of sites, and to predict the location of sites in unsurveyed areas. The project will conclude with a report describing methods and techniques used to establish the data base and results from initial analysis.

The GIS cultural resource files (and related environmental data layers) will be interfaced with the Servicewide Archeological Sites Management Inventory System and the Cultural Landscapes Inventory computerized databases, currently being developed in WASO. Compatible data should be required for all subsequently recorded sites. Address the need and standards for GIS data input in contracts and scopes of work for non-NPS researchers. Individual projects will provide funding for input of recorded sites. Given the need for confidentiality in site location information, access to data files that contain sensitive archeological site location information will be restricted.

B. Protection

C-100.051: Develop Cultural Resource Protection/Education Strategy

All types of cultural resources are vulnerable to human impacts. Common threats include vandalism, theft and illegal collecting. Although loss is known to have occurred in Denali, there is insufficient information about the nature and extent of the problem to evaluate the impact on park resources. Working with both law enforcement staff and archeological resource protection specialists, establish a program to assess the nature and extent of loss. Provide training in the Archeological Resources Protection Act for law enforcement staff and promote awareness of the problem with other staff. Establish clear procedures for evaluating, reporting and intervening in resource protection violations.

Federal cultural resource programs are one of the primary sources of public education and information about archeological resources (public outreach is one of the six identified goals of the interagency Federal Archeology Program). These efforts have grown out

of recognition that increased public involvement and education lead to a public that is more responsive and involved in conservation and preservation efforts. With the guidance of NPS archeological resource protection specialists, develop a local program to create awareness of potential impacts and the need for conservation in visitors, staff and residents. Support educational programs and where appropriate, provide volunteer opportunities. Working with park law enforcement, interpretation staff and archeological resource protection specialists, explore ways to inform visitors of the legal and ethical need to leave cultural resources undisturbed (for example, park publications like the Alpenglow and Denali Dispatch, park map and signs, visitor center displays).

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Cultural Resource Planning	50/.7	50/.7	35/.3	35/.3	170/2.0
- Resource Apprenticeship Program	10/.5	10/.5	10/.5	10/.5	40/2.0
- Partnerships	30/.5	30/.5	15/.2	15/.2	90/1.4
- Thematic Framework		20/.2	20/.2		40/.6
- Training	16/.2	16/.2	16/.2	16/.2	64/.8
- GIS	30/.3	30/.3	30/.3	30/.3	120/1.2
PROTECTION					
- Protection/Education	20/.2	20/.2	20/.2	20/.2	40/.8
TOTALS	156/2.4	176/2.6	146/1.9	126/1.7	572/8.8

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Bacon, G. 1978. Archeology in the Upper Susitna River Basin. Report prepared for the U.S. Army Corps of Engineers, Alaska District, Contract No. DACW85-78-C-0017, BLM Reference No. AG-AK910-297.

Bacon, G. and C. Mobley, T. Cole, and C. Holmes. 1983. The final report of the 1981 and 1982 cultural resources survey of the Anchorage-Fairbanks transmission intertie. Report to the Alaska Power Authority, Anchorage. R-2516.

Betts, R. 1987. Archeological investigations at Butte Lake, Alaska: an inquiry into Alaskan notched point-micro blade assemblages. A report to the University of Alaska Museum Geist Fund. Fairbanks.

Bishop, R. 1978. Subsistence resource use in the proposed north addition to Mount McKinley National Park. Occasional Paper No.17, Anthropology and Historic Preservation Cooperative Park Studies Unit, University of Alaska, Fairbanks.

Bowers, P. 1978. Research summary: 1977 investigations at the Carlo Creek archeological site, central Alaska. Report submitted to the University of Alaska Museum, Fairbanks by the Laboratory of Anthropology, Arctic Research Section, Washington State University, Pullman.

Brown, W. 1990. Historical resources study, Denali National Park and Preserve. United States Department of the Interior, National Park Service, Alaska Regional Office, Anchorage.

Dixon, R. 1977. New archeological discoveries near Cantwell. In archeological survey projects, 1976, miscellaneous publications, history and archeology Series, No.6. Office of History and Archeology, Alaska Division of Parks, Anchorage.

Davis, C. 1981.1980 Archeological reconnaissance of Mount McKinley National Park-- 'Yes, Virginia, it's worth another look.' Paper presented at the 8th annual meetings of the Alaska Anthropological Association, Anchorage.

Dixon, E. J., G. Smith, W. Andrefsky, Jr., B. Saleeby, C. Utermohle and M. King. 1985. Draft report: Susitna hydroelectric project cultural resources investigations 1979-1985. University of Alaska, Fairbanks.

Evans, G. 1987. From myth to reality: travel experiences and landscape perceptions in the shadow of Mount McKinley, Alaska, 1876-1938. Unpublished master's thesis, Public Historical Studies Department, University of California, Santa Barbara, California.

Greiser, T., S. Greiser, G. Bacon, T. Foor, P. Kari, J. Kari, D. Gallacher and J. Caywood. 1985. Susitna hydroelectric project phase I report: background research and predictive model for cultural resources located along the Susitna hydroelectric project's features, final report, vol.1. Historical research associates with contributions from Alaska Heritage Research Group under contract to Harza-Ebasco Susitna joint venture to the Alaska Power Authority, Document 2865.

Gudgel-Holmes, D. (compiler).1991. Kantishna oral history project, phase II, Part 2: native place names of the Kantishna drainage. Prepared for the U.S. Department of the Interior, National Park Service, Alaska Regional Office, Anchorage. PX 9700-8-1067.

Hoffecker, J. 1980. Archeological field research, 1980, the North Alaska Range early man project. In North Alaska Range Project, final report on 1978-1982 Geoarchaeological studies (1984) edited by Norman W. Ten Brink. A report to the National Geographic Society and the U.S. Department of the Interior, National Park Service.

Holmes, C. 1986. Lake Minchumina prehistory: an archeological analysis. Alaska Anthropological Association Monograph Series No. 2, Anchorage.

Holmes, C. 1988. An early post paleo-arctic site in the Alaska Range. Paper presented at the 15th annual meeting of the Alaska Anthropological Association, Anchorage.

Irving, W. 1957. An archeological survey of the Susitna Valley. Anthropological papers of the University of Alaska vol.6(1):37-52.

Lynch, A. J. 1996. Archeological investigations of five remote tracts of land within Denali National Park and Preserve, Alaska, 1988-1989: National Park Service Resources Report/ARRCR/CRR-95/24. United States Department of the Interior, National Park Service, Alaska System Support Office, Division of Cultural Resources, Anchorage, Alaska.

Morgan, H. 1965. An archeological survey of Mount McKinley National Park. U.S. Department of the Interior, National Park Service. Contract 14-10-0434-951.

Plaskett, D. 1976. The Nenana river gorge site, a late prehistoric Athapaskan campsite in Central Alaska. Master's thesis, University of Alaska, Fairbanks.

Plaskett, D. 1978. Final report: a cultural resource survey in an area of the Nenana and the Teklanika rivers of central Alaska. Submitted to the State of Alaska Department of Natural Resources, Division of Parks, Contract No. 02-76-00035-00.

Powers, W., R. D. Guthrie and R. Hoffecker. 1983. Dry Creek: archeology and paleoecology of late Pleistocene Alaskan hunting camp. U.S. Department of the Interior, Alaska Regional

Office, Anchorage.

Saleeby, B. (ND). The Quest for gold: An overview of cultural resources mining inventory and monitoring program. United States Department of the Interior, National Park Service, Alaska System Support Office, Anchorage, Alaska.

Saleeby, B., E. Dixon and G. Smith. 1985. Susitna hydroelectric project, cultural resources-significance. Prepared for the Alaska Power Authority, Anchorage.

Schimberg, D. and P. Schledermann. 1967.Additional material from two sites in Mount McKinley National Park, anthropology 214. Manuscript on file, U.S. Department of the Interior, National Park Service, Alaska Regional Office, Anchorage.

Schneider, W., D. Gudgel-Holmes and J. Dalle-Molle. 1984. Land use in the north additions of Denali National Park and Preserve: an historical perspective. Research/ resources management report AR-9, U.S Department of the Interior, National Park Service, Alaska Region.

Schoenberg, K. 1995.Alaska Regional Plan, System wide Archeological Inventory Program, National Park Service, Division of Cultural Resources, Alaska Regional Office, Anchorage, Alaska.

Skarland, I. and C. Keim. 1958. Archeological discoveries on the Denali Highway, Alaska. Anthropological papers of the University of Alaska, vol. 6(2):79-88.

Snow, D., G. Evans, R. Spude, and P. Gleason. 1987. Historic Structure report, Mt. McKinley National Park Headquarters District and Wonder Lake, vol. 1. U.S. Department of the Interior, National Park Service, Division of Cultural Resources, Alaska Regional Office, Anchorage, Alaska.

Ten Brink, N. 1984. North Alaska Range project final report on 1978-1982 geo-archeological studies. Report to the National Geographic Society and the National Park Service. Department of Geology, Grand Valley State College, Allendale, Michigan.

Thorson, R. and T. Hamilton. 1977. Geology of the Dry Creek site, a stratified early man site in Interior Alaska. Quaternary Research 7(2):149-176.

Treganza, A. 1964. An archeological survey of Mount McKinley National Park. University of Alaska and U.S. Department of the Interior, National Park Service, Contract No. 14-10-0434-1547.

United States Department of the Interior. 1993. National Park Service thematic framework.

National Park Service, Government Printing Office.

USNPS. (ND). Cultural resource compliance files. Cultural Resource Division, Alaska System Support Office, Anchorage, Alaska.

West, F. 1967. The Donnelly ridge site and the definition of an early core and blade complex in central Alaska. American Antiquity 32(3):360-382.

West, F. 1975. Dating the Denali complex. Arctic anthropology 12(1):76-81. University of Wisconsin, Madison.

West, F. 1981. The archeology of Beringia. Columbia University, New York.

ARCHEOLOGICAL RESOURCES

PROJECT CODE: DENA-C-200

SERVICEWIDE ISSUES:

C02	Identification and Evaluation Studies
C03	Site Documentation and Data Management
C04	Data Recovery
C05	Site Stabilization/Preservation/ Protection
C08	Special Studies-Archeology
C10	Cultural Landscape Inventory
C11	Cultural Landscape Report
C19	Inadequate Cultural Resource Monitoring Programs
C20	Cultural Landscape Program Development
C36	National Register Documentation
C62	Geographical Information System
C73	Resource Protection and Security
C83	Cultural Resource Management Staff
C96	Law Enforcement, Protection Training

STATEMENT OF PROBLEM

Present Condition

Previous archeological research in the park has resulted in the documentation of 188 archeological sites representing several time periods and types of cultural material. These include 84 prehistoric sites and 104 historic sites. The park museum collection also includes archeological materials collected during research and compliance projects.

Archeological survey work in the park has been conducted at the reconnaissance level and locations covered have been clustered in a limited number of areas. As a result, knowledge of prehistoric resources should be viewed as preliminary and not taken as a reliable sample on which to characterize the resource. Most of the recorded prehistoric sites are surface deposits of lithic tools or tool fragments, which are more vulnerable than buried deposits to impacts and also more difficult to classify and evaluate. Most of these sites are minimally documented; even fewer have been formally evaluated for national register eligibility.

One exception is the Teklanika archeological district, which is listed on the National Register of Historic Places. The Teklanika sites contain stratified prehistoric remains that are (at the present state of research) rare in Denali. Stratified sites often preserve important environmental and cultural context that is lost when cultural material remains exposed on the ground surface. The Teklanika sites also played an important role in defining the Denali Complex, a hallmark early cultural type site that eventually was named for the park's defining feature (West 1965). Although researchers continue to evaluate and debate West's conclusions about the age of the Teklanika sites based on more recent research, they retain significance for their role in the history and development of archeological research in Alaska.

Perhaps the most archaeologically interesting aspect of Denali is its close proximity to some of interior Alaska's best known research areas. Significant research has been conducted at the following sites: Lake Minchumina, at the northwest corner of the park (Holmes 1986), in the Susitna drainage southeast of Denali (Bacon 1978, Bacon et al. 1983, Dixon et al. 1985, Greiser et al. 1985, Irving 1957, Saleeby et al. 1985), in the North Alaska Range/Nenana Valley (Powers et al. 1983, Ten Brink 1984, Hoffecker 1980, Plaskett 1976, 1978, Thorsen 1977, Bowers 1980, Holmes 1988), and in the Denali Highway and Tangle Lakes region (Skarland and Keim 1958, West 1967, 1981, Dixon 1977, Betts 1987). These projects have documented 12,000 years of prehistoric activity from early man occupations to the late prehistoric era.

Sites with archeological value associated with the historic era account for more than half of the recorded archeological sites in the park (104 sites). These are divided between mining and other historic activities in Denali's past and range from nearly intact mining camps and operations to cabin ruins and scatters of isolated tools and equipment. Some of the types of historic sites with archeological potential recorded in the park are placer and lode mining camps and operations, mining communities, habitation sites, transportation sites, cairns, gravesites, and other resource extraction sites.

The park has good documentation of mining related sites in the park due to completion of an intensive multi-year research project (the Cultural Resource Mining Inventory and Monitoring program (CRMIM)) concluded in 1993. Prior to this program, it was standard for researchers in Denali to apply different strategies for recording and studying historic and prehistoric sites. Prehistoric sites were recorded with the goal of recovering information about site activities through documentation and analysis of physical remains while historical research and architectural documentation were more commonly applied to historic sites and structures.

The increasing body of historic archeological data gathered for Denali's historic sites will provide for a much more detailed cultural reconstruction of historic era sites. National register evaluation of the recorded CRMIM sites is ongoing. Currently six of the CRMIM sites have been determined eligible for the National Register and are being included in a pending nomination for a Kantishna Historic District. Prehistoric and non-mining historic sites recorded during the project have not yet been evaluated for national register eligibility. A number of the

remaining mining sites will eventually be documented as contributing elements of multiple property nominations under a mining theme.

In summary, Denali National Park and Preserve contains a wide variety of prehistoric and historic archeological resources but relatively few of those sites have been documented in sufficient detail to place them in a meaningful research context or address national register significance. Existing assessments of park archeological resources and research discoveries in regions surrounding the park suggest the area contains many unrecorded archeological sites and features, some of which may bring to light new time periods and technological/cultural classifications. Although the stratified contexts needed for in-depth analysis of prehistoric sites have proved rare in the park, the presence of such contexts at the Teklanika sites and at several areas immediately outside park boundaries indicates that this area has potential for recovering important research data.

Current Management Actions and Results

The management of archeological resources on park lands is mandated by federal law and policy. Responsibilities include identifying cultural resources, determining their significance in terms of national register eligibility, assessing threats and impacts, finding alternatives that support long-term preservation, and creating a system of care that ensures preservation through planning, research and stewardship.

An archeological overview and assessment, the basic planning document for archeological resources, was completed for the park in 1990. The overview summarized known archeological resources in Denali, described past research, identified problems and made recommendations. Recommendations included improved data management, completed national register evaluations for archeological sites, additional survey and excavation, and expanded research in historical archeology and ethnography (Griffin 1990).

In recognition of a servicewide need for archeological inventory of park lands, NPS developed the Systemwide Archeological Inventory Program (SAIP). Staff from the Alaska Support Office (AKSO) prepared a SAIP report that addressed recommended priorities for the Alaska Region parks. For Denali, the report supported recommendations identified in the overview, specifically highlighting improved database management, research on late prehistoric and protohistoric sites linked to ethnohistoric data, continuing development of historical archeology. Continuing inventory and evaluation of park resources were recommended as general objectives (Schoenberg 1995).

The park's archeological research history involves numerous past archeological research efforts designed to locate, document and record resources, or provide some level of further research or analysis. These include the following: reports on excavation of the Teklanika sites (West 1965, 1975), early reconnaissance survey work near the park road (Morgan 1965, Treganza

1964), an analysis of archeological materials collected from two sites in the park (Schimberg and Schlederman 1967), a Teklanika River reconnaissance survey (Plaskett 1976), a review of previously recorded sites with additional reconnaissance survey to provide data for a park general management plan (Davis 1981), a report on an extensive inventory of cultural resources associated with mining lands (Saleeby, in progress), a report on a proposed land exchange (Lynch 1996), and numerous compliance projects, many of them associated with the headquarters area and the Park Road (park files).

Together, these projects and reports document the status of known archeological resources in the park. However, given the park's size and archeological potential as demonstrated by independent research in areas surrounding the park, research efforts have been minor. The following describes important management issues:

General Management Plan Required Actions - The general management plan briefly outlines a series of actions that should be taken to improve the park's preservation of archeological resources. These included controlled survey and excavations, monitoring and documentation. Descriptions of actions below explain the details of implementation of these recommendations.

Intensive Survey/Research - Archeological surveys conducted in the park have been essentially reconnaissance surveys designed to provide a preliminary assessment of area potential (Secretary of the Interior's Standards and Guidelines for Historic Preservation). The preliminary nature of reconnaissance surveys also extends to site documentation; most recorded sites lack the detail necessary to make national register eligibility determinations. This is an important management issue because the national park service, like all federal agencies, bases it's degree of preservation obligation on the resource's national register eligibility. Opportunities to gather more intensive data such as excavations or intensive survey, have been rare in Denali. With the exception of the Teklanika excavations, archeological research has been largely driven by legal compliance, which is generally the need to investigate a particular area or category of resource in response to a threat or specific management need. Compliance information can be an important source of information about park resources and serves the purpose of preventing inadvertent human impacts to known resources. In most cases, however, it differs from more problem-oriented research required by the Secretary of the Interior's Standards and Guidelines for Historic Preservation. As a result, national register determinations have not been made for the vast majority of archeological resources in the park leaving their management status unclear.

Exceptions include the CRMIM program, which included national register evaluations for six sites associated with mining and mining related areas, the excavation of the Teklanika sites, and the contributing structures associated with the headquarters and patrol cabin national register nominations. As a result of these factors, baseline data for the park is scant, difficult to interpret, and geographically clustered making it inadequate to reliably characterize the resource and meet basic management needs.

Data Management - Improved standards for gathering and managing archeological data, with the goal of greater usefulness to researchers and managers, was addressed in the park's archeological overview and assessment (Griffin 1990). Data gathered during early projects in particular lacks adequate detail, existing data are not systematically maintained in comprehensive site files, and the lack of a computerized site database makes it difficult to access and analyze data. These issues have received servicewide attention as indicated by efforts to develop standards and procedures for recording and maintaining site documentation (Cultural Sites Inventory), creating and maintaining accessible resource-specific inventories (Archeological Sites Inventory, Cultural Landscapes Inventory, Ethnographic Resource Inventory, etc.), and develop informational databases (National Archeological Database, Cultural Resource Bibliography, Geographic Information System). The Archeological Sites Management Inventory System (ASMIS), a new archeological site database intended to replace previous efforts, is being developed by the service but is not operational in the Alaska Region.

Themes - One identified need that transcends different categories of cultural resources in Denali is the need to identify and develop themes and contexts that are illustrated by individual cultural resources. Themes and contexts are important because they provide for meaningful and understandable interpretation of resources and, more importantly, they facilitate the legally mandated process for evaluating cultural resources.

With few exceptions, archeological resources are considered eligible for the national register if they meet evaluation criterion D and "have yielded, or have potential to yield, information important to history or prehistory." Established research themes and contexts are the basis on which this evaluation can be made. To assist in the development of themes and contexts, the NPS provides a framework of very broad themes. The current version of this framework (revised in 1993) offers a starting point but Denali needs to identify, refine and apply specific themes based on it's unique resource base and needs.

RECOMMENDED ACTIONS

A. Program Administration and Planning

C-200.001: National Register Evaluation

Although mandated by Section 110 of the National Historic Preservation Act, national register evaluations have not been made for the majority of known archeological sites in Denali. In many cases, sites have not been recorded in sufficient detail to permit evaluation. The service would develop a program to identify sites that lack national register evaluation criteria. This would include visiting recorded sites, as needed, to obtain additional information needed to complete evaluations. The service would conduct field, lab or collection research needed to assess national register eligibility, and prepare

nomination forms where appropriate.

B. Research

C-200.011: Improve Archeological Site/Resource Data

The need for an improved system of database management has been identified in park planning documents (Griffin 1990, Schoenberg 1995). Currently many archeological sites, mostly those from early research and compliance projects, are poorly documented, which limits their usefulness for research and management purposes. To address this problem, the service would retroactively create comprehensive site files, with copies at the park and at AKSO, that include (or cross reference) all available site documentation (field notes, maps, photos, slides, reports, informants, artifacts and other collected materials, etc.) for all known sites. Data recording and management standards in research efforts (scopes of work, research contracts, etc.) would be addressed. The service would determine which original materials need to be treated as archival collections. When available, resource information would be added or updated on the Archeological Sites Management Inventory System (ASMIS) database.

C-200.012: Stratified, Intensive Archeological Survey

Based on the recommendation of the Denali Archeological Overview and Assessment (Griffin 1990), the service would design and conduct a stratified archeological survey in Denali National Park and Preserve. Strata would be delineated according to variables identified in existing biological, geological, geoarcheological, ethnohistorical, historical and archeological research. The research would include numerous site location models, including those of the North Alaska Range Project (Ten Brink 1984), and the predictive model of the aboriginal site types along the road corridor (Holmes and Gudgel-Holmes 1989). Systematic survey and limited testing will be done with known site locations mapped and evaluated. Site disturbance and collecting to be held to a minimum. A comprehensive GIS cultural data base will be developed to aid in the evaluation of information and development of future research designs, archeological investigations and park planning efforts.

C-200.013: Native Place Names Archeological Survey

Athabaskan elders have identified numerous Native place names in Denali (Gudgel-Holmes 1991) reflecting a history of traditional use but few of the identified sites have been examined by archeologists to document the physical remains associated with that use. This information has potential to document, confirm or challenge late historic through contemporary traditional use practices, and also to develop land use models for comparative study with prehistoric site types and locations. Based on existing place

name research, traditional use patterns, and ethnohistorical research, the service would identify these areas and conduct focused archeological survey to locate, define and document the nature of traditional use areas.

C-200.014: Establish Park Prehistoric Cultural Chronology

The placement of archeological sites within a timeframe is a major goal of archeology. For the known archeological sites in Denali, assessments of time depth are hampered by the lack of temporally diagnostic artifacts and sufficient stratification to preserve datable materials. As a result, with few exceptions (Teklanika, documented historic era sites), the time depth of prehistoric human activity is unknown in the park. Using regional site location models to identify areas with potential to contain stratified, testable, datable contexts (Ten Brink 1984), the service would conduct an archeological survey with subsurface testing and excavation as appropriate to determine the nature and age of deposits. The service would provide funding for processing of radiocarbon, tephrachronological comparison, or other dating techniques.

C-400.013: Define Denali Athabaskan Cultural Landscape

Identified elsewhere is the need to inventory and identify ethnographic cultural landscapes for Denali. One of the landscapes that needs to be identified is a prehistoric cultural landscape that will include the unique landforms, natural and cultural resources that were part of the prehistoric human environment in Denali and the archeological sites that resulted from patterns of prehistoric land use. Identification of the prehistoric cultural landscape(s) will provide a clearer understanding of prehistoric settlement and land use in Denali, and provide context for evaluating the national register eligibility of the sites and resources associated with the landscape. Refer to Cultural Landscape Project Statement (DENA-C-400).

C. Mitigation

C-200.021: Teklanika Archeological District Site Stabilization

The Teklanika sites comprise the Teklanika Archeological District (HEA-085) and are listed on the National Register of Historic Places. The sites played an important role in the development of archeological research in Alaska. Following their initial excavation in 1960, the sites were not adequately backfilled, leaving the sites vulnerable to vandalism (artifact collecting) and erosion due to weathering. This proposal calls for stabilization of the Teklanika West archeological site, applying preservation techniques necessary to arrest further deterioration of the site excavation area including stabilization of excavation unit walls and backfilling, as necessary. The action will be limited to specific studies to retrieve data that will be lost as a result of the stabilization effort. The

project is designed to seal the excavation for long-term preservation purposes.

D. Monitoring

C-200.031: Develop Monitoring Program

Need for a cultural resource monitoring program is noted in the park statement for management (1995). Currently there is no program designed to monitor and assess threats to archeological resources; natural (erosion, fire, deterioration) and human (vandalism). The service would develop a parkwide monitoring system for cultural resources. Refer to Project Statement DENA-C-100.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- National Register Evaluation	10/.2	10/.2	10/.2	10/.2	40/.2
RESEARCH					
- Improve Arch. Site Data	250/2.5	250/2.5	250/2.5	250/2.5	1000/2.5
- Native Name Place Survey	30/.7	30/.7	30/.7	30/.7	120/.7
- Prehistoric Chronology			35/.2	35/.2	70/.4
MITIGATION					
- Teklanika Stabilization		50	50	50	150
MONITORING					
- Monitoring Program		25/.1	25/.1	25/.1	75/.3
TOTALS	290/3.4	365/3.5	400/3.7	400/3.7	1455/14.3

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Bacon, G. 1978. Archeology in the Upper Susitna River Basin. Report prepared for the U.S. Army Corps of Engineers, Alaska District, Contract No. DACW85-78-C-0017, BLM Reference No. AG-AK910-297.

Bacon, G. and C. Mobley, T. Cole, and C. Holmes. 1983. The final report of the 1981 and 1982 cultural resources survey of the Anchorage-Fairbanks transmission intertie. Report to the Alaska Power Authority, Anchorage, Alaska. R-2516.

Betts, R. 1987. Archeological investigations at Butte Lake, Alaska: an inquiry into Alaskan notched point-micro blade assemblages. A report to the University of Alaska Museum Geist Fund. Fairbanks, Alaska.

Bowers, P. 1978. Research summary: 1977 investigations at the Carlo Creek archeological site, central Alaska. Report submitted to the University of Alaska Museum, Fairbanks by the Laboratory of Anthropology, Arctic Research Section, Washington State University, Pullman.

Bowers, P. 1980. The Carlo Creek site: geology and archeology of an early Holocene site in the central Alaska Range. Occasional Paper No. 27, Anthropology and Historic Preservation. Cooperative Park Studies Unit, University of Alaska Fairbanks. Fairbanks, Alaska.

Davis, C. 1981. 1980 Archeological reconnaissance of Mount McKinley National Park-- 'Yes, Virginia, it's worth another look.' Paper presented at the 8th annual meetings of the Alaska Anthropological Association, Anchorage, Alaska.

Dixon, E. J., G. Smith, W. Andrefsky, Jr., B. Saleeby, C. Utermohle and M. King. 1985. Draft report: Susitna hydroelectric project cultural resources investigations 1979-1985. University of Alaska, Fairbanks, Alaska.

Dixon, R. 1977. New archeological discoveries near Cantwell. In archeological survey projects, 1976, miscellaneous publications, history and archeology Series, No.6. Office of History and Archeology, Alaska Division of Parks, Anchorage, Alaska.

Greiser, T., S. Greiser, G. Bacon, T. Foor, P. Kari, J. Kari, D. Gallacher and J. Caywood. 1985. Susitna hydroelectric project phase I report: background research and predictive model for cultural resources located along the Susitna hydroelectric project's features, final report, vol.1. Historical research associates with contributions from Alaska Heritage Research Group under contract to Harza-Ebasco Susitna joint venture to the Alaska Power Authority, Document 2865.

Griffin, K. 1990. An overview and assessment of archeological resources, Denali National Park and Preserve, Alaska. Research/Resources Management Report AR-16. U.S. Department of the Interior, NPS, Alaska Region. Anchorage, Alaska.

Gudgel-Holmes, D. et al. 1989. Predictive model of aboriginal site types and locations for a catchment basin along the Denali Park Road within Denali National Park and Preserve. U.S. Department of the Interior, NPS, Alaska Regional Office. Anchorage, Alaska.

Gudgel-Holmes, D. (compiler).1991. Kantishna oral history project, phase II, Part 2: native place names of the Kantishna drainage. Prepared for the U.S. Department of the Interior, National Park Service, Alaska Regional Office, Anchorage. PX 9700-8-1067.

Hoffecker, J. 1980. Archeological field research, 1980, the North Alaska Range early man project. In North Alaska Range Project, final report on 1978-1982 Geoarchaeological studies (1984) edited by Norman W. Ten Brink. A report to the National Geographic Society and the U.S. Department of the Interior, National Park Service.

Holmes, C. 1986. Lake Minchumina prehistory: an archeological analysis. Alaska Anthropological Association Monograph Series No. 2, Anchorage.

Holmes, C. 1988. An early post paleo-arctic site in the Alaska Range. Paper presented at the 15th annual meeting of the Alaska Anthropological Association, Anchorage.

Irving, W. 1957. An archeological survey of the Susitna Valley. Anthropological papers of the University of Alaska vol.6(1):37-52.

Lynch, A. J. 1996. Archeological investigations of five remote tracts of land within Denali National Park and Preserve, Alaska, 1988-1989: National Park Service Resources Report/ARRCR/CRR-95/24. United States Department of the Interior, National Park Service, Alaska System Support Office, Division of Cultural Resources, Anchorage, Alaska.

Morgan, H. 1965. An archeological survey of Mount McKinley National Park. U.S. Department of the Interior, National Park Service. Contract 14-10-0434-951.

Plaskett, D. 1976. The Nenana river gorge site, a late prehistoric Athapaskan campsite in Central Alaska. Master's thesis, University of Alaska, Fairbanks.

Plaskett, D. 1978. Final report: a cultural resource survey in an area of the Nenana and the Teklanika rivers of central Alaska. Submitted to the State of Alaska Department of Natural Resources, Division of Parks, Contract No. 02-76-00035-00.

Powers, W., R. D. Guthrie and R. Hoffecker. 1983. Dry Creek: archeology and paleoecology of late Pleistocene Alaskan hunting camp. U.S. Department of the Interior, Alaska Regional Office, Anchorage.

Saleeby, B., E. Dixon and G. Smith. 1985. Susitna hydroelectric project, cultural resources-significance. Prepared for the Alaska Power Authority, Anchorage.

Saleeby, B. (ND). The Quest for gold: An overview of cultural resources mining inventory and monitoring program. United States Department of the Interior, National Park Service, Alaska System Support Office, Anchorage, Alaska.

Schimberg, D. and P. Schledermann. 1967. Additional material from two sites in Mount McKinley National Park, anthropology 214. Manuscript on file, U.S. Department of the Interior, National Park Service, Alaska Regional Office, Anchorage.

Schoenberg, K. 1995. Alaska Regional Plan, System wide Archeological Inventory Program, National Park Service, Division of Cultural Resources, Alaska Regional Office, Anchorage, Alaska.

Skarland, I. and C. Keim. 1958. Archeological discoveries on the Denali Highway, Alaska. Anthropological papers of the University of Alaska, vol. 6(2):79-88.

Ten Brink, N. 1984. North Alaska Range project final report on 1978-1982 geo-archeological studies. Report to the National Geographic Society and the National Park Service. Department of Geology, Grand Valley State College, Allendale, Michigan.

Thorsen, R. and T. Hamilton. 1977.Geology of the Dry Creek site, a stratified early man site in Interior Alaska. Quaternary Research 7(2):149-176.

Treganza, A. 1964. An archeological survey of Mount McKinley National Park. University of Alaska and U.S. Department of the Interior, National Park Service, Contract No. 14-10-0434-1547.

West, F. 1965. Excavations at two sites on the Teklanika River, Mount McKinley National Park, Alaska. University of Alaska. Fairbanks, Alaska.

West, F. 1967. The Donnelly ridge site and the definition of an early core and blade complex in central Alaska. American Antiquity 32(3):360-382.

West, F. 1975. Dating the Denali complex. Arctic anthropology 12(1):76-81. University of Wisconsin, Madison.

West, F. 1981. The archeology of Beringia. Columbia University, New York.

ETHNOGRAPHIC RESOURCES

PROJECT CODE: DENA-C-300

SERVICEWIDE ISSUES:

C11	Cultural Landscape Report
C20	Cultural Landscape Program Development
C21	Ethnographic Overview and assessment
C24	Ethnographic Landscape Study
C27	Ethnographic Oral and Life Histories
C28	Ethnographic Resources Inventory (ERI)
C29	Park Ethnographic program Strategy
C30	Notification and Consultation
C31	Special Studies
C83	Cultural Resource Management Staff
C93	Cultural Resource Management Training
C94	Cultural Landscape Preservation Maintenance

STATEMENT OF PROBLEM

Present Condition

The NPS ethnographic program seeks to identify traditionally associated groups and the resources that are part of their cultural systems, and establish collaborative relationships between the service and the peoples whose customary ways of life affect, and are affected by, park resource management (NPS-28;165). The Denali Statement for Management (1995) addressed the status of ethnographic research in the park as follows:

> From an ethnographic perspective, Denali is virtually a blank map, with little synthesized information available to assist park management. Denali has a special need for baseline ethnographic information, such as an ethnographic overview and assessment, ethnohistory, cultural affiliation studies, and special, applied anthropological studies of important groups such as climbers and miners.

Although research specifically designed to identify ethnographic resources has not been conducted in Denali, use of the park and surrounding area by different cultural groups and communities predates park development and is documented by past research. The best documented of these groups are five different Athabaskan groups. It is possible that other

occupational groups, who have figured in Denali's history, (mountaineers, pilots, park employees, subsistence users, miners, etc.) may be identified as defined ethnographic groups as well.

Traditional Native Culture - The Athabaskan groups known to have used the park are the Ahtna, Tanaina (Dena'ina), Upper Kuskokwim (Kolchan), Lower Tanana, and Koyukon. There is no firm agreement by researchers as to the antiquity of the cultural pattern and identity associated with Athabaskan culture today; some trace it back 1,000 years before present, while others suggest a much older age.

Cultural resources associated with traditional use in the park include prehistoric campsites and hunting sites (shown by varying concentrations of stone tools and tool fragments), villages identified in the northern additions land use study (Schneider et al. 1984), historic cemeteries, fishing camps, trails, traplines and other subsistence use areas.

Subsistence Use - The park's natural environment also supports communities of families and individuals who are not part of local traditional Native culture. These groups are linked by a shared subsistence lifestyle rather than ethnic heritage; individuals may be non-Native or descendants of non-local traditional Native cultural groups. Resources associated with this community include traplines, trails, cabins and communities. The tangible remains of these activities, which are 50 or more years old, can be evaluated for national register eligibility. More contemporary resources do not fall under the preservation guidelines of the National Historic Preservation Act.

The Mining Community - Mining is a well established activity in Denali's history. Gold mining began in Kantishna in 1903 and, with the exception of a brief hiatus during World War II, continued until 1985. Antimony, coal, and silver were also important mineral resources in the park's mining history. The national register eligible Stampede Mine, incorporated within the park by the 1980 northern land additions, was the nation's largest producer of antimony during World War II. Miners still hold a number of claims in Denali, although no mines are currently operational.

Throughout the history of mining, activity occurred in various drainages and employed various techniques, leaving a significant record of use and habitation. Cultural resources associated with mining in Denali include placer and lode mining camps, sites of placer and lode operations, mining communities and roadhouses, cabin sites, scattered equipment, and a variety of features such as roads and trails.

As noted above, a number of research projects and reports have focused on Native and non-Native traditional culture in the park. These include: a report on subsistence use in the park (Bishop 1978), a study of land use in the park's northern additions (Schneider et al. 1984), a study of Kantishna place names (Gudgel-Holmes 1991), an archeological overview and

assessment (Griffin 1990), a site predictive model for the Park Road corridor, an historic resource study (Brown 1993), a report on cultural resource investigations at mining sites (Saleeby in progress), a report on archeological investigations in four proposed park land exchange areas (Lynch 1996), and a traditional cabin study. An important source of information about patterns of subsistence use for communities adjacent to park boundaries (Nikolai, Telida, Minchumina and Cantwell) are the Community Profile Database studies conducted by the Alaska Department of Fish and Game, Division of Subsistence.

Most of this research has been conducted in localized areas, to provide background information for other interdisciplinary studies or for specific management needs. None has focused on the park in its entirety and none have been conducted specifically to improve ethnographic understanding.

Although these sources have provided background ethnographic data, acquiring more in-depth research for park management needs is clearly appropriate. According to NPS-28, a park requires specialized ethnographic research when particular communities, tribes or groups are known to have traditional links to park resources, or when special needs are identified. Relevant needs in Denali include acquiring baseline information to support management of subsistence resources, planning/implementing ecosystem management (mining area restoration), and developing an understanding of traditional cultural affiliations and territories to guide appropriate consultation with Native groups.

As stated in NPS-28, ethnographic oral and life histories are the standard anthropological method for studying the development, change, and stability in human life cycles and the resources that support them. A program of planned, focused oral history research designed to document the lives and cultural systems of the above noted groups as they relate to park history, would be an important contribution to the park ethnography program. The need to implement this program is reinforced by the advancing age of key informants. As stated in NPS-28: "It is imperative to initiate them (oral histories) as soon as possible when elderly community consultants are involved because crucial information about the community and resident life ways is threatened daily as older residents recall their former circumstances with less clarity and changing social and economic conditions lead to new ways of life."

Park staff have worked to record park history through oral interviews where possible and add recordings to the Park archives. In addition, the park obtained funding to collect oral history with CD-ROM technology through a cooperative agreement with the University of Alaska Fairbanks (Project Jukebox). Interviews under the theme "Denali Pilots" and the equipment for accessing the interviews are available in the park library. Additional funding is needed to expand present efforts and explore other historical themes.

Consultation with Native groups is an important aspect of ethnographic resource management. While a major goal of NPS ethnographic resource management is to facilitate collaborative

relationships between the service and the peoples whose customary ways of life affect, and are affected by, park resource management (NPS-28), there is an important management distinction between Native and non-Native groups. Specifically, the federal government recognizes a special obligation to consult, on a government-to-government basis, with the Federally recognized tribal entities that have documented ties to park lands. Examples of situations in which such consultation is required include anticipating and responding to requests pertaining to the Native American Graves Protection and Repatriation Act (NAGPRA) and park collections. These are significant undertakings that involve the National Historic Preservation Act (NHPA) and the American Indian Religious Freedom Act (AIRFA).

Currently, the required patterns of close consultation and dialog between park managers and identified Native groups are undeveloped. For example, compliance with NAGPRA, which required analysis of the park collection for NAGPRA eligible materials, was conducted by staff at the NPS Alaska Support Office. In order to remain in compliance with the above noted policies and legislation and obtain the desired preservation goals of the NPS ethnographic program, the park needs specialized ethnographic data to identify and define ethnographic groups, especially Native subgroups and their territories, establish procedures for consultation, and document cultural systems.

RECOMMENDED ACTIONS

A. Program Administration and Planning

C-300.001: Develop Native Consultation Network

Working with an anthropologist, the service would research and develop a local Native consultation network. The Bureau of Indian Affairs list of federally recognized tribes would be obtained for NAGPRA. The service would conduct specialized research into local tribes and territories (ethnographic overview and assessment). Identify programs, projects and actions that require consultation. Park staff responsible for consultation would be identified, and funding would be provided for appropriate training (historic preservation, NAGPRA).

B. Research

C-300.011: Ethnographic Overview and Assessment

An initial ethnographic overview and assessment is needed to summarize and evaluate existing ethnographic information regarding contemporary and historic cultural systems in Denali. The overview and assessment would provide information to develop

management plans to protect cultural resources; to understand the cultural significance of certain sites, structures or natural areas; to understand and protect traditional subsistence practices; to develop working relationships with appropriate Native or ethnic groups; to develop relevant interpretive programs; and to provide the context for developing specialized ethnographic studies.

The proposed project will define relevant groups and cultural systems, especially Native traditional use. The project will also identify specific resources used by ethnographic groups and record identified resources in the proposed NPS Servicewide Ethnographic Resources Inventory (ERI) computerized database. Threats to resources and cultural systems will also be addressed. While the focus of the overview and assessment is the park and preserve, the ethnographic reconstruction will take a regional perspective. Goals will be to identify, collect and evaluate written, oral, legal, historical and prior ethnographic information for Denali. Cultural resources, traditional use areas, and religious and sacred lands in and adjacent to Denali will be identified and documented. A complete listing of bibliographic references, locations of collections, oral recordings, legal documents, photographs, unpublished reports, and knowledgeable persons will be developed. Information will be evaluated and synthesized into a written report with recommendations for needed cultural management actions, subject areas for additional research and planning efforts. The project needs to be conducted in full consultation with relevant Native groups. A key topic for the overview is the identification of specific groups and their territories or areas of use. This is particularly essential for the Park's Native user groups, because it is the means of establishing the basis for consultation (determining which issues and actions would be of concern to which groups).

C-300.012: Record and Preserve Oral History of Park Administration

The service would develop a program to record and preserve park oral history describing the history of Denali National Park and Preserve. Interviews will be conducted and appropriate supportive material such as photographs will be located to complement the oral record of the creation and development of Denali National Park and Preserve. The project should include identifying, searching for, locating and scheduling interviews. Interviews will be recorded, copied and transcribed. Transcripts will be edited, indexed, digitized and scanned into a computer based program. Transcripts and supporting documentation will be archived into appropriate repositories.

C-300.013: Record and Preserve Oral History of Denali Miners

Mining is recognized as a major theme in park history. Cultural resource sites associated with mining are documented through traditional archeological methods and historical sources. Knowledge and interpretation of these sites would be enhanced by recording and preserving oral history associated with the history of mining in Denali. Through the

existing AKSO/University of Alaska Cooperative Agreement (#CA 9700-1-9020), the service would record and preserve park oral history of Denali miners.

Interviews will be conducted and appropriate supportive material such as photographs and maps will be located to compliment the oral record of mining in Denali. Historical themes related to mining industry and lifestyle will be developed for this study. The project should include identifying, searching for, locating and scheduling interviews with informants. Interviews will be recorded, copied and transcribed. Transcripts will be edited, indexed, digitized and scanned into a computer based program, and archived into appropriate repositories. Historical and contemporary photographs of miners/mining activities will be reproduced when available, then archived in the park historical photo collection. Previous oral histories collected by NPS, universities, private individuals and other agencies will be collected and included in the Denali oral history database.

C-300.014: Record and Preserve Oral History of the Railroad in Denali

Develop a program to record and preserve oral history describing the building of the railroad through the former Mount McKinley National Park and the influence it had on early park life. The project should include identifying, searching for, locating and scheduling interviews with informants. Interviews will be recorded, copied and transcribed. Transcripts will be edited, indexed, digitized and scanned into a computer based program, and archived into appropriate repositories. Historical and contemporary photographs of miners/mining activities will be reproduced when available, then archived in the park historical photo collection. Previous oral histories collected by NPS, universities, private individuals and other agencies will be collected and included in the Denali oral history database.

C-300.015: Record and Preserve Oral History of Park Employees

Develop a program to record and preserve oral history regarding early park duties, resources and activities. Interviews should be conducted with but not limited to, national park service, concessioner, and Alaska Road Commission (ARC) employees. The project should include identifying, searching for, locating and scheduling interviews with informants. Interviews will be recorded, copied and transcribed. Transcripts will be edited, indexed, digitized and scanned into a computer based program, and archived into appropriate repositories. Historical and contemporary photographs of miners/mining activities will be reproduced when available, then archived in the park historical photo collection. Previous oral histories collected by NPS, universities, private individuals and other agencies will be collected and included in the Denali oral history database.

C-300.016: Native Language Oral History and Record

Work with the Alaska Native Language Center to develop a Native place names map of the Park and Preserve. The project should also include identifying, searching for, locating persons to be interviewed. Oral history interviews will be conducted in Native languages.

C-300.017: Record and Preserve Oral History of Subsistence Users

Through the existing AKSO/University of Alaska Cooperative Agreement (#CA 9700-1-9020), the service would record and preserve park oral history of subsistence users of Denali. Interviews will be conducted and appropriate supportive material such as photographs and maps will be located to complement the oral record of subsistence use in Denali. Historical themes related to subsistence users and lifestyle will be developed for this study. The project should include identifying, searching for, locating and scheduling past users for interviews. Interviews will be recorded, copied and transcribed. Transcripts will be edited, indexed, digitized and scanned into a computer based program, and archived into appropriate repositories. Historical and contemporary photographs of subsistence users and/or subsistence use activities will be reproduced when available, then archived in the park's historical photo collection. Previous oral histories collected by NPS, universities, private individuals and other agencies will be collected and included in the Denali oral history database.

C. Monitoring

C-300.031: Identify and Assess Threats to Ethnographic Resources

Once ethnographic resources are identified, develop and implement a program to assess threats to important natural resources that support cultural systems, to the cultural systems themselves and to important cultural resources that illustrate cultural systems.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
-Develop Native Consultation Network		2.0/0.1	2.0/0.1	2.0/0.1	6.0/0.3
RESEARCH					
-Ethnographic Overview & Assessment	70.0	35.0			105.0
-Oral Histories	10.0	10.0	10.0	10.0	40.0
MONITORING					
-Identify and Assess Threats to Ethnographic Resources			20.0/0.2	20.0/0.2	40.0/0.4
TOTALS	80.0	47.0/0.1	32.0/0.3	32.0/0.3	191.0/0.7

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Bishop, R. 1978. Subsistence resource use in the proposed north addition to Mount McKinley National Park. Occasional Paper No.17, Anthropology and Historic Preservation. Cooperative Park Studies Unit, University of Alaska Fairbanks. Fairbanks, Alaska.

Brown, W. 1990. Historical resources study, Denali National Park and Preserve. United States Department of the Interior, National Park Service, Alaska Regional Office, Anchorage, Alaska.

Griffin, K. 1990. An overview and assessment of archeological resources, Denali National Park and Preserve, Alaska. U.S. Department of the Interior, NPS, Alaska Region. Anchorage, Alaska.

Gudgel-Holmes, D. (compiler).1991. Kantishna oral history project, phase II, Part 2: native place names of the Kantishna drainage. Prepared for the U.S. Department of the Interior, National Park Service, Alaska Regional Office. Anchorage, Alaska.

Lynch, A. J. 1996. Archeological investigations of five remote tracts of land within Denali National Park and Preserve, Alaska, 1988-1989: National Park Service Resources Report/ARRCR/CRR-95/24. United States Department of the Interior, National Park Service, Alaska System Support Office, Division of Cultural Resources, Anchorage, Alaska.

Saleeby, B. (ND). The Quest for gold: An overview of cultural resources mining inventory and monitoring program. United States Department of the Interior, National Park Service, Alaska System Support Office, Anchorage, Alaska.

Schneider, W., D. Gudgel-Holmes and J. Dalle-Molle. 1984. Land use in the north additions of Denali National Park and Preserve: an historical perspective. Research/ resources management report AR-9, U.S Department of the Interior, National Park Service, Alaska Region.

C - 400

CULTURAL LANDSCAPES

PROJECT CODE: DENA-C-400

SERVICEWIDE ISSUES:

C10	Cultural Landscape Inventory
C11	Cultural Landscape Report
C20	Cultural Landscape Program Development
C72	Resource Protection and Security
C83	Cultural Resource Management Staff
C93	Cultural Resources Management Training
C94	Cultural Landscape Preservation Maintenance

STATEMENT OF PROBLEM

Present Condition

Cultural landscapes are cultural resource systems that reflect human land use and adaptation. The goal of a cultural landscape management program is the preservation of a cultural landscape's unique physical attributes, biotic systems, cultural associations and use, when that use contributes to its historical significance. Although no cultural landscapes have been formally identified or recorded in Denali, there is no question that qualified vernacular, archeological and ethnographic landscapes exist within the range of sites and time periods represented by the identified cultural resources and past land use in the park. Cultural landscapes should be considered an unevaluated category of cultural resources in Denali.

Current Management Actions and Results

As a relatively newly recognized major type of resource, cultural landscapes are less likely to have been formally identified than other categories of cultural resources. Landscapes are also less likely to have been integrated into funding, staffing, and planning efforts. As a result, NPS-28 directs field areas and parks to "...systematically evaluate their funding and staffing needs for landscapes and identify them in park resource management plans (NPS-28:101)."

According to federal law and NPS policy, cultural landscapes are to be managed as cultural resources. Section 110 of the National Historic Preservation Act requires the NPS to identify and nominate to the national register all resources under its jurisdiction that appear eligible, including cultural landscapes. The cultural landscape program focuses on landscapes listed in,

or eligible for, the National Register of Historic Places. Thus, management obligations for cultural landscapes are the same as for other categories of cultural resource. These include identifying cultural landscapes, determining their significance (defining the features, values and associations that make them significant), assessing threats and impacts, finding alternatives that support long-term preservation, and creating a system of care that ensures preservation through condition assessments, maintenance, and appropriate training for staff.

The lack of documentation of cultural landscapes, identified as a servicewide material weakness, has led to support for cultural landscape inventory beginning in FY97. According to NPS-28, cultural landscapes can be identified, defined and evaluated by initiating a special cultural landscape study, or through other resource-specific studies. For example, ethnographic landscapes are most often identified through ethnographic research and planning, or an ethnographic overview and assessment. Historical cultural landscapes are commonly identified in a park historic resource study (HRS). Currently, a Denali HRS is underway, containing site specific information and national register evaluations.

Resources under discussion for development as cultural landscapes include the Kantishna mining district, the Geese House and specific fishing sites (traditional ethnographic landscapes), selected traplines and subsistence cabins, the Park Road, and the park headquarters historic district. A servicewide computerized inventory database of cultural landscapes, the cultural landscape inventory (CLI), is described in NPS-28. The CLI is currently under development by the service and expected to be operational in FY97.

Potential threats to cultural landscape integrity include facility development and inappropriate design, motorized means of access, and air quality degradation. Each of these are discussed in the Project Statements I-610, I-640, I-670, N-110, and N-520.

RECOMMENDED ACTIONS

A. Research

C-400.011: Cultural Landscape Inventory

Although managers are required to identify cultural landscapes and evaluate their eligibility for the National Register of Historic Places, a lack of information about cultural landscapes has been identified as a servicewide material weakness. This weakness holds true for Denali; cultural landscapes have yet to be formally identified or developed. To correct this deficiency, a cultural landscape inventory program would be conducted. The inventory would include a review of existing research, known resources and cultural systems to identify critical (threatened), intensively used, or high potential

areas. Surveys of cultural landscapes will be conducted by qualified teams to identify and record the full range of cultural systems and culturally relevant natural resources likely to be encountered in the project area (landscape architects, archeology, ethnography, history, geomorphology, biology). The teams will locate and document cultural landscapes identifying boundaries and culturally relevant zones of use. The teams will assess the integrity and condition of cultural landscapes with the goal of obtaining all of the data necessary to evaluate national register eligibility for identified landscapes and resources. This program should also generate data needed for the NPS cultural landscapes inventory database and add identified landscapes and resources to the inventory when the program is fully operational. NPS will develop the project in consultation with Native groups and park inholders where appropriate.

C-400.012: Kantishna Cultural Landscape Report

The Kantishna Mining District, including the community known as Kantishna, has been a focus of mining related history in the park. The area contains many cultural resource sites, including a number of structures with potential eligibility for the National Register of Historic Places. Potential threats to these resources include increasing visitor utilization, the unresolved status of present day mining claims in the area, and general deterioration of historic structures. Based on recorded sites and cultural systems, a cultural landscape report on the Kantishna Mining District would be prepared. National register forms for eligible landscapes would be completed. The report would identify the resources (cultural, biotic) that comprise the landscape, assess threats and potential threats, provide management direction, and propose recommended treatment of the Kantishna cultural landscape and the diverse cultural resource sites it includes. Central to the enumeration of the treatment recommendations will be an evaluation of the relationship between reclamation and cultural landscape protection.

C-400.013: Park Headquarters Cultural Landscape Report/Site Plan

The park headquarters is a national register historic district, with numerous historic structures characterized by rustic architecture. The area currently receives intensive use as the park administrative center, and many of the structures have experienced severe deterioration. Based on recorded history and documentation of the park headquarters complex, a cultural landscape report for the headquarters area would be prepared. National register forms for eligible landscapes would be completed. The report would identify the cultural and natural resources that comprise the landscape(s), assess threats and potential threats, provide management direction, and propose recommended treatment of the headquarters cultural landscape(s) and the historic structures and features it includes.

C-400.014: Ethnographic Cultural Landscape Report; Athabaskan Cultural Systems

A long history of traditional use of the park by at least five Athabaskan cultural groups is documented by research in several areas within the park. Currently, this research is inadequate to develop Athabaskan cultural landscape(s). The service would provide funding to prepare a cultural landscape report defining, describing and recording the Native ethnographic cultural landscape(s) of the park (Ethnographic Resources Project Statement). National register forms for eligible landscape(s) would be completed. The service would identify the cultural and natural resources that comprise the landscape(s), evaluate their significance, assess threats and potential threats, provide management direction, and propose recommended treatment of the cultural landscape(s) and relevant resources. The project should include consultation with appropriate Native groups.

C-400.015: Park Road Corridor Cultural Landscape

The Park Road corridor has been and continues to be an integral part of Denali's history. The construction of the Park Road and the associated roadside patrol cabins built in the 1930's by the Alaska Road Commission (ARC), have a long standing history of use. The road is currently managed to limit vehicle traffic. The patrol cabins are still in use by staff in summer and winter. Based on recorded history and documentation of the Park Road corridor, prepare a cultural landscape report on the road corridor. Complete national register forms for eligible landscape(s). The report would identify the cultural and natural resources that comprise the landscape(s), assess threats and potential threats, provide management direction, and propose recommended treatment of the road corridor cultural landscape(s) and the historic structures and features it includes.

B. Mitigation

C-400.021: Restoration of Cultural Landscapes

Park staff would implement actions to restore landscapes in areas such as the Wonder Lake Ranger Station and park headquarters.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
RESEARCH					
- Cultural Landscape Inventory	10.0	10.0			20.0
- Cultural Landscape Reports (road, HQ, Kantishna)	36.0	41.0	50.0	25.0	152.0
- Ethnographic CLR; Athabaskan Cultural Systems			50.0	50.0	100.0
MITIGATION					
- Landscape Restorations			50.0	25.0	75.0
TOTALS	46.0	51.0	150.0	100.0	347.0

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Evans, G. 1987. From myth to reality: travel experiences and landscape perceptions in the shadow of Mount McKinley, Alaska, 1876-1938. Unpublished master's thesis, Public Historical Studies Department, University of California, Santa Barbara, California.

PARK HISTORY

PROJECT CODE: DENA-C-500

SERVICEWIDE ISSUES:
C37 Administrative History
C38 Special History Studies
C83 Cultural Resource Management Staff

STATEMENT OF PROBLEM

Present Condition

Denali has experienced a rich cultural history, characterized by the interaction of traditional Native groups, explorers, miners, mountaineers, scientists and adventurers with the park's unique natural environment. This history is illustrated by a diversity of historic era sites, structures features, objects and archival materials.

Historical research is an essential element in cultural resource management. It provides the background and context that determine preservation needs of the resource and allows the public to understand and benefit from the resource. The NPS prescribed historical research program includes two main categories of research: identification and evaluation studies, and documentation and investigation studies.

Historic resource studies, the list of classified structures (LCS), and national register nominations are the main types of NPS identification/evaluation studies. The status of these for historical resources is good. The Denali LCS is complete and a park historic resource study is underway. Volume I, a narrative describing park history, was completed in 1991 and Volume II, which will include National Register evaluations for eligible structures, is in progress.

The historic structures included in the Denali Headquarters Historic District and those included in a group thematic national register nomination as the Denali patrol cabins have received adequate documentary research (refer to nomination forms). Documentation is ongoing for national register eligible historic structures in the Kantishna area. The Stampede Mine, determined eligible for the national register, has been recommended for both historic American buildings survey (HABS) documentation and formal nomination to the national register.

An archival management program has been recommended for the park. Of the 251,376 items

in the collection, an estimated 239,904 items are classified as archival materials; important documentary materials recording park history. By far the largest segment of the total collection, archival materials also represent the most severe backlog to be cataloged; an estimated 200,000 items. As a strategy for improving the handling of archival materials, a 1995 collection management plan recommended developing an action plan for the organization and administration of park archives, establishing a suitable archival work and storage area, and developing in-park procedures for archival collection management (for example, identifying which materials need to be taken out of general circulation and added to the archival collection).

A comprehensive park administrative history is considered a source of baseline research information and an important tool for management. The current park administrative history is in need of updating. Since it was written, the park has experienced a number of important management challenges, including changes in federal and state subsistence management, boundary changes, conflicts regarding road access to the park, and a mining injunction. These events warrant an updated administrative history.

In addition to a comprehensive administrative history, special history studies can provide topically specific administrative histories intended to more fully document and describe particular events, themes or time periods that are significant in park history. There are a number of topics that warrant such research in Denali. These include the history of scientific research in the park, bush pilots, mountaineering and the history of dog mushing.

RECOMMENDED ACTIONS

A. Research

C-500.011: Comprehensive Park Administrative History

A park administrative history is considered a source of baseline research information and an important tool for management. The existing park administrative history for Denali is outdated. The park has experienced significant administrative changes since it was completed. Prepare a revised and updated comprehensive administrative history for Denali National Park and Preserve up to the present day. The history will use all appropriate sources of historical documentation (library, archives, oral history) to describe the establishment of Denali National Park and Preserve and the changes and challenges it has gone through since its inception. The history should include the park's legislative history, and important issues in planning, land acquisition, development, public relations and other topics of ongoing management concern. The history will be prepared to the standards and specifications outlined in National Park Service Administrative History: A Guide (National Park Service 1991).

C-500.012: Special History Study: Administrative History of Research in Denali

Since it's inception, Denali National Park and Preserve has functioned as a scientific laboratory as well as a recreational preserve. This function began with the wildlife observations of Sheldon and Murie and continues today. This project would provide a focused administrative history of Denali's scientific history. It would identify and describe the park's significant research projects (purpose, methods and results). It would summarize the results of different types of research and identifies patterns, if appropriate. It would include an annotated bibliography of research and an index by author and subject. The history will be prepared to the standards and specifications outlined in National Park Service Administrative History: A Guide (National Park Service 1991).

C-500.013: Special History Study: Mountaineering On Denali

The history of mountaineering on Denali is relatively young with the first expeditions occurring around the turn of the century. Many of the mountaineers that have attempted Denali and adjacent mountains are still alive. Oral histories should be gathered from the individuals, a treatise on mountaineering should be written, and artifacts from those climbs should be collected.

C. Mitigation

C-500.021: Archival Management Program

Significant park historical documentation is contained in archival materials in the park collection and is in use in active files. Lack of a strategy for managing archival materials could result in loss of irreplaceable historical documentation. To correct this problem, the service would develop an action plan for the organization and administration of park archives, establish a suitable archival work and storage area, and develop in-park procedures for archival collection management. For example, the service would identify which materials need to be taken out of general circulation and added to the archival collection. Refer to Project Statement DENA-I-300.

C. Interpretation

C-500.041: Develop Dog Mushing Exhibit

Within the broad historical theme of transportation and access to the park, the use of dog teams in Denali is a unique historical theme that is also immensely popular with visitors. Dog teams have been used by rangers at Denali National Park and Preserve for 70 years and by Alaskans for many more. In Alaska, the dog was the animal of choice, used by

Eskimo and Athabaskan people to move their camps and hunt for seals, caribou, and other animals. The proposed project will create an interpretive exhibit relating to dog mushing. Some replica items may be purchased as necessary to adequately bring the story to life.

Because the kennel facility is a working dog kennel and a contributing element of a national register historic district, development of the exhibit must consider potential impacts. Consideration must be given to effects the project could have on the structures and successful and efficient operation of the kennels in the earliest stages of development. Development of the exhibit will require collaboration of the collection manager, the kennel manager, the chief of interpretation, and the AKSO historical architect .

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
RESEARCH					
- Comprehensive Admin History		50.0	50.0	25.0	125.0
- Research History			25.0	25.0	50.0
MITIGATION					
- Archival Management			10.0	5.0	15.0
INTERPRETATION					
- Dog Mushing Exhibit	5.0				5.0
TOTALS	5.0	50.0	85.0	55.0	195.0

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Brown, W. 1990. Historical resources study, Denali National Park and Preserve. United States Department of the Interior, National Park Service, Alaska Regional Office, Anchorage.

HISTORIC STRUCTURES

PROJECT CODE: DENA-C-600

SERVICEWIDE ISSUES:

C10	Cultural Landscape Inventory
C11	Cultural Landscape Report
C20	Cultural Landscape Program Development
C56	Rehabilitation/Restoration/Reconstruction
C72	Resource Protection and Security
C83	Cultural Resource Management Staff
C93	Cultural Resources Management Training
C94	Cultural Landscape Preservation Maintenance
C99	Structure Preservation Maintenance Training

STATEMENT OF PROBLEM

Present Condition

Historic structures are the most apparent of Denali's cultural resources. They include such features as cabins, structures associated with park headquarters, bridges, roads, and tailings piles. Cabin ruins associated with larger site complexes are also managed as historic structures. Isolated cabin ruins are not considered historic structures but are dealt with as archeological resources. Denali's list of classified structures (LCS) is current (as of September 1997) and includes 143 structures. The LCS summarizes a number of types of management information, including national register status, treatment category, and management recommendations (Appendix F - Structure Summary Chart).

The two major objectives of management of historic structures are to slow loss and maintain historic character. These objectives are accomplished by following mandated policies and procedures requiring inventory, Section 106 review, and assessment of national register significance, by addressing impacts to historic structures in park planning, and by prioritizing and implementing appropriate treatment of historic structures (Secretary of the Interior's Standards and Guidelines for Historic Preservation).

Programs to inventory and evaluate the national register eligibility of park historic structures are functioning well. The park has identified one national register historic district, Denali Headquarters Historic District, and one thematic or group national register nomination, the

Patrol Cabins. A third national register nomination, for the Kantishna Mining District, is in progress. That district will encompass six historic structures recorded and determined eligible during an intensive inventory of historic mining areas. The Stampede Mine complex has also been determined potentially eligible for the national register, but has not been nominated. A draft nomination was initiated for Kantishna's Caribou Creek mining operation in response to a proposed mining plan of operation, but the determination process was never completed or formalized.

The Park Headquarters Historic District, which includes the Wonder Lake Ranger Station, consists of 17 historic structures and connecting roads. The district's structures are considered significant as an illustration of the presence and early growth of the National Park Service in Alaska and in recognition of the structures overall distinctive rustic style of architecture. The historical and architectural background for the district is detailed in a three volume historic structures report (HSR) and an NPS report prescribing design guidelines for the district (Snow 1985, Spude et al. 1987). More recently, architectural plans and drawings for exterior treatment of the district's structures were prepared by the Alaska Support Office historical architect in 1993. The structures are in use as the park's administrative center.

A group of 14 remote cabins were added to the national register in a thematic nomination titled "Patrol Cabins, Mount McKinley National Park". The nomination includes five cabins associated with the Alaska Road Commission activities in the park and nine National Park Service ranger cabins used to shelter rangers on patrol in remote areas of the park. The cabins share a similar rustic style; all are small, one story, buildings with horizontal log wall construction. All but one feature peeled logs. The cabins date to different construction eras (1924 - 1935), but most have experienced few exterior alterations. The original Savage River cabin was cut in half with the remaining half relocated to its current location. All of the cabins are in use today as patrol cabins and residences. The Savage River cabin is in use as an interpretive exhibit.

The Stampede Mine, located in the northeast corner of the park was, at one time, the second largest producer of antimony in the United States. The site has been determined potentially eligible for the national register. Discovered in 1910, the mine was operated by Alaskan historical figure Earl Pilgrim between 1936 and 1970. The mine complex consists of shops, a bunkhouse, an assay lab, an office, a warehouse, a greenhouse, a few storage sheds and a 4 story mill building. Management of the site is complicated by the fact that while the land and structures are owned by the NPS, but the mineral rights and equipment are owned by the University of Alaska Fairbanks. In 1987, while attempting to clear the site of explosives and hazardous materials, a prescribed explosion destroyed some structures (assay lab) and damaged others. Since that time the site has been cleaned up and damaged structures were stabilized. Following the explosion, NPS agreed to complete a national register nomination for the site when it reached the minimum age designation for the register in 1992, and to record the site through photographs and architectural drawings. Neither action has been carried out. Recent

site visits have indicated that artifacts and equipment are being removed from the site at an unknown rate. A memorandum of understanding between the University of Alaska Fairbanks and the NPS concerning management of the site was signed. In 1997, the National Park Service agreed to buy out all University interests at the site. As of this writing, that purchase was in progress.

Current Management Actions and Results

Denali's historic structures have received different kinds of attention over the years, including documentation, rehabilitation, and other treatment. These actions are detailed in a number of NPS reports. In addition to the historic structure report (HSR) and design guideline noted above (Spude et al. 1987), three national register historic cabins have been detailed in individual historic structure reports; the Upper Windy Creek Patrol Cabin (Evans and Evans 1992), the Shushana River Ranger Station (Evans and Evans 1992), and the Dog Feed Cache and Sled Storage Building (Building 105), which is an addendum to the original headquarters district HSR (Skeirik and Peterson 1993).

In addition, an historic furnishings report (HFR) was prepared for the Pearson Cabin . The report was prepared to provide guidance for the accurate interpretation of the site after the Park Interpretive prospectus recommended the cabin as an interpretive exhibit (1990). The proposed exhibit was intended to provide visitors with an opportunity to learn about the lifestyle of the early Denali rangers. Although the Pearson Cabin is not currently used as an interpretive exhibit, the Savage River Cabin is used for that purpose. The cabin was furnished without an HFR. Visitors view the interior of the cabin from outside and are not allowed in it. The sled dog kennels and cache, part of the Park Headquarters Historic District, is also operated as a unique and popular interpretive site that receives more than 40,000 visitors per year. The cache, kennels, and related structures were extensively rehabilitated between 1995 and 1997 and a proposal was made to develop an additional interpretive exhibit.

Treatment of historic structures in the park occurs through cultural cyclic maintenance projects as well as through targeted repair and rehabilitation projects. Stabilization and rehabilitation of the patrol cabins were successfully carried out in a phased approach. The Alaska Support Office historic architect and park staff identified priorities for specific structures. Treatment was achieved in phases. From 1984 to 1993, 10 patrol cabins received treatment: Savage, Sanctuary (1984), Igloo (1985), Upper East Fork (1990), Upper Toklat (1988), Pearson (1986), Lower Savage (1984), Shushana (1993), Upper Windy (1992), and Lower Windy (1992).

The Park Headquarters Historic District has several historic structures that have been treated: ranger cache, the warehouse (now the interpretive office), and park headquarters received new roofs in 1992. Exterior treatment was performed on the ranger cache in 1993. Further work is needed on other structures. Building #106, the horse barn, requires a new foundation and replacement of 30 or more rotting logs. Building #107, the power plant and boiler House, also

requires replacement of an undetermined number of logs due to soil pressure from the hillside. These two buildings are among the oldest that remain in the historic district. The remaining log buildings in the headquarters area are in less severe condition, but still warrant treatment. Several structures have deteriorating exposed end logs. Although rehabilitation needs were addressed in the Park Headquarters Historic Structure Report (Snow et al. 1987) and architectural drawings and plans for exterior rehabilitation for the Park Headquarters Historic District were prepared in 1995, a plan prioritizing, securing funding and implementing the recommendations was partially prepared in 1997.

Wonder Lake Ranger Station needs treatment to deal with a shifting foundation. Other issues associated with historic structures include the buildup of vegetation in close proximity to the buildings creating wildland fire hazards and the presence of mine tailings and residues in or near buildings that may pose public health concerns if elevated levels of contaminants are present. All of these issues need to be dealt with.

RECOMMENDED ACTIONS

A. Program Administration and Planning

C-600.001: Site Management Plan for Park Headquarters Historic District

Currently this historic district experiences intensive use by staff, visitors and vehicles. Develop a plan for use of the historic district. The plan should identify threats and impacts that current and projected levels of use will have on the condition of the structures and historic character of the headquarters historic district and make recommendations for avoiding impacts. This may be accomplished by evaluating the headquarters area as a Cultural Landscape. Refer to Cultural Landscapes Project Statement (DENA-C-400).

C-600.002: National Register Nomination, Stampede Mine

Following the 1987 explosion at Stampede Mine, the national park service committed to preparing a national register nomination when the site reached the minimum 50 year age to be considered eligible for the national register. The site achieved the minimum 50 year age requirement in 1992. Consolidate existing historical sources relating to Stampede Mine (correspondence, archival materials, oral history, photos and architectural drawings). Provide necessary historical documentation, prepare and submit national register nomination form for Stampede Mine.

C-600.003: Site Management Plan, Stampede Mine

Clear objectives for the future use of Stampede Mine have not been established. Without an agreement on objectives, the site is likely to experience deterioration that could eventually limit preservation potential. The best example of this is the loss of equipment at the site. Although the structures have been stabilized, the equipment and artifacts at the site, much of which is not secured, are experiencing loss through theft. This impact is difficult to measure without an inventory but valuable items have been removed including a large generator, a 200 lb historic anvil, and an assay scale. To correct this problem, the National Park Service should develop a detailed plan regarding management of the Stampede Mine site. The agreement should establish the best use of the site and set agreed upon preservation alternatives and priorities for the site's structures and equipment. As a first priority, develop a plan to inventory equipment and potentially historic objects. Determine which objects possess historical significance, and prepare a collection/curatorial plan. Within the scope of the collection/curatorial plan, collect vulnerable historic items. Provide secure storage for equipment to be left on site.

B. Mitigation

C-600.021: Historic Structure Stabilization, Park Headquarters Historic District

The Mount McKinley National Park Headquarters Historic District has been found eligible for the National Register of Historic Places. The structures are a significant part of the cultural resources of Denali National Park and Preserve. They are critical to the management and administration of Denali from a functional office standpoint and contribute greatly to the visitors experience and understanding of the history of the park.

The historic district is recorded and described in an historic structures report (HSR) and the park's list of classified structures and district design guidelines. An Architectural Plan and Specifications for Rehabilitation were prepared in 1995. Over many years of occupancy, the 17 historic structures within the historic district have been repaired, refurbished, or modified to meet administrative needs. These changes have had a cumulative impact on the historic fabric of these structures. The goal of this project is to return the structures within the district to their original exterior appearance. In addition, a 1993 wildlands fire fuel assessment (USNPS 1993) has indicated that the district is known to be in a high risk area for wildland fires due to excessive wildland fire fuels in the area. This poses a threat to the structures. Many have cedar shake roofs that are vulnerable to fire.

With adequate demonstration of need and basic planning documents in place, proceed with repair and rehabilitation of the historic structures in the Park Headquarters Historic District. A prioritized repair and rehabilitation plan based on the recommendations of

the historic structures report, and Architectural Plan and Specifications for Rehabilitation has been developed. The highest priorities are (1) dog feed and sled storage building, (2) superintendent's quarters, (3) the barn or sign shop, and (4) the plumbing shop. Secure funding and implement the recommendations. This project will provide exterior rehabilitation of the 17 historical structures within the district in order to slow loss and restore/maintain historic character. This project includes weather sealing, repair of structural deteriorations, and replacement of doors, windows and trim in order to return structures to their appropriate historical appearance. It will reduce the threat of destruction from wildland fire by treating and/or replacing vulnerable roofs. All treatments, including selection of roofing materials, will be consistent with the historical architecture of the historic district.

C-600.022: Preservation Treatment of the Wonder Lake Ranger Station

The foundation of the Wonder Lake Ranger Station is shifting as the ground under it moves. Preservation treatment is needed to correct this problem.

C-600.023: Preservation Treatment of the Quigley Cabin

The NPS has only recently taken possession of the Quigley Cabin. A full assessment of its condition should be completed and preservation treatment provided accordingly.

C-600.024: Further Treatment of Patrol Cabins

Appropriate treatment would be performed on the Riley Creek, Lower Windy, Moose Creek, Cache/Lower Toklat, and Lower East Fork cabins.

C-600.025: Stabilization of the Kantishna Roadhouse

The Kantishna Roadhouse has received some stabilization in the past but is in poor condition. Minimum stabilization should continue as this is the most visible historic structure to visitors to the Kantishna area.

C-600.026: HABS Photograph Documentation, Stampede Mine

Following a damaging explosion at the Stampede Mine, the National Park Service committed to document the site through record photographs and selective architectural drawings. Files maintained in the AKSO contain a variety of materials documenting the site (sketches, sketch maps, photographs) but none is in a finished format. Working with the Support Office historic architect, program for Historic American Buildings Survey documentation of the Stampede Mine through record photographs and selective architectural drawings.

C. Monitoring

C-600.031: Monitor and Assess Historic Structures

Inventories like the LCS and the Denali cabin inventory provide management with information about the condition, threats, and treatment needs of historic structures. However, some structures are more likely to receive assessment visits and updates than others. High priority usable structures, structures with easy access, or structures requiring other management attention, such as fire protection assessments, are most likely to be targeted for assessment visits. This impacts the reliability of the inventories because current information is not uniformly available for all structures. An effort should be made to periodically visit all historic structures to provide adequate information for management.

C-600.032: Monitor and Maintain Historic Structures, Stampede Mine

An initial cleanup and stabilization of Stampede Mine was completed over a 13 week period in 1989. The project had three main objectives; to gather and consolidate explosion debris, to repair and mothball historic structures (primarily roof repairs and and renailing), and to clear brush from previously cleared areas between buildings. At this time preventive maintenance recommendations were made. In accordance with the recommendations of the preservation specialists conducting the cleanup, conduct annual inspections of the site to monitor structural integrity and inspect roof repairs and structural bracing, repairing and replacing as needed.

D. Interpretation

C-600.041: Interpret Headquarters Historic Structures

Develop a self-guided tour, using signs, of the headquarters district. Include information to help visitors better understand the district's significance and architectural style.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- HQ Site Plan		10.0	5.0		15.0

- Stampede NR Nomination	10.0				10.0
- Stampede Site Plan	10.0	5.0			15.0
MITIGATION					
- HQ Structures Stabilization	50.0	50.0	50.0		150.0
- Wonder Lake Ranger Station	50.0	50.0			100.0
- Quigley Cabin		50.0	20.0		70.0
- Patrol Cabins	20.0	20.0	20.0	20.0	80.0
- Kantishna Roadhouse		20.0			20.0
- Stampede HABS			50.0	20.0	70.0
MONITORING					
- Occupied Structures Monitoring	5.0	5.0	5.0	5.0	20.0
- Stampede Monitoring	2.0	2.0	2.0	2.0	8.0
INTERPRETATION					
- HQ District Signs			10.0	5.0	15.0
TOTALS	147.00	212.00	162.00	52.00	573.00

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Evans, H.D. and G.E. Evans. 1992a. Historic structure report, Upper Windy Creek patrol cabin. U.S. Department of the Interior, National Park Service, Alaska Regional Office, Division of Cultural Resources. Anchorage, Alaska.

Evans, H.D. and G.E. Evans. 1992b. Historic structure report, Sushana River ranger station. U.S. Department of the Interior, National Park Service, Alaska Regional Office, Division of

Cultural Resources. Anchorage, Alaska.

Evans, G. 1987. From myth to reality: travel experiences and landscape perceptions in the shadow of Mount McKinley, Alaska, 1876-1938. Unpublished master's thesis, Public Historical Studies Department, University of California, Santa Barbara, California.

Koue, A.L. and R.V. Simmonds. 1970. Historic structure report, Toklat patrol cabin complex. U.S. Department of the Interior, National Park Service, Western Service Center. San Francisco, California.

Skeirik, and Peterson. 1993. Historic structure report, Dog Feed Cache and Sled Storage building.

Snow, D.E. 1985. Design guidelines, Mt. McKinley Park Headquarters Historic District. U.S. Department of the Interior, National Park Service, Alaska Regional Office, Division of Cultural Resources. Anchorage, Alaska.

Snow, D., G. Evans, R. Spude, and P. Gleason. 1987. Historic structure report, Mt. McKinley National Park Headquarters District and Wonder Lake, vols. 1,2,3. U.S. Department of the Interior, National Park Service, Division of Cultural Resources, Alaska Regional Office, Anchorage, Alaska.

USNPS. 1993. Hazard fuels assessments. Park Files. U.S. Department of the Interior, NPS, Denali National Park and Preserve. Denali Park, Alaska.

Wallace, D.H. 1995. Historic furnishings report, Pearson cabin. U.S. Department of the Interior, NPS, Harpers Ferry Center, Division of Historic Furnishings. Harpers Ferry, West Virginia.

SUBSISTENCE PROGRAM MANAGEMENT

PROJECT CODE: DENA-S-100

SERVICEWIDE ISSUES:
N19 Loss of Park Resources Due to Consumptive Practices
N20 Lack of Basic Data

STATEMENT OF PROBLEM

Introduction

The Alaska National Interest Lands Conservation Act (ANILCA) is one of the most significant and complex pieces of conservation legislation in this Nation's history. Implementation of ANILCA mandates have provided many challenges and opportunities for the Federal conservation agencies and the courts, not the least of which is subsistence management.

Congress recognized the uniqueness and importance of a subsistence way of life to rural residents by identifying it as one of the purposes of ANILCA. Through Title VIII of ANILCA, Congress established a policy that rural residents engaged in a subsistence way of life be provided the opportunity to do so, consistent with sound management principles and the conservation of healthy fish and wildlife populations; that the utilization of public lands in Alaska is to cause the least adverse impact possible on rural residents who depend upon subsistence resources; that the non-wasteful subsistence use of fish and wildlife be the priority consumptive use should it become necessary to restrict the taking; and that in managing subsistence activities the Federal land managing agencies shall cooperate with adjacent landowners and land managers, including Native Corporations, State and Federal agencies.

Language in ANILCA specific to Denali states that subsistence uses by local residents shall be permitted in the park additions, where such uses are traditional, in accordance with the provisions of Title VIII. As such, subsistence uses are also allowed in Denali National Preserve (ANILCA 201(3)(a), 203).

Subsistence activities encompass a living tradition that is not static in time and place. Patterns of subsistence use vary from time to time and from place to place depending on the availability of wildlife and other renewable natural resources. In addition, subsistence customs and

traditions evolve as users adapt and adjust to new technologies, economies, and social and political influences. The National Park Service (NPS) recognizes the necessity for continued development and modification of the subsistence program based on review and input from resource managers, subsistence advisory groups, subsistence users, the public, and legal and technical advisors.

To achieve the complex synthesis of protection and use mandated by ANILCA, Congress felt it was important to provide an administrative structure which would allow rural residents the opportunity to have a meaningful role in the management of fish and wildlife and subsistence use on public lands in Alaska.

Present Condition

Title VIII of ANILCA specifies many subsistence management activities which require both NPS and public participation. Section 804 deals with the allocation and preference for subsistence users if it becomes necessary to limiting take of fish and wildlife to protect the viability of populations. Section 805 directs the coordination and consultation with regional subsistence advisory councils. Section 808 established and directs the coordination and consultation with the park Subsistence Resource Commission. Section 810 mandates the evaluation of any proposed actions on park and preserve lands to determine if there is a potential to impact subsistence users or resources. Section 811 ensures that subsistence users have reasonable access to subsistence resources. Section 812 directs agencies to undertake research on fish and wildlife and subsistence uses needed to help guide subsistence management. Section 814 directs the Secretary through the regulatory process to develop regulations as necessary and appropriate to carry out responsibilities under Title VIII.

In 1981, the NPS promulgated regulations to implement and clarify the mandates and programs specified by ANILCA. These regulations were the minimum necessary for the interim administration of Alaska park areas addressing access, use of cabins, carrying firearms, camping, preservation of natural features, subsistence eligibility and use of resources, and application procedures.

In 1984, the Denali Subsistence Resource Commission (SRC) was formed to advise the park Superintendent, the Governor of the state of Alaska, and the Secretary of the Interior regarding a subsistence hunting program for the park. The commission continues to meet regularly to provide recommendations on the park's subsistence hunting program, and to advise the recently established Federal Regional Subsistence Advisory Councils and the Federal Subsistence Board regarding Denali's subsistence users needs.

The state of Alaska managed statewide subsistence harvests until 1989, when the Alaska Supreme Court ruled that rural residency preference required by Federal law violated the Alaska Constitution. As a result, in 1990 the federal government established a federal subsistence

management program to manage subsistence take of fish and wildlife on federal public lands in Alaska. Nine Federal Regional Subsistence Advisory Councils were established to advise and make recommendations to the Federal Subsistence Board regarding subsistence use of fish and wildlife. The Federal Subsistence Board oversees subsistence harvests on all Federal public lands in Alaska. The state Board of Game oversees the general and sport wildlife harvest authorized in Denali National Preserve.

In March of 1995, the Ninth Circuit Court of Appeals found, in a case dealing with subsistence fisheries, that the United States has jurisdiction in navigable waters for which the U.S. has reserved waters for purposes of implementing Title VIII of ANILCA. The U.S. Supreme Court's refusal to hear the State's appeal significantly expands federal subsistence management of fisheries beyond the boundaries of federal conservation units in Alaska unless the state revises its subsistence law before December 1, 1998, to be consistent with the provisions of Title VIII.

Current Management Actions and Results

As a result of recent court cases which have increased management responsibilities regarding subsistence use of fish and wildlife resources on federal public lands in Alaska, a full time position has been established at Denali to administer the park and preserve subsistence program. The subsistence specialist is dedicated to coordinating and participating in both natural and cultural research activities related to subsistence use, coordinating activities with public advisory groups and regulatory boards, and performing the administrative duties required by ANILCA and federal regulations.

Currently the NPS is reviewing subsistence law and regulations affecting Alaska park and preserve areas to gain insights into the intent of those laws and regulations, and to review the legislative history as appropriate. Through this review process, the NPS hopes to identify issues and establish actions necessary to resolve subsistence management concerns. This review effort is one step in an ongoing process to develop a program for management of subsistence use that meets the mandates specified in ANILCA and the long term need for preservation of the park areas. The continued development and modification of the NPS's subsistence program will be based on review and input from the public in general, subsistence users, subsistence advisory groups, and legal and technical advisors. Denali's SRC has an active role in this review and evaluation process (USNPS 1995).

The Denali SRC meets regularly, at least twice, a year to discuss specific subsistence issues affecting Denali and to make recommendations regarding the park's subsistence hunting program. In addition, the commission submits proposals, reviews other proposals, and submits comments to the Federal Regional Advisory Councils and the Federal Subsistence Board for changes to the federal subsistence regulations.

It was the intent of Congress to restrict eligibility for subsistence activities within Denali National Park to local rural residents who have a personal or family history of use of park resources. It was also Congress's intent that the NPS should manage eligibility by identifying eligible communities to the greatest extent possible rather than basing eligibility upon an individual permit system. Through NPS rulemaking in 1981, four communities near Denali National Park were designated as subsistence resident zone communities for the Park. Cantwell, Lake Minchumina, Telida and Nikolai were identified as communities with a significant concentration of subsistence users who have utilized park resources. After consultation with Denali's SRC, boundaries for these resident zone communities were established. Individuals who reside outside of the resident zone communities, who have had a customary and traditionally used park subsistence resources, may apply to the superintendent for a subsistence use permit. Approximately 320 local rural residents qualify for subsistence use activities within Denali National Park and Preserve.

The following table summarizes all actions that are currently underway related to subsistence management at Denali.

Table 15.

CURRENT RESOURCE MANAGEMENT ACTIONS - FULLY OR PARTIALLY FUNDED

RMP Project Statements	Action Items
N-362.2 Moose Management	.231 Moose Census
N-362.3 Caribou Management	.331 Annual Census
N-364.1 Wolf Management	.131 Monitoring .133 Monitor State Control .141 Public Information
N-364.2 Bear Management	.205 Include in Planning .211 Bear Research .223 Implement Aversive Conditioning .224 Interagency Links .232 Bear Monitoring .237 Berry Production Monitoring .241 Public Information .251 Regulation Enforcement
N-368 Subsistence Trapline Management	.001 Management Program
N-369 Subsistence Hunting	.003 Define Terms .021 Manage Permit Hunts
C-300 Ethnography	.011 Overview and Assessment

S-100 Subsistence Program Management	.001 Eligibility .002 RAC Coordination .003 Native Coordination .004 Hunting Plan .005 Cabin Management Plan .008 GIS Applications .012 Cabin Study .013 Overview and Assessment
S-110 Traditional Use Patterns	.001 Use Zone Identification
S-120 Traditional Access	.022 Moose Hunting Access .031 Monitor ATV Use

RECOMMENDED ACTIONS

No document on subsistence can be all inclusive nor can it predict all of the issues that may confront managers and subsistence users in the future. Park staff recognizes the necessity for continued development and modification of the subsistence program based on input and review from subsistence users, legal and technical advisors and the public in general.

Park staff will work to continue to maintain the balance Congress intended between conservation of renewable resources according to NPS and ANILCA mandates while allowing traditional subsistence uses by local rural residents. Park staff will administer the NPS and federal subsistence management programs by conducting and coordinating public meetings providing a forum for meaningful public and advisory group participation; gather and provide data and information on fish and wildlife populations and community use patterns; administer and issue special hunting, trapping, fishing, and cabin permits as required by Federal regulations; assist in the development of the SRC hunting program, trapping and cabin management plans; develop proposals for and coordinate subsistence research studies; establish cooperative subsistence use monitoring programs; provide administrative support the Denali's Subsistence Resource Commission; develop educational and information outreach programs.

To obtain a complete understanding of subsistence issues and proposed actions the following Project Statements should be consulted: Subsistence Firewood and Cabin Log Management (N-344), Subsistence Trapline Management (N-368), Subsistence Hunting Programs (N-369), Ethnographic Resources (C-300), Customary and Traditional Uses (S-110), and Subsistence Access (S-120).

A. Program Administration and Planning

S-100.001: Manage Subsistence Eligibility

Congress intended that a community based eligibility system for national parks be utilized to the greatest extent possible as long as the community consists of a significant population of subsistence users. Park staff will continue to work closely with the Denali SRC and the advisory councils to more clearly define what constitutes a significant concentration of subsistence users within Denali's resident zones. Park staff will periodically evaluate and report to the SRC the status of Denali's four resident zones communities.

As recommended by the Lake Clark and Denali SRC's, the NPS will continue to work on promulgating the "Roster Regulations" which would establish the roster list concept as an alternative method for determining eligibility for communities. As guided by NPS regulations, park staff will continue to receive and process individual subsistence eligibility permits for qualified persons residing outside of the designated Denali resident zones. In consultation with Denali's SRC and regional advisory councils, park staff will periodically evaluate whether there is a need to establish an federal eligibility system for Denali's National Preserves.

S-100.002: Coordination with Subsistence Advisory Groups

Park staff will continue consultation and coordination with the Denali Subsistence Resource Commission regarding subsistence use of the park and preserve. Administrative assistance will be provided for planning, scheduling, and conducting at least two SRC meetings annually. SRC meetings will be coordinated so that timely comments may be submitted to the Federal Regional Advisory Councils and Federal Subsistence Board.

Park staff will intensify efforts to provide biological data on fish and wildlife populations, reported fish and wildlife harvest levels, and other pertinent information to Denali's Subsistence Resource Commission, local advisory committees, regional advisory councils, and Federal and state fish and wildlife boards. Park staff will continue to provide assistance to the SRC in the development and submittal of hunting plan proposals to the Secretary of the Interior, and annual hunting regulation recommendations to the Federal Regional Advisory Councils, the Federal Subsistence Board, and the Secretary of the Interior.

Three seats on Denali's Subsistence Resource Commission are appointed by regional advisory councils for the Denali area. ANILCA requires that regional council appointees to Denali's SRC must be actively engaged in subsistence uses within the park. It was Congress's intent that these appointees have direct and first hand subsistence experience

in the park. Park staff will continue to work with the regional councils to ensure that appropriate appointments are made to the Subsistence Resource Commission.

S-100.003: Coordination and Consultation with Native Groups and Associations and Interested Organizations

Several neighboring villages have organized tribal or village councils which are not formally linked to the federal subsistence program. Park staff will provide notification of subsistence issues which may affect their members and locations and dates of public subsistence meetings should they wish to submit comments.

Several native villages and regional corporations have selected lands or conveyed inholding within Denali National Park and Preserve boundaries. Under current Federal regulations for Title VIII subsistence use, these selected and conveyed lands are not open for Federal subsistence activities. Denali's Subsistence Resource Commission has recommended that subsistence use should be allowed on selected or conveyed lands within Denali National Park. Proposed federal regulations are pending which will open selected lands within conservation units to subsistence use. Park staff will continue to work with village and regional corporations to resolve land selection issues and provide subsistence use opportunities.

S-100.004: Subsistence Cabin Management Plan

Upon completion of the current subsistence cabins and shelters study for the north additions to Denali National Park and Preserve (DENA-S-100.012), park staff will begin development of a subsistence cabin management plan. This study describes the historical and contemporary use of cabins and other shelters associated with trapping by local rural residents in and around the north additions of Denali National Park. Utilizing information regarding the customary and traditional use of subsistence cabins and the guidelines stipulated in NPS regulations, park staff will develop a management program for the use of subsistence cabins. The subsistence cabin program will include inventory, monitoring, and maintenance components, as well as construction or replacement guidelines. (Subsistence Firewood and Cabin Log Management N-344)

S-100.005: Employee Training

Training programs to educate park employees and managers about ANILCA subsistence mandates and policies will be made available. Subsistence staff will provide orientation and seasonal employee training. Subsistence users will be invited to employee orientation and training session to discuss their needs and perspectives.

S-100.006: Develop Subsistence Reference Material

Park staff will continue to develop a subsistence photo collection, conduct subsistence oral histories interviews, and acquire subsistence and culturally related publications and literature. A complete listing of bibliographic references, location of collections, legal documents, and unpublished reports will be developed. Past interviews, transcriptions, and tapes regarding subsistence activities or resource use will be collected and incorporated into the park resource files.

Other subsistence related databases such as the state's Subsistence Community Use Profile Data Base, Subsistence Research Strategies, and the Department of Fish and Game's fish and wildlife harvest records will be acquired and incorporated into Denali's subsistence information.

S-100.007: Develop Subsistence Applications of GIS

The park's GIS subsistence database will continue to be developed and expanded. Park staff will contact other agencies for pertinent information and data acquisition. The park's capabilities to store and reproduce mapped thematic data will be expanded.

B. Research

Closely related research projects are discussed in Ethnographic Resources (C-300.011 and C-300.017).

S-100.011: Subsistence Community Use Profile and Traditional Use Areas Study

ANILCA states subsistence use by local residents shall be permitted in the park, where such uses are traditional. A review of the existing information, and possibly a study, needs to be initiated in cooperation with the SRC and regional advisory councils to identify contemporary and historical traditional subsistence use areas for each resident zone community. Many terms and criteria must be agreed on before any such research can be undertaken. Some subsistence use information is available for several of Denali's resident zone communities from the Subsistence Community Profile studies done by the state Division of Subsistence in the early 1980's, but the database is not complete. No community profile studies have been completed for the Lake Minchumina community. Most of the state's community profile studies were completed in the early 1980's and need to be updated. Research will be conducted by a qualified specialist, as specified by NPS professional and ethical standards, selected for their experience, involvement and sensitivity to local subsistence programs and issues.

S-100.012: Denali Subsistence Cabin Use Study

This study will document the historical and contemporary use of cabins and structures associated with subsistence use activities in the northern additions to Denali National Park and Preserve. The study will describe the established traditions regarding cabin construction, including residences, base cabins (summer and winter), trapline cabins and other shelters associated with subsistence uses such as fish camps, hunting shelters, elevated caches, smoke houses, steam baths, dog shelters, etc.

The customs and traditions associated with the use and occupancy of cabins will be documented, such as: ownership and transfer practices, frequency of use, length of stay, season of occupancy, construction types, styles and materials used, spacing of cabins and size of structures, means of access and trail networks, maintenance practices, reconstruction and relocation patterns, and efficiency and health and safety concerns.

S-100.013: Support Independently Funded Subsistence Research

C. Monitoring

S-100.031: Establish Monitoring Program For Denali Resident Zones Communities

Park staff will work with the subsistence advisory groups to develop the criteria which will be used to evaluate whether a resident zone community has a significant concentration of subsistence users. Denali's four resident zone communities of Cantwell, Lake Minchumina, Telida and Nikolai will be periodically monitored to evaluate whether they still contain significant concentrations of subsistence users. Reports and recommendations regarding the status of the resident zones will be made to the Subsistence Resource Commission.

S-100.032: Establish Monitoring Program for Use of Subsistence Cabins

A component of the subsistence cabin management plan will be to establish a subsistence cabin monitoring program. The focus of this program would be to ensure the appropriate subsistence use and maintenance of cabins occurs.

D. Interpretation

S-100.041: Increase Public Awareness About Subsistence Use

Interpretive information in park brochures, newsletters, and media publications would be used to increase awareness of, understanding about, and importance of, subsistence use

to local rural residents. Interactive computer programs such as Project Juke-box would be used to educate visitors regarding subsistence activities and the realities of life a remote part of Alaska.

Park staff will contact local schools to inquire what interests and opportunities there are for presenting educational school programs. Programs regarding the park will be developed to meet the community or teacher's interests.

S-100.042: Increase Presence in Subsistence Communities

Park staff will spend more time in subsistence communities to exchange information and foster communications.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Subsistence Eligibility	12.0/0.3	0.0/0.0	0.0/0.0	12.0/0.3	24.0/0.6
- Coordinate Sub Advisory Groups	14.0/0.3	14.0/0.3	14.0/0.3	14.0/0.3	56.0/1.2
- Coord Native Grps/Assoc	2.0/0.1	2.0/0.1	2.0/0.1	2.0/0.1	8.0/0.4
- Cabin Management Plan		10.0/0.4			10.0/0.4
- Subsistence Data	3.0/0.1	3.0/0.1	3.0/0.1	3.0/0.1	12.0/0.4
- Develop GIS database		2.0/0.0	2.0/0.0		4.0/0.0
RESEARCH					
- Traditional Use Areas	50.0/1.0	50.0/1.0			100.0/2.0
MONITORING					
- Monitor Resident Zone	8.0/0.4			8.0/0.4	16.0/0.8

- Cabin Use Monitoring			3.0/0.1	3.0/0.1	3.0/0.2
EDUCATIONAL ACTIONS					
- Public Awareness		5.0/0.2	5.0/0.2	5.0/0.2	15.0/0.6
TOTALS	96.0/2.9	86.0/2.1	29.0/1.8	47.0/1.5	248.0/6.6

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Alaska National Interest Conservation Act. Public Law 96-487, 96th Congress.

Alaska Department of Fish and Game. 1987. Subsistence research strategies report for Denali National Park and Preserve. On file at Denali NP&P, Division of Research and Preservation.

Alaska Department of Fish and Game. 1995. Community Profile Database, Juneau AK.

Alaska Department of Fish and Game. 1995. Harvest Ticket Data. Microcomputer database, updated July 1995.

Code of Federal Regulations. 36 CFR Part 13. 1995.

USNPS. 1986. Final general management plan, land protection plan. USNPS, Denali NP&P. 231pp.

USNPS. 1995. Draft review of subsistence law and national park service regulations. On file at Denali NP&P, Division of Research and Resource Preservation.

USNPS. 1996. Use of cabins and other shelters associated with subsistence activities in selected areas of the north additions to Denali National Park and Preserve. Draft Cabin Study

Report. On file at Denali NP&P, Division of Research and Resource Preservation.

CUSTOMARY AND TRADITIONAL USES

PROJECT CODE: DENA-S-110

SERVICEWIDE ISSUES:
- N19 Loss of Park Resources Due to Consumptive Practices.
- N20 Lack of Basic Data
- C04 Need for Ethnographic Overviews and Assessments.

STATEMENT OF PROBLEM

Introduction

Customary and traditional use is the cornerstone upon which both the federal subsistence program and National Park Service subsistence programs are based. The term "subsistence uses" is defined in ANILCA as the customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption. All subsistence uses authorized in Federal regulations are based upon some determination or criteria regarding customary and traditional uses.

In Denali National Park for example, the enabling legislation in Section 202(3)(a) of ANILCA states "...Subsistence uses by local residents shall be permitted in the park, where such uses are traditional, in accordance with the provisions of Title VIII". The statute offers no further specifics regarding where subsistence uses are traditional. Since the legislative guidance is incomplete, the NPS has decided not to designate traditional use areas until additional information is developed through research, public comment, and advice from local committees, subsistence resource commissions, and federal regional advisory councils.

Designation of Denali National Park's resident zone communities for subsistence eligibility are based upon those communities having a significant concentration of local rural residents which have customarily and traditionally engaged in subsistence activities within the park. Resident zone communities need to be periodically evaluated to ensure that they still meet the criteria. Individuals who reside outside of the residents zones who receive individual subsistence use permits must also demonstrate a personal or family customary and traditional use.

The Federal Subsistence Board through the annual hunting regulatory process determines which

wildlife species or fish stocks have been customarily and traditionally taken as a subsistence resource and identifies which communities or areas are eligible to harvest them.
This will be a large task since the customary and traditional determinations are to be made for each wildlife species within each wildlife management unit. There are many species which have not had determinations made yet and numerous appeals of existing determinations made by the state before federal assumption occurred in 1990.

At Denali National Park, traditional modes of subsistence access and traditional use of subsistence trapline cabins are important issues to subsistence users, the Subsistence Resource Commission and park managers. Several residents from Cantwell have requested that a traditional determination for the use of ATV as a form of subsistence access be authorized. Denali has also received several request to reconstruct traditional subsistence trapline cabins.

Present Condition

In 1981 the NPS promulgated regulations to implement and clarify the mandates and programs specified by ANILCA. Since the legislative guidance on where subsistence uses are traditional in the five specified areas is incomplete, the NPS decided not to designate traditional "subsistence hunting zones" for these areas in this interim rulemaking. Rather, the NPS intends to gather additional information and to receive public comment on this issue through research, further rulemaking endeavors, and most importantly, advice from the Subsistence Resource Commissions, local committees and Federal regional councils.

In 1984 the Denali Subsistence Resource Commission was formed to advise the park superintendent, the Governor of the state of Alaska, and the Secretary of the Interior regarding a subsistence hunting program for the park. The commission continues to meet regularly to provide recommendations on the park's subsistence hunting program, and to advise the recently established Federal Regional Subsistence Advisory Councils and the Federal Subsistence Board regarding Denali's subsistence users needs.

In 1990 the federal government established a federal subsistence management program to manage subsistence take of fish and wildlife on federal public lands in Alaska. Nine Federal Regional Subsistence Advisory Councils were established to advise and make recommendations to the Federal Subsistence Board regarding subsistence use of fish and wildlife. The Federal Subsistence Board oversees subsistence harvests on all federal public lands in Alaska.

Current Management Actions and Results

Currently the National Park Service is reviewing subsistence law and regulations affecting Alaska park and preserve areas to gain insights into the intent of those laws and regulations, and to review the legislative history, as appropriate. Through this review process the NPS hopes to identify issues and establish actions necessary to resolve subsistence management concerns.

This review effort is one step in an ongoing process to develop a program for management of subsistence use that meets the mandates specified in ANILCA and the long term need for preservation of the park areas. The continued development and modification of National Park Service's subsistence program will be based on review and input from the public in general, subsistence users, subsistence advisory groups and legal and technical advisors.

Denali's Subsistence Resource Commission has an active role in this review and evaluation process and has submitted written comments and recommendations to the NPS.

After federal assumption of subsistence fish and wildlife management on federal public lands in 1990, Denali National Park and Preserve established a subsistence coordinator position to assist in managing Denali's subsistence programs. Park staff is active in reviewing and commenting on proposed regulations for the federal hunting programs. Park comments and concerns are sent to the Federal Regional Advisory Councils representing the Denali area and to the Federal Subsistence Board. Park staff in consultation with the Denali Subsistence Resource Commission have prepared and presented proposals at the regional council meetings and before the Federal Subsistence Board.

Park staff have processed and authorized three traditional subsistence trapline cabin reconstructions, and another two requests are under consideration. In 1994, a subsistence cabin study was initiated to document the historical and contemporary use of cabins and structures associated with subsistence use activities in the north additions to Denali National Park and Preserve (DENA-S-100.006). This study will further document the customs and traditions regarding subsistence trapline activities.

During the Denali General Management Plan process in 1986, the National Park Service did not receive evidence establishing the traditional use of ORV\ATVs and has therefore maintained that they are not permitted in Denali for subsistence purposes. At that time, existing information indicated that specific off-road vehicle use within Denali National Park and Preserve has not been regularly used for subsistence purposes although some ATV subsistence use was known to occur in the Cantwell and Kantishna areas. The general management plan states that any additional information about traditional access will be reviewed on a case-by-case basis, and that off-road vehicle could be permitted for subsistence access where they can be shown to be a traditional means of access.

Several Cantwell residents requested the superintendent make a traditional subsistence ATV access determination for use of certain routes and trails in the Windy Creek, Cantwell Creek, and Bull River areas near Cantwell.

A public meeting was held in Cantwell to collect comments and information on past ATV subsistence use on park additions for the Cantwell area. Sixteen individuals attended the meeting and submitted written information and maps of their subsistence ATV use. The comment period

for subsistence users to submit additional information was open for the following year. No additional written comments were received. To gather further information, the park telephoned numerous subsistence users from the Cantwell area.

In 1995, the superintendent and subsistence coordinator accompanied a several Cantwell subsistence users along routes and trails they identified as traditional subsistence ATV routes. Aerial photographs were taken of the park lands in the Cantwell and Dunkle Hills region to depict current visible routes and trails. In 1996, a preliminary archeological inspection was conducted along several of the proposed traditional ATV routes in the Cantwell area. Additional information will be needed before a traditional ATV designation can be made.

RECOMMENDED ACTIONS

A. Program Administration and Planning

S-110.001: Identify Traditional Use Zones

The enabling legislation for the park and preserve states subsistence use by local residents shall be permitted in the park, where such uses are traditional. A review of the existing information, and possibly a study, needs to be initiated in cooperation with the Subsistence Resource Commission and Federal Regional Advisory Councils associated with the Denali area to identify contemporary and historical traditional subsistence use areas for each resident zone community. The evolution of customs and traditions should also be documented. Many terms and criteria must be agreed on before any such research can be undertaken.

S-110.002: Species Customary and Traditional Determinations

Park staff will work with USFWS subsistence staff, the Denali Subsistence Resource Commission, and Federal Regional Advisory Councils to review customary and traditional determination requests for wildlife species and use areas which are being processed through the annual regulatory cycle. Where appropriate, Denali staff will take the lead in preparing and presenting the regulatory analysis for the regional councils and the Federal Subsistence Board. In other cases, Denali staff will serve as a consultant to other agency personnel who are assigned to prepare the analysis.

Denali will work to update the community profile studies conducted by the Subsistence Division, Alaska Department of Fish and Game, in the 1980's. The park will seek funding to conduct a Lake Minchumina Community Profile Study since that community's use has not been documented. Subsistence community use information is needed to provide recent, reliable, summary information about the subsistence harvests and uses

within rural communities.

B. Research

Discussion on related studies can be found in Subsistence Program Management (S-100.012) and Subsistence Access (S-120.011).

S-110.011: Evolution of New Subsistence Customs and Traditions

This study will identify and document the emergence of contemporary traditional practices, the adoption and use of new technologies regarding subsistence activities, the evolution of customs and traditions and the time frame in which that occurs, and the impact or impacts of National Park Service and federal subsistence management regulations and polices on the subsistence way of life.

Today many pressures are being exerted on traditional subsistence users such as increasing numbers of people seeking "rural lifestyles", complex and changing land status in and around communities and subsistence use areas, new restrictive management strategies evolving from private land owners, new developments on public and private lands, and increasing competition for local resources from newly arriving subsistence users as well as the ever-increasing pressure from sport hunting, trapping and fishing interests.

Subsistence activities encompass a living tradition that is not static in time and place. Patterns of subsistence use vary from time to time and from place to place depending on the availability of wildlife and other renewable natural resources. In addition, subsistence customs and traditions do evolve as users adapt and adjust to new technologies, economies, and social and political influences. This study will identify the current changes and patterns of the contemporary subsistence way of life.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Identify Traditional Use Zones		12.0/0.5	12.0/0.5		24.0/1.0
- Species Customary and Tradition Determination	2.0/0.2	2.0/0.2	2.0/0.2	2.0/0.2	8.0/0.8

RESEARCH					
- Evolution of New Customs and Traditions			80.0/1.0	80.0/1.0	160.0/2.0
TOTALS	2.0/0.2	14.0/0.7	94.0/1.7	82.0/1.2	192.0/3.8

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Alaska National Interest Lands Conservation Act. Public Law 96-487, 96th Congress.

Bishop, R. 1978. Subsistence Resource Use in the Proposed North Addition to Mt. McKinley National Park. Occasional Paper No. 17. 115 pp.

Code of Federal Regulations. 36 CFR Part 13, 1995.

Report of the Committee on Energy and Natural Resources, United States Senate, 1979. Report Number 96-413, 96th Congress.

USNPS. 1984. Land Use in the North Additions of Denali National Park and Preserve: An Historical Perspective. National Park Service, Alaska Region, Research/Resources Management Report AR-9. 91pp.

USNPS. 1986. Final General Management Plan, Land Protection Plan. National Park Service, Denali National Park and Preserve. 231pp.

SUBSISTENCE ACCESS

PROJECT CODE: DENA-S-120

SERVICEWIDE ISSUES:
N19 Loss of Park Resources Due to Consumptive uses.
N18 Visitor Use Impact on Backcountry Park Resources.

STATEMENT OF PROBLEM

Introduction

Congress specified in Section 811 of ANILCA that rural residents engaged in subsistence uses shall have reasonable access to subsistence resources. And that the Secretary of the Interior shall permit on public lands for subsistence purposes the appropriate use of snowmachines, motorboats, and other means of surface transportation traditionally employed by local rural residents subject to reasonable regulation.

Congress intended to limit the use of aircraft as a means of access for the subsistence taking of wildlife in most units of the National Park Service, except in cases of extraordinary hardship (Senate Report 96-413, p. 169). Congress provided little guidance regarding the use of All Terrain Vehicles (ATVs) for subsistence purposes.

The legislative history of ANILCA indicates that it was not Congress's intent to foreclose the use of new or presently unidentified means of surface transportation (Senate Report 96-413, p. 275). New modes of access that are developed and implemented for general use in rural Alaska and originate from technological advances which cannot be shown to have been traditionally employed may be allowed in the future for subsistence purposes under circumstances that prevent waste or damage to fish, wildlife, or terrain and would not degrade other park resources or values.

At the time of passage of ANILCA (1980), some subsistence users from the Cantwell area were utilizing all terrain vehicles for fall hunting activities on park additions in the Windy Creek, Cantwell Creek and Bull River areas. A few subsistence users from the McKinley Village area used ATVs on mining roads in the Kantishna Hills area. Subsistence use of ATVs for fall hunting of moose and caribou continued through the 1980's. In 1992, Denali National Park began enforcing a no subsistence ATV use policy.

As in many areas of Alaska, conflict exists between the current access regulations for parks and preserves units and the desires of local rural subsistence users to employ modern technology for subsistence harvesting. Subsistence users from the Cantwell area, and the Denali Subsistence Resource Commission have requested that ATV use on certain routes in the Cantwell region be authorized as a traditional subsistence access routes for that community. No formal traditional access study has been completed.

Present Condition

The current authorized means of access for subsistence uses in Denali National Park and Preserve are snowmachines, motorboats and dog teams, which are governed by existing regulations in (36 CFR 13.46 and 43 CFR 36.11). If another means of surface access is shown to have been traditionally employed in the unit for subsistence purposes, it may be permitted in that unit subject to reasonable regulations. In the early 1980's, Cantwell subsistence users were asked to limit their use of ATV's to routes that have been traditionally used for subsistence purposes. No subsistence ATV routes have been formally documented or designated.

During the Denali General Management Plan process in 1986, the National Park Service did not receive evidence establishing the traditional use of ORV\ATVs and has therefore maintained that they are not permitted in Denali for subsistence purposes. At that time, existing information indicated that specific off-road vehicle use within Denali National Park and Preserve has not been regularly used for subsistence purposes although some ATV subsistence use was known to occur in the Cantwell and Kantishna areas. The general management plan states that any additional information about traditional access will be reviewed on a case-by-case basis, and that off-road vehicle could be permitted for subsistence access where they can be shown to be a traditional means of access.

In other park areas, the National Park Service has documented impacts from ORV use and has concerns about protecting resources from these impacts. The National Park Service has not documented the historical methods and means used to access hunting and trapping grounds by local rural residents, or what were the customary and traditional access practices.

Current Management Actions and Results

After the general management plan was approved in 1986, it was the park's policy that ATV's use for subsistence activities was generally prohibited, although enforcement of that policy was not actively pursued. Some subsistence ATV use continued in the Cantwell area on selected trails and routes primarily to extract moose and caribou harvests.

Subsistence use in the Kantishna Hills ceased in 1987 as a result of the Alaska Board of Game

determination that McKinley Village subsistence users did not have customary and traditional use of moose and caribou for that area.

In 1992, Denali National Park began enforcing the ATV restriction in the Cantwell area. This resulted in several Cantwell residents requesting that the superintendent make a traditional subsistence ATV access determination for use of certain routes and trails in the Windy Creek, Cantwell Creek, and Bull River areas near Cantwell.

A held public meeting in Cantwell to collect comments and information on past ATV subsistence use on park additions for the Cantwell area. Sixteen individuals attended the meeting and submitted written information and maps of their subsistence ATV use. The comment period for subsistence users to submit additional information was open for the following year. No additional written comments were received. To gather further information, the park telephoned numerous subsistence users from the Cantwell area.

The Cantwell ATV issue and information collected was discussed at two subsequent Subsistence Resource Commission meetings. With only twenty four comments received, it was recommended that further information should be collected. The Subsistence Resource Commission recommended that a limited use of ATV's to extract moose harvests be allow through use of a permits or other authorizations until the needed information to make a traditional determination can be collected.

In 1995, the superintendent and subsistence coordinator accompanied a several Cantwell subsistence users along routes and trails they have utilized for subsistence ATV access. Aerial photographs were taken of the park lands in the Cantwell and Dunkle Hills region to depict current visible routes and trails. In 1996, a preliminary archeological inspection was conducted along several of the proposed traditional ATV routes in the Cantwell area.

RECOMMENDED ACTIONS

A. Program Administration and Planning

S-120.001: Manage Subsistence Use of ATVs

Work with the AKSO to establish a program and process for making traditional access determinations for the National Park Service in Alaska. Conduct the traditional access study for Denali and if ATV use is found to be traditional, designate traditional access routes for the Cantwell area. Evaluate where and when traditional ATV subsistence use may be authorized without significant degradation of park resources. Identify purpose and time of year of authorized ATV use for subsistence access. Establish a permitting

program for use on identified routes. Consult with the Denali Subsistence Resource Commission regarding proposed actions and plans.

B. Research

S-120.011: Conduct Traditional Subsistence Access Study

A research study will be conducted to document and evaluate what are the traditional modes of access for subsistence purposes in Denali National Park and Preserve. The Division of Subsistence, Alaska Department of Fish and Game would be consulted in this effort. Particular focus will be made on what areas utilized ATVs, what types of ATVs or ORVs were used, when the use began, what routes were used, what subsistence activities the ATV use was in support of, what the frequency and consistency of use has been, to what extent the communities as a whole have depended upon ATV use to engage in subsistence activities and whether this use could be considered traditional.

The study would focus on the road and trail accessible areas of Windy Creek, Cantwell Creek, Bull River, Dunkle Hills, the Stampede Road corridor and the Kantishna Hills. A ground assessment of the ATV use areas will be made documenting and mapping all roads, routes and trails. Historical photo records and files would be gathered from military aerial photographs, landsat imagery, local agencies or users themselves to reference when trails, roads or other signs of vegetative impacts started to show up. The present extent of impacts to vegetation and soils would be evaluated, ground monitoring plots established and accurate maps of existing trails and road would be developed. Aerial photographs of existing routes and trails will be taken and aerial photo points established utilizing GPS coordinates and altimeter.

C. Mitigation

S-120.021: ATV Use on Selected Lands within Denali Park

Park staff will coordinate with the Native corporations which have selected lands within the park in the Cantwell area regarding the use of and potential authorization of ATV's for subsistence purposes. Nearly all of the requested traditional ATV routes are on selected lands near Cantwell.

S-120.022: Evaluate Alternative Times and Access Modes for Subsistence Moose Hunting

The primary issue regarding ATV use in the Cantwell region centers around the need to have fall access to moose resources in Wildlife Management Unit 13E which currently has only a September season for moose hunting. Providing an alternative late fall or

early winter moose hunting season would provide an opportunity to harvest moose resources when adequate snow cover makes snowmachine access feasible. Park staff and the Subsistence Resource Commission should evaluate the status of the moose population in the Broad Pass region, past and current harvest levels of eligible subsistence moose hunters from the Cantwell area, past customary and traditional moose hunting seasons for this region, and desires of the Cantwell subsistence community to have an alternative season. Proposals would be submitted to the Federal Subsistence Board for a change in the federal subsistence harvest regulations.

D. Monitoring

S-120.031: Initiate A Monitoring Program For ATV Routes

Monitor subsistence use of and impacts related to ATV use along routes in the Cantwell area. The present extent of impacts to vegetation and soils would be evaluated, ground monitoring plots established and accurate maps of existing trails and roads would be developed. Aerial photo points would be established for periodic photo documentation.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Manage Sub ATV Use	1.0/0.1	1.0/0.1	1.0/0.1	1.0/0.1	4.0/0.4
RESEARCH					
- Traditional Access Study	60.0/1.0	60.0/1.0			120.0/2.0
MITIGATION					
- Selected Lands, ATV Use			2.0/0.1		2.0/0.1
- Alternative Access to Subsistence Resources		4.0/0.2	4.0/0.2		8.0/0.4
MONITORING					
- Monitor ATV Routes			2.0/0.1	2.0/0.1	4.0/0.2
TOTALS	61.0/1.1	65.0/1.3	9.0/0.5	3.0/0.2	138.0/3.1

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Alaska National Interest Conservation Act. Public Law 96-487, 96th Congress.

Code of Federal Regulations. 36 CFR Part 13, 1995.

USNPS. 1986. Final General Management Plan, Land Protection Plan. National Park Service, Denali National Park and Preserve. 231pp.

Appendicies

APPENDIX A

FUNDING TABLE

APPENDIX B

PERSONNEL TABLE

APPENDIX C

ONGOING AND FUNDED ACTIVITIES PROGRAMMING SHEET

APPENDIX D

UNFUNDED ACTIVITIES PROGRAMMING SHEET

APPENDIX E

CULTURAL RESOURCES DOCUMENTATION CHECKLIST

DENALI NATIONAL PARK AND PRESERVE

CULTURAL RESOURCE DOCUMENTATION CHECKLIST

Place an X in the appropriate column. Leave columns blank if document is not required for the park. Remember that items in the first section, Planning Documents, may also apply to natural resources. See NPS-28, Chapter 2, for description of each inventory or study.

TITLE	CURRENT AND APPROVED	INCOMPLETE; NEEDS REVISION OR UPDATING	NEEDED
PLANNING DOCUMENTS			
Preauthorization and Authorization			
Statement of Management (SFM)	X		
Outline of Planning Requirements (OPR)			
General Management Plan (GMP)	X		
Development Concept Plan (DCP)	X		
Resources Management Plan (RMP)		X	
Interpretive Prospectus (IP)		X	
SERVICEWIDE INVENTORIES, LISTS, CATALOGS AND REGISTERS			
Cultural Resources Management Bibliography (CRBIB)			X
Cultural Sites Inventory (CSI)		X	
List of Classified Structures (LCS)	X		
National Catalog of Museum Objects		X	
Cultural Landscapes Inventory (CLI)			X
National Register of Historic Places		X	

DENALI NATIONAL PARK AND PRESERVE

CULTURAL RESOURCE DOCUMENTATION CHECKLIST CONT.

TITLE	CURRENT AND APPROVED	INCOMPLETE; NEEDS REVISION OR UPDATING	NEEDED
BASIC CULTURAL RESOURCE DOCUMENTS			
Archeological Overview and Assessment	X		
Archeological Identification Studies		X	
Archeological Evaluation Studies		X	
Rapid Ethnographic Assessment Procedures (REAP)			X
Cultural Affiliation Study			X
Ethnographic Landscape Study			X
Ethnographic Overview & Assessment		X	
Ethnographic Oral Histories & Life Histories		X	
Ethnographic Program			X
Historic Resource Study		X	
Historical Base Map		X	
Park Administrative History		X	
Scope of Collection Statement	X		
SPECIAL RESOURCE STUDIES AND PLANS			
Archeological & Ethno. Collections Studies		X	
Archeological Data Recovery Studies		X	
Collection Management Plan	X		
Collection Storage Plan			X
Collection Condition Survey		X	
Cultural Landscape Report (CLR)			X

DENALI NATIONAL PARK AND PRESERVE

CULTURAL RESOURCE DOCUMENTATION CHECKLIST CONT.

TITLE	CURRENT AND APPROVED	INCOMPLETE; NEEDS REVISION OR UPDATING	NEEDED
SPECIAL RESOURCE STUDIES AND PLANS CONT.			
Ethnohistory			X
Exhibit Plan			X
Historic Furnishing Report	X		
Historic Structure Report (HSR)		X	
Inventory & Condition Assessment Program (ICAP)		X	
Social Impact Study			
Special History Study			X
Traditional Use Study			X
Other			

APPENDIX F

CULTURAL RESOURCES STATUS SUMMARY CHARTS

DENALI NATIONAL PARK AND PRESERVE

SUMMARY CHART FOR ARCHEOLOGICAL SITES

Significance		Condition					Impacts				Documentation		
		Good	Fair	Poor	Destroyed	Unknown	Severe	Moderate	Low	Unknown	Good	Fair	Poor
National													
State & Regional													
Local													
Not Evaluated	188					188				188		188	
Totals	188					188				188		188	

DENALI NATIONAL PARK AND PRESERVE

SUMMARY CHART FOR STRUCTURES

Significance		Condition				Impacts				Documentation		
	Total	Good	Fair	Poor	Unknown	Severe	Moderate	Low	Unknown	Good	Fair	Poor
National												
Contributing												
State												
Local												
Not Significant												
Not Evaluated												
Totals	143				143				143		143	

DENALI NATIONAL PARK AND PRESERVE

SUMMARY CHART FOR CULTURAL LANDSCAPES

Significance		Condition				Impacts				Documentation		
		Good	Fair	Poor	Unknown	Severe	Moderate	Low	Unknown	Good	Fair	Poor
National												
State & Regional												
Local												
Not Evaluated												
Totals	UNK				UNK				UNK			

DENALI NATIONAL PARK AND PRESERVE

SUMMARY CHART FOR ETHNOGRAPHIC RESOURCES

Resource Types	National Register	Authority	Non-Recreational Use	Documentation Level
Sites	UNKNOWN			
Structures	UNKNOWN			
Objects	UNKNOWN			
Natural Resources	UNKNOWN			
Ethnographic Landscapes	UNKNOWN			
Other	UNKNOWN			

APPENDIX G

OBJECT STATUS SUMMARY CHART

DENALI NATIONAL PARK AND PRESERVE

SUMMARY CHART FOR OBJECTS

DOCUMENTATION	Archeology	Ethnology	History	Archives	Biology	Paleontology	Geology	TOTALS
Registration Data Only	0	0	0	0	0	0	0	0
Registration & Catalog Data	2586	8	2749	42590	4454	16	42	52,445
Total Items Cataloged	2,586	8	2,749	42,590	4,454	16	42	52,445
Backlog to be Cataloged	0	0	150	190000	1500	0	0	191,650
Total Collection Summary	2,586	8	2,899	232,590	5,954	16	42	296,540

CONDITION	Archeology	Ethnology	History	Archives	Biology	Paleontology	Geology
Excellent	0	0	0	0	0	0	0
Good	1000	0	2000	0	1000	0	0
Fair	0	8	500	42590	0	0	0
Poor	0	0	249	0	454	0	0
Unknown	1586	0	0	0	3000	16	42

APPENDIX H

ANNUAL PROJECT STATUS AND ACCOMPLISHMENTS REPORTS

APPENDIX I

RELATED ACTION PLANS

Completed Plans:

Aviation Management Plan

Backcountry Management Plan

Bear-Human Conflict Management Plan

Collection Management Plan

Internal Working Drafts:

Alaska Consolidated Interagency Fire Management Plan - Operational Draft

Geographic Information Systems Plan

Long Term Ecological Monitoring Strategic Plan and Conceptual Design

Reclamation Plan

Research and Resource Preservation Division Strategic Plan

Research Administration Guideline

APPENDIX J

PERSONS AND AGENCIES CONSULTED

Denali National Park and Preserve

Jim Benedict, former Resource Management Specialist
Joe Durrenberger, Engineer
Patty DelVecchio, former Biological Technician
Lisa Eckert, Chief of Interpretation
Kris Fister, District Naturalist
Bill Friesen, Roads and Trails Foreman
Tom Habecker, District Ranger
Marcus Hathaway, Chief of Administration
Chris Jones, Chief of Concessions
Hershel Lester, Buildings and Utilities Foreman
Elwood Lynn, Chief of Maitenance
Ken Kehrer, Chief Ranger
Dennis Knuckles, Backcountry Ranger
Sandy Kogl, former Backcountry Ranger
Kim McLean, District Naturalist
Clare Shuster, Visitor Services Supervisor
Nancy Swanton, Chief of Planning and Compliance
J.D. Swed, District Ranger
Jim Trumbull, former Biological Technician
Jim Unruh, former Park Pilot

Gates of the Arctic National Park

Patty Rost, Chief, Resources Management

Alaska Support Office

Bruce Dale, Wildlife Biologist
Ross Kavanagh, Fishery Biologist
Sue Mills, Management Biologist
Mark Schroeder, Wildlife Biologist
Thetus Smith, Editor
Gary Somers, Archeologist
Clarence Summers, Subsistence Specialist
Gary Vequist, Management Biologist

Natural Resource Program Offices, NPS

Mark Flora, Water Resources Division
Eric Hauge, Air Resources Division
Barry Long, Water Resources Division

Biological Resources Division, USGS

Layne Adams, Research Wildlife Biologist, Alaska Biological Science Center
Jeff Keay, Research Wildlife Biologist, Denali Field Station

Office of the Governor, Division of Governmental Coordination

Sally Gibert, State CSU Coordinator

Alaska Department of Fish and Game

Al Carson, ANILCA Coordinator
Tina Cunning, State-Federal Issues Coordinator
Terry Haynes, Statewide Subsistence Coordinator
Don Perrin, Program Assistant
John Westlund, Wildlife Biologist

Alaska Department of Natural Resources

Patty Bielawski, Special Assistant
Judy Chapman, Division of Land
Dick Mylius, Division of Land
Dave Stephens, Division of Parks and Outdoor Recreation
Jules Tileston, Division of Mining and Water Management

Alaska Department of Transportation and Public Facilities

John Tolley, Chief of Planning and Administration

Citizens' Advisory Commission on Federal Areas

Stan Leaphart, Executive Director

APPENDIX K

PLANNING TEAM

Jerry Belant, Wildlife Biologist
Andrea Blakesley, Air Quality Specialist
Phil Brease, Chief, Branch of Water, Air, Geology, and Soils
Steve Carwile, Compliance Officer
Elaine Furbish, Plant Ecologist
Kristen Griffin, Cultural Resource Technician
Ann Kain, Cultural Resources Specialist
Ken Karle, Hydraulic Engineer
Mike Klensch, Biological Technician
Penny Knuckles, Ecologist
Carol McIntyre, Wildlife Biologist
Gordon Olson, Chief, Research and Resource Preservation
Pat Owen, Biological Technician
Jan Passek, Fire Management Officer
Jon Paynter, Chief, Branch of Information Resources
Jamie Roush, Physical Science Technician
Ken Stahlnecker, Chief, Branch of Wildlife and Vegetation
Mike Tranel, Environmental Specialist
Hollis Twitchell, Chief, Branch of Subsistence and Cultural Resources
Joe Van Horn, Staff Natural Resource Specialist
Jennifer Wolk, Museum Technician

respurces in the southern additions to Denali National Park and Preserve.

Subsistence use of plant materials include spruce and birch trees for cabins, shelters, structures, and for firewood. Diamond willow, spruce burls, birch, cottonwood and birch bark are used for making furniture, and other hand crafted items such as dog sleds, snowshoes and bark baskets. Abundant and commonly used berries include blueberries, lingonberries and raspberries. Wild greens include, fireweed, lambsquarter, and ferns.

Traditional and Contemporary Knowledge

Traditional and contemporary knowledge is the body of information consisting of Native place names, resource names, legends, resource use regimes and strategies, including harvest methods, modes of transportation, processing, distribution, and consumption of resources and so forth. Traditional aspects of this information have generally not been developed for Denali, although some pieces of it may be identified in the aforementioned reports and documents. Contemporary aspects are better documented, but that documentation tends to be distributed in multiple sources including regulation documents, Subsistence Resource Commission and Regional Advisory Council records and community profiles.

The different means and methods of subsistence access and the seasonal timing of their use are critical for acquiring resources and are as diverse as the resources being sought. Common methods of traditional access include hiking, skiing, snowshoeing, dog sled teams, horses, snowmachines, motorboats or canoes, and in some cases such as near Cantwell and in the Kantishna Hills, the use of off road vehicles. Along the eastern region of the park subsistence users from McKinley Village, and more recently some individuals from Cantwell, use motor vehicles for driving the Park Road to access the Kantishna Hills. There is no known use of aircraft by local rural subsistence users to access preserve lands for the taking of subsistence fish or wildlife.

Subsistence trapping and bartering of fur animals has long been a customary and traditional activity for the Denali area. Trapping continues to be one of the predominant subsistence activities occurring on park and preserve lands. Winter travel in pursuit of furbearers can be extensive and in the northern and western regions supported by a network of winter trails, shelters and cabins.

Local social norms and traditions of trapping differ greatly from culture to culture and from region to region within Denali. In the north and western regions of Denali, local residents of communities maintain strong informal norms associated with the use of trapping areas and "ownership" of cabins on public lands. In some communities, families or individuals are known to utilize large trapping areas with support trails and cabins for decades. Thus, local community

norms encourages the sustainable harvest of fur in these areas and helps provide for the orderly and peaceful relationships between members of the community who harvest furs. These social norms and traditions, which serve to allocate use territories are integral in the conservation of fur animals and to manage social conflict, are not as evident and in some cases no longer exist in the eastern and southern regions of the park and preserve.

Summary of Baseline Information

Table 3 provides a subjective assessment of the subsistence resource baseline information available to the park. Although this assessment indicates that the level of information is adequate, much of that information is not readily available to park staff without significant effort. Collection, organization and in-park storage of this information should be a top priority.

Table 3.

SUBSISTENCE RESOURCE BASELINE INFORMATION

Resource Category	Level I	Level II	Level III
User Demographics	Adequate	Inadequate	
Harvested Resources	See Natural Resources Table		
Traditional/Contemporary Knowledge	Adequate	Inadequate	

F. Subsistence Resource Conditions

Current Conditions

One of the purposes of ANILCA is to provide the opportunity for local, rural residents engaged in a subsistence way of life to continue to do so. Accordingly, Congress provided for traditional subsistence uses by qualified local rural residents within the ANILCA additions to Denali National Park and Preserve. Many native and non-native local rural residents engage in, and depend upon, resources from the park and preserve for personal consumption and cultural identity.

Subsistence activities vary considerably from year to year because of factors such as weather, wildlife migration patterns, wildlife population fluctuations, and political or regulatory

considerations. Although the magnitude of subsistence use was probably much greater historically than it is now, the use and relative importance of certain species are similar today. Changing environmental and political conditions, and seasonal availability of many resources, makes flexibility and adaptability key components to a successful subsistence way of life. Cash wages and subsistence activities form a mixed economy in the subsistence communities which surround the park and preserve. Changes in socio-economic conditions, such as fur prices and availability of seasonal jobs, greatly influence the reliance on, and ability to engage in traditional hunting, gathering, fishing, and trapping activities.

Aquatic Biota

The condition of subsistence fisheries in the park is basically unevaluated.

Terrestrial Biota

The NPS is charged with conserving natural and healthy populations of fish and wildlife on park lands and healthy populations in the preserves. Currently, the only wildlife population considered to be seriously stressed is the Denali Caribou Herd, which has been closed to both subsistence and sport hunting since 1976. Overall, wildlife populations are still naturally regulated within the park and preserve and subsistence harvest within the new additions is considered to be of minimal influence at this time.

As stated in the previous section under Natural Resource Conditions, it is recognized that certain basic inventories and ongoing conditions assessments are lacking at Denali, so detailed resource condition trend analysis for all species, use areas, or systems is premature. Existing information does allow some intuitive conclusions about the condition of park resources. In general, the natural resources of Denali National Park and Preserve are still in excellent condition. The habitat within and surrounding the park and preserve is still basically intact, the structure and composition of the ecosystem is still unaltered, and ecosystem process are still functioning naturally.

The continuation of traditional subsistence activities depends directly on the availability of healthy and diverse wildlife, plant and fish populations. The natural diversity and abundance of resources important to subsistence activities is, in turn, directly dependent upon intact and healthy ecosystems. These systems and the subtle interplay of natural process, including subsistence use, must be carefully protected. In order to protect these resources and social values, the traditional knowledge of native people and long-term residents must be integrated with the technical scientific approach to park management.

ANILCA provides a preference for local rural subsistence users should a shortage of subsistence resources occur and allocation of harvest becomes necessary. Currently there are no wildlife species being allocated under this provision.

Significant Sources of Potential Adverse Impacts

There are many potential threats to the continuation of a customary and traditional subsistence way of life. Any activity that impairs the overall health of an ecosystem, natural processes or resource availability has the potential to adversely impact subsistence uses for both the short and long term. Some management or regulatory actions can also alter subsistence patterns of use and use areas. The discussions on the state of knowledge about and threats to natural resources applies equally to park and preserve subsistence resources. Internal and external threats form access, industrialization, plant and wildlife harvests, settlements and population increases all have the potential to impact subsistence.

Increasing numbers of recreational users in both the developed areas of the park and particularly in the remote backcountry areas has increased the potential for conflicts between consumptive and nonconsumptive users. Increasingly special interest groups and organization are exerting political and public pressure to limit, close or restrict subsistence use areas or activities. International fur markets and trapping policies can significantly affect trapping effort and harvest. A significant potential exists for increased competition for resources and use areas by sport hunting, fishing and trapping users. Private and governmental facility development further increases visitor use, community growth, and alteration habitat may adversely impact subsistence resources.

Access (Issue Codes: N05, N06, N15, N16, N18, N19, N22)

There have been repeated efforts during the history of the park to establish an additional public access road along the Stampede Trail to the Kantishna area. Renewed political and private interests in establishing a northern road or railroad access to Kantishna has resulted in several recent proposals and a feasibility study.

Recently, the Alaska Department of Transportation was considering routes for a new road to interior Alaska along the northern region of the park and preserve connecting Lake Minchumina, Telida, Nikolai and McGrath. A spur road into Kantishna area was included in this study. In the eastern region of the park there is an RS 2477 easement extending into the Dunkle Hills south of Cantwell. Proposals in the South Denali Development Concept Plan for Denali call for improved bridge access and parking areas along the Dunkle Hills road as well as improvements to the existing Petersville Road in the Tokositna area.

In 1986, the Denali Subsistence Resource Commission submitted to the Secretary of the Interior a formal hunting program recommendation and subsequently reiterated with letters in 1993 and 1994 to the Secretary that the Commission strongly opposes any construction of new roads or railroads in Denali National Park and Preserve. The Commission was concerned that routes being considered will have adverse and negative impacts on the livelihood and social lifestyles

of subsistence users. Suggested routes through the park and preserve would traverse lands that support vegetation, wildlife and fish resources. Additionally, new roads or railroads would open areas presently used by subsistence users exposing subsistence traplines, cabins, caches and structures to vandalism. This could result in theft or damage to cabins, firewood, or food which could result in hardship to those who are dependent on these supplies.

Use of ATVs and snowmachines has increased dramatically in recent years. Some regions are used intensively by several means of access creating overlapping impacts and conflicts between user groups. Some means of mechanized access such as ATVs have a very high potential to physically damage vegetation and soil resources even with very limited use.

Currently, sport hunting occurs primarily in the Alaska Range of the southern preserve which is very remote and rugged and where trophy size animals are most likely to be found. Sport hunters, trappers and fishermen primary means of access to the preserves is by aircraft. Subsistence hunting, in contrast, is more opportunistic in nature and occurs mostly around areas more easily accessed and involves use of water or ground-base methods. Thus, to a large extent, the areas used for sport hunting and the areas used for subsistence hunting tend to be geographically distinct. Should this trend shift and sport hunters increase their use of the northern preserve, competition for wildlife with subsistence users could significantly increase.

Loss of Traditional Use Practices (Issue Codes: C04, N06, N16, N19, N20)

Dramatic increases of recreational use and private facility development in the Kantishna area has occurred in the last decade. Due to concerns for public health and safety near the Kantishna visitor service and transportation facilities, a temporary closure to the discharge of firearms is established during the periods of high summer visitation on park lands within one mile on either side of the Kantishna Road. This has the potential to impact subsistence users by limiting an area of approximately 10 square miles to the discharge of a firearm during the first half of the moose season.

Eligible subsistence users are identified by the use of resident zone communities and individual subsistence use permits . Three of Denali's four subsistence resident zone communities have experience growth over the past decade. Any residents permanently residing within one of these resident zones are eligible subsistence users of park resources. Individuals moving to and permanently residing a residents zone assume the communities eligibility even if they have no past personal or family history of using park resource. The number of potential subsistence users continue to grow along with these communities population. Subsequently the number of user and competition for resources will increase over time.

Trapping in Denali's northern region operates on the basis of formal and informal agreements between individuals since there is no recognized legal guarantee that extends ownership or

property rights to a trapline or the public lands where the trapping occurs. In recent years, this system of social norms and peer pressure has been threatened by increasing numbers of users. Strict agency regulations regarding the construction of new cabins, the reconstruction of collapsed cabins, and the use of existing subsistence use cabins has impacted the number of trapper, spacing and use of cabins and the distance and length of traplines. Park policies regarding maintenance and brushing of old winter trapline trails, and brushing of new winter trails will have further affects on trapping traditions. Different trapping management and harvest strategies by local subsistence users may have potential impacts on local furbearer populations.

The Federal Subsistence Board makes customary and traditional use determinations for use of fish and wildlife species on a community or area basis. For the part, these communty and area determinations are adequate to meet local rural users needs, but occassionaly the exclude individuals who have traditionally utilized park resource who do not live in the determined area. Without a mechanism to allow for individual exceptions, these individuals are excluded from using a traditional resource.

Summary of Conditions and Adverse Impacts

Table 4 supplies a subjective summary of the condition of park subsistence resources and the degree of their impact. In general, subsistence resources are in good condition and mimimally to moderately threatened.

Table 4.

SUBSISTENCE RESOURCE GENERALIZED CONDITIONS

Resource Category	Resource Condition	Degree of Adverse Impact
Aquatic Biotic Resources	----------	----------
Fish	Good	Low
Terrestrial Biotic Resources	----------	----------
Timber	Good	Low - Moderate
Other Vegetation	Good	Low
Birds	Good	Moderate
Furbearers\small mammals	Good - Fair	Moderate
Moose	Good - Fair	Low - Moderate
Wolves	Good	Low - Moderate
Bears	Good	Low - Moderate

G. Collection Condition

Current Conditions

Denali National Park and Preserve has a collection of approximately 251,376 museum objects that dates to the park's early years. The current Collection Management Plan (USDI 1995), describes the collection as including:

> ...natural history specimens, prehistoric and historic objects, as well as archives. The park's purpose of protecting and interpreting its resources has resulted in an extensive research study collection. Early naturalists built up an extensive herbarium collection (including nonvascular plants), mammal, bird, insect, invertebrate, and geologic and paleontological specimens. Cultural collections include prehistoric archeological, historic and ethnographic materials, photographs and associated archives.

Of the items in the collection, an estimated 239,904 are classified as archival materials, important documentary materials recording the history of the park. By far the largest segment of the total collection, archival materials also represent the most severe backlog to be cataloged; an estimated 200,000 items. The remaining collection backlog to be cataloged is 1,650 items, 1,500 biological objects and 150 history objects. Most of the collection is in either excellent or good condition, but a formal conservator's analysis has yet to be conducted.

A Collection Management Plan (CMP) assessing the status of the collection and collection management program was completed 1995. The CMP noted that significant improvements to collection management had been made in the last 10 years. These improvements include establishing appropriate administrative responsibility for the collection, assigning permanent staff to care for the collection, dedicating space for the collection and working to improve that space. One deficiency noted in the CMP was the exclusion of collection needs and concerns in basic park planning documents (General Management Plan, Resource Management Plan, Statement For Management). The CMP particularly identified the need to address the collection in the park's Emergency Operating Plan (EOP) in order to prevent or minimize impacts to the collection in emergency situations. The most significant challenges to collection management are the limitation of the facility (critically undersized), the need to develop a plan for managing archival materials and the need to evaluate the collection from a conservation perspective (conduct a conservation assessment).

In addition, the collection needs to be analyzed in terms of its being a complete representation of all species in the park. The collection is known to be inadequate in terms of representing the various life stages and morphology of each species.

Appendix G contains an Objects Status Summary Chart that should be used in concert with this

narrative.

Significant Sources of Potential Impact

Significant issues include the need for collection condition surveys (C43), museum storage (C47), conservation treatment (C48), improvements to the museum environment (C49) and fire protection and security (C50).

H. References

Andrews, E. and J. Stokes. 1984. An overview of the Upper Kuskokwim controlled use area and the use of moose by area residents, 1981-984. Technical Paper No. 99. Alaska Department of Fish and Game, Subsistence Division.

Bishop, R.H. 1978. Subsistence resource use in the proposed north additions to Mt. McKinley National Park. CPSU Occasional Paper No. 17. University of Alaska, Fairbanks, Alaska. 115pp.

Brooks, A. 1911. The Mt. McKinley region, Alaska. USGS Professional Paper 70. U.S. Department of the Interior, USGS. Washington, DC.

Capps. S.R. 1940. Geology of the Alaska railroad region. USGS Bulletin 907. U.S. Department of the Interior, USGS. Washington, DC.

Csejtey, B. Jr. et al. 1992. Geology and geochronology of the Healy quadrangle, Alaska, USGS Misc. Invest. Series.

Dean, F.C. and D.K. Heebner. 1982. Landsat-based vegetation mapping of Mount McKinley National Park region, Alaska. Final Report NPS Contract No. CX-9000-6-E084. Alaska Cooperative Park Studies Unit, University of Alaska, Fairbanks, Alaska. 198pp.

de Laguna, F. and C. McClellan. 1981. Ahtna. in Handbook of North American Indians, Vol. 6: The Subarctic. Smithsonian Institution. Washington, DC.

GAO. 1987. Limited progress made in documenting and mitigating threats to the parks. GAO/RCED-87-36. Washington, DC. 71pp.

GAO. 1994. Activities outside park borders have caused damage to resources and will likely cause more. GAO/RCED-94-59. Washington, DC. 34pp.

Griffin, K. 1990. An overview and assessment of archeological resources, Denali National Park, Alaska. Research/Resource Management Report AR-16. U.S. Department of the Interior, NPS, Alaska Regional Office. Anchorage, Alaska.

Gudgel-Holmes, D. 1979. Ethnohistory of four interior Alaska waterbodies. Alaska Department of Natural Resources, Division of Research and Development, Anchorage, Alaska. 148pp.

Hosley, E.H. 1961. The McGrath Ingalik. Apua 9(2): pp93-113.

Hosley, E.H. 1966. Factionalism and culture change in an Alaskan Athapaskan community. Dissertation, Department of Anthropology, University of California, Los Angeles, California. 348pp.

Hosley, E.H. 1968. The Kolchan: delineation of a new northern Athapaskan Indian group. Arctic 21(1): pp6-11.

Kari, J. ed. 1983. Athna place names list. Copper River Native Association and Alaska Native Language Center. University of Alaska, Fairbanks, Alaska.

Moxham, R.M., R.A. Eckhart, and E.H. Cobb. 1959. Geology and cement raw materials of the Windy Creek area, Alaska. USGS Bulletin 1039-D. U.S. Department of the Interior, USGS. Washington, DC. 100pp.

Oswalt, W.H. 1980. Historic settlement along the Kuskokwim river, Alaska. Historic Society Monograph No. 7. Alaska State Library. 104pp.

Patterson, A. 1973. Community profiles by Native region. 521pp.

Reckord, H. 1983. That's the way we live; subsistence in the Wrangell-St. Elias National Park and Preserve. CPSU Occasional Paper No. 34. University of Alaska Fairbanks. Fairbanks, Alaska. 281pp.

Reed, J. C. 1961. Geology of the Mt. McKinley quadrangle, Alaska. USGS Bulletin 1108A.

Reed, B. L. and S. W. Nelson. 1980. Geologic map of the Talkeetna quadrangle, Alaska. USGS Misc. Invest. Series Map I-1174.

Schneider, W.S., D. Gudgel-Holmes, and J. Dalle-Molle. 1981. Cultural resources in the northern extension of Denali National Park. Unpublished Draft.

Schoenberg, K. 1995. Alaska Regional Plan, Systemwide Archeological Inventory Program, National Park Service, Division of Cultural Resources, Alaska Regional Office, Anchorage, Alaska.

Selkregg, L. 1975. Alaska regional profiles - Yukon region. University of Alaska, Fairbanks, Alaska. 346pp.

Selkregg, L. 1977. Copper River region community folios: a background for planning. University of Alaska, Fairbanks, Alaska.

Shinkwin, A.D. 1975. The Dixthada site: results of 1971 excavations. W. Canadian Journal of Anthropology 5(3-4): pp 148-158.

Shinkwin, A. and M. Case. 1984. Modern foragers: wild resource use in Nenana Village, Alaska. Technical Paper No. 91. Alaska Department of Fish and Game, Subsistence Division.

Stickney, A. 1981. Subsistence resource utilization: Nikolai and Telida. Technical Reports #20 and #21. Alaska Department of Fish and Game, Subsistence Division.

Stokes, J. 1982. Subsistence salmon fishing in the Upper Kuskokwim river system, 1981 and 1982. Technical Paper #23. Alaska Department of Fish and Game, Subsistence Division. 29pp.

Stokes, J. 1984. Natural resource utilization of four Upper Kuskokwim communities. Technical Paper #86. Alaska Department of Fish and Game, Subsistence Division.

Stratton, L. and S.E. Georgette. 1984. Resource use in the Copper River region, Alaska: a report on a 1983 household survey. Technical Paper No. 107. Alaska Department of Fish and Game, Subsistence Division. Anchorage, Alaska.

Stratton, L. and S.E. Georgette. 1985. Copper basin resource use map index and methodology. Technical Paper No. 124. Alaska Department of Fish and Game, Subsistence Division. Anchorage, Alaska.

Tanana Chiefs Conference, Inc. 1983. Interior communities. Tanana Chiefs Conference, Planning and Information Office. Fairbanks, Alaska. 227pp.

Toghotthele Corporation. 1983. Nenana Denayee. Toghotthele Corporation. Nenana, Alaska. 97pp.

USDOI. 1974a. Draft environmental impact statement, proposed Mt. McKinley National Park addtions. U.S. Department of the Interior, Washington, DC.

USDOI. 1974b. Proposed Mt. McKinley National Park additions, Alaska, final environmental statement. U.S. Department of the Interior, Washington, DC.

USNPS. 1992. Natural resource inventory and monitoring guideline. NPS-75. U.S. Department of the Interior, NPS. Washington, DC. 37pp.

USNPS. 1995. Collection management plan, Denali National Park. U.S. Department of the Interior, NPS, Alaska Regional Office. Anchorage, Alaska. 39pp.

West, F. 1965. Excavations at two sites on the Teklanika River, Mount McKinley National Park, Alaska. University of Alaska. Fairbanks, Alaska.

Part Three: Management Objectives & Guiding Principles

A. Management Objectives

Legislation is the basis for policies of the Department of the Interior and the National Park Service (see Management Policies, National Park Service, 1988); and these, in turn, guide park-specific plans, including the Resource Management Plan. The vision and objectives for a park's resource management program are based on legislation, executive orders, departmental and service policy and planning documents such as the park's Strategic Plan and General Management Plan.

In 1997, the National Park Service adopted a mission statement that says, in part:

> The National Park Service is dedicated to conserving unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations.

The framework for Alaska park resource management programs has been articulated in ANILCA Title I-Purposes; Title VIII-Subsistence Management and Use; Title XI-Transportation and Utility Systems in and Across, and Access Into, Conservation System Units; and Title XIII-Administrative Provisions. This material consistently points to concerns about the relatively pristine nature of park resources, the need for founding management decisions on scientific information and the recognition that certain special uses must be permitted in conservation system units while providing opportunities for public enjoyment.

Also during 1997, park staff prepared a Park Mission Statement:

> Denali National Park and Preserve is committed to furthering the basic tenets proclaimed in the National Park Service Organic Act of 1916: to ensure the protection of wildlife, natural and cultural resources, and aesthetic and wilderness values along with the use and enjoyment of the park by present and future generations. It is the park's mission that visitors understand and appreciate the significance of natural systems. Recognizing the unique development and character of Alaska, we are also responsible for sustaining subsistence lifestyles and a setting conducive to scientific investigation.

Programmatic objectives for resource management at Denali flow from those mission statements originally articulated in the park's General Management Plan and reinforced in the park's Strategic Plan. Following is the current version of those objectives:

- Conduct long-term ecological monitoring to assess park resource conditions, monitor regional and global changes and detect impacts resulting from activities in the area.

- Through implementation of a fully developed subsistence management program, continue subsistence uses of wildlife, fish, and plants in the park additions and subsistence uses and sport hunting in the preserve without impairing natural and healthy populations.

- Protect significant cultural resources with methods that are compatible with the wilderness characteristics of the area.

- Encourage an ecosystem management approach and provide for outstanding visitor experiences within a wilderness setting while maintaining, restoring or enhancing park resources and preserving natural processes.

- Develop visitor facilities that fit into the natural and cultural landscape and that do not significantly impair park resources. Provide opportunities for resource-based activities, and encourage development in areas least vulnerable to resource degradation.

- Design and develop visitor and administrative support facilities that are environmentally and economically sustainable.

- Encourage and participate in efforts to acquire and analyze information to support the best possible management strategies for resource protection and visitor enjoyment.

B. Program Philosophy or Guiding Principles

If the service is to excel in meeting resource preservation objectives at Denali National Park, park staff must:

- value a professional, science-based resource preservation program,
- recognize the importance of all disciplines in the park organization and in the resource management fields, representing diverse skills and expertise and collective, institutional knowledge about park resources, to the success of our resource stewardship mission,

- be culturally diverse to be most responsive to human use issues [1],
- seek to establish close working relations with other land/resource managers, academic institutions, and private industry,
- recognize that resource protection is a long-term endeavor,
- adopt an "ecosystem" approach whenever feasible [2],
- be responsive to current and new issues as they emerge,
- be proactive whenever possible,
- strive to make the program a model of stewardship through application of current and appropriate technology and sustainability,
- help the public to forge ties to our natural and cultural heritage,
- assure that the program is utilitarian and cost effective, and
- make partnerships our way of doing business.

C. References

BLM. 1994. Ecosystem management. Idaho BLM Technical Bulletin No. 94-5. Boise, ID.

GAO. 1994. Ecosystem management - additional actions needed to adequately test a promising approach. GAO/RCED-94-111. Washington, DC.

NTIS. 1995. The ecosystem approach: healthy ecosystems and sustainable economies - Volume I - Overview. Interagency Ecosystem Management Task Force, Washington, DC.

NTIS. 1995. The ecosystem approach: healthy ecosystems and sustainable economies - Volume II - Implementation Issues. Interagency Ecosystem Management Task Force, Washington, DC.

USNPS. 1994. Ecosystem management in the National Park Service - Discussion draft. U.S. Department of the Interior, Washington, DC.

USNPS. 1994. Fire management and ecosystem health in the National Park System - Problem analysis. U.S. Department of the Interior, Boise, Idaho.

USNPS. 1996. Adapting to change, Humanities and the National Parks. U.S. Department of the Interior, Washington, DC.

---

[1] See references for materials that describe the concepts supporting these principles.

[2] Ditto.

USNPS. 1997a. National Park Service strategic plan. U.S. Department of the Interior, NPS. Washington, DC.

USNPS. 1997b. Strategic plan - Denali National Park and Preserve. Denali National Park and Preserve, Denali Park, Alaska.

Part Four: Park Resource Program

A. Programmatic Needs and High Priority Recommendations

Section Purpose

The park Resource Management Plan (RMP) is written to document current knowledge about resource conditions, to identify issues based on threats related to the protection of park resources and to organize ideas and actions that can be taken to resolve those issues. A key element of the RMP is the Overview and Needs section (this section) that sets priorities among the many actions that are generally identified in the RMP and outlines the course of action park staff is to take over a four or five year period.

This section serves several purposes. First, it supplies the rationale and management context for the park's resource preservation program, thus setting the standard for determining programmatic priorities and directions and providing the links between park managerial/operational needs, resource needs and what will be done to meet those needs. Second, and most importantly, this section prescribes an overall strategy for addressing the most pressing resource problems that remain unaddressed by current resource programs.

Program Needs and Their Rationale

The Process of Establishing Program Needs and Rationale

Preparation of an RMP and development of resource management program priorities is very complex and often subjective because of inherent limits of scientific understanding. The following outline provides a brief overview of the preparation process and methods used to establish priorities. It is hoped that this outline will improve understanding of the plan and its preparation.

Step I: Scoping - Information is gathered from various sources, including other planning documents, published and grey literature, the Servicewide Strategic Plan, park resource files, firsthand knowledge of staff and other agency personnel, and program/project proposals. Information is also gleaned from sources such as the park Subsistence Resource Commission. Scoping efforts generate several products:

* Vision, Objectives, and Program Philosophy Statements
* Legal and Administrative Constraint Descriptions
* List of Sources of Potential Adverse Impacts
* Resource Condition Summaries

* Lists of Possible RMP Topics

Step II: Project Statement Preparation - Park staff writes detailed statements tied to issues identified in scoping. In situations where park staff members lack expertise or where collaboration with other agency or scientific personnel is appropriate, project statement preparation is a joint effort. Statements describe the problems and current conditions and supply comprehensive lists of potential actions aimed at resolving problems. During initial preparation, only general timeframes are linked to actions. No thought is given to relative priorities.

Step III: Setting Program Priorities (Park Strategic Planning and RMP Link) - Local strategic planning provides an initial filter useful to park staff in determining what issues, including resource issues, need to be addressed in a five to ten year timeframe. Considerations or criteria that are applied during strategic planning include legal mandates, relative peril to resources, systematic importance of resource, severity and pervasiveness of impacts, state of knowledge about the source of impact and park resources, established management objectives and public and political sensitivity. This filter, as applied to the RMP, narrows the number of issues and actions that should be addressed during the life of both the Strategic Plan and the RMP.

Step IV: Setting Action Priorities - Issues and actions from Step III are then judged against more detailed criteria and the list is narrowed further. These constitute the highest priority needs. These feed into the park's Annual Performance Plan. Detailed criteria include appropriate activity sequencing (inventory before monitoring), strategic versus tactical needs, relative state of scientific information, likelihood of achieving desired outcomes, programmatic guiding principles and availability of financial and personnel resources.

Application of the Process

Step I: Scoping - Park staff members critically examined the park's resource preservation program between 1991 and 1997 in a series of initiatives. Resource management planning scoping sessions were conducted between park staff and a number of other non-NPS resource managers in 1991. The content of this plan was, in a large part, the result of that scoping session. Brainstorming sessions, specifically aimed at identifying resource issues and shortfalls were conducted in 1992. Those sessions led to preparation of a draft Strategic Plan for the Division of Research and Resource Preservation. Major

programmatic shifts (creation of NBS - now BRD, establishment of the Long-Term Ecological Monitoring (LTEM) program and completion of the primary elements of the wolf research project) resulted in the need to adjust priorities and to forecast future needs and programmatic direction. A series of major planning efforts established the need for responsiveness to emerging resource issues and proposed park developments.

Finally, implementation of the Government Performance and Results Act by agency staff brought critical analysis of goals, expectations and actions necessary to improve performance. In 1997, in response to the mandates of the Government Performance and Results Act, the National Park Service adopted a strategic plan that describes fourteen mission goals that are grouped into four general goal categories. Tiered from these broad goals are numerous subgoals that are anticipated to be achieved by the year 2002 as well as annual subgoals (Servicewide Annual Performance Plan) that are enumerated for each year between 1998 and 2002. Many of these goals are targeted specifically at resolving park resource issues.

In addition, some national program offices (natural resources and museum management specifically) have developed strategic plans that tier off of the above mentioned documents but focus on specific deficiencies in those programs.

While not packaged in a cohesive group with a clear path of processing, the combination of these efforts has laid a foundation of regular examination, reexamination and change in response to new needs.

These efforts coalesced and culminated in the preparation of the Resource Management Plan, including identification of high priority resource issues and associated actions that might be taken to resolve them.

Step II: Project Statements - Between 1992 and 1997, park staff, in coordination with others, wrote 58 individual project statements. 715 individual actions are included in those statements. About 10% of those are duplicated between statements. Ten additional project statements are contemplated. Section B of this part of the RMP includes those project statements.

Step III: Setting Program Priorities (Park Strategic Planning and RMP Linked) - Park staff developed a park Strategic Plan in 1997. This plan tiers off of the Servicewide Strategic Plan and sets out park mission and long-term (five year) goals that are specific to the management of Denali National Park and Preserve. The purposes of these plans have been to assure results-oriented performance, to improve the measurement and quantification of progress, and to develop clear accountability systems in meeting the congressionally mandated mission of the service.

Resource goals within the Strategic Plan were formulated by applying the following criteria:

- Importance of Resource - Are resources that are either ecologically or thematically important at risk? See Part One.
- Legal Mandates - Are programs or specific actions required by law? See Part One.
- State of Knowledge - What is known about park resources. See Park Two.
- Peril to Resources - What is the nature, severity, and pervasiveness of factors that may adversely affect resources? See Part Two.
- Vision and Objectives - Do issues fall within the scope of predetermined management objectives? See Part Three.
- Sensitivity - Are the issues or resources of high public or political interest?

Numerous resource related goals are included in the park's Strategic Plan. Park mission and long-term goals related to resource issues, in summary form, are:

* Human activities, inside and adjacent to the boundaries of the park, do not result in unacceptable damage to park resources:
  - Implement restoration and revegetation programs
  - Acquire land in Kantishna
  - Maintain air quality
  - Preserve historic structures
  - Manage the park collection professionally
  - Identify cultural landscapes
  - Protect archeological sites
  - Implement a subsistence program
  - Practice environmentally responsible park development

* An appropriate balance between wilderness recreation and protection of park values is preserved:
  - Implement and enforce regulations
  - Plan backcountry management

* Park management and planning are based on sound research and review of pertinent historical and administrative history, are within applicable laws and park purposes, and are done with appropriate public involvement:
  - Complete resource inventories
  - Gather resource and sociological information
  - Establish the LTEM program
  - Implement studies proposed in development plans
  - Record human history

- Complete national register nominations

* Visitors and employees experience a safe environment while in the park:
- Reduce the visitor safety incident rate

The following table displays the relationship between park long-term goals and project statements in this plan. The reader will note that only 46 project statements have a direct link. Therefore, the remaining 12 project statements can generally be assumed to be of a lessor priority.

Table 5.

CROSSWALK BETWEEN PARK STRATEGIC PLANNING AND RESOURCE MANAGEMENT PLAN

Park Long-Term Goal	**Project Statement Number/Title**
Implement Restoration/Revegetation	I-610 Frontcountry Management I-700 Hazmat/Waste Management N-313 Minerals Management N-342 Exotic Plants N-530 Ecological Restoration
Acquire Land in Kantishna	I-500 Land Resources
Maintain Air Quality	N-110 Air Quality
Preserve Historic Structures	C-600 Historic Structures
Manage Collection Professionally	I-300 Curatorial Management
Identify Cultural Landscapes	C-400 Cultural Landscapes
Protect Archeological Sites	C-200 Archeological Resources
Implement Subsistence Program	N-344 Firewood/Cabin Log Mgmt. N-368 Trapline Management N-369 Subsistence Hunting S-100 Subsistence Prog. Mgmt. S-110 Traditional Use Patterns S-120 Traditional Access
Implement Studies in Park Development Plans	I-220 Resource Inventory I-610 Frontcountry Management I-670 Road Use Impacts I-800 Administrative Use of Resources

Park Long-Term Goal	Project Statement Number/Title
Plan Backcountry Management	I-620 Wilderness/Backcountry I-640 Winter Recreation I-660 Mountaineering
Complete Resource Inventories	I-220 Resource Inventory N-311 Geologic Resources N-320 Soil Resources N-330 Terrestrial Vegetation
Gather Resource/Sociological Information	I-100 Program Management (includes social science & information transfer components) I-220 Resource Inventory
Establish Long-Term Monitoring	I-210 Long Term Ecological Monitoring N-110 Air Quality N-120 Meteorology N-210 Water Resources N-240 Aquatic Invertebrates N-314 Glaciology N-320 Soil Resources N-330 Terrestrial Vegetation N-361.1 Passerines N-361.4 Raptors N-361.5 Ptarmigan and Grouse N-362.1 Dall Sheep N-362.2 Moose N-362.3 Caribou N-363 Furbearers N-364.1 Wolves N-364.2 Bears N-520 Wildland Fire Ecology
Record Human History	C-300 Ethnography C-500 Park History
Complete National Register Nominations	C-200 Archeology C-600 Historic Structures
Reduce Visitor Incidents	N-341 Hazardous Tree Management N-364.2 Bear Management

Step IV: Setting Action Priorities - Within each project statement there are numerous actions that are proposed to resolve the issue or problems presented. It is inappropriate to undertake all of those actions simultaneously. The following criteria were used to separate the most critical actions from those that should eventually be implemented but

can wait.

Sequencing - Good science and management dictate that some types of actions need to be implemented in a sequential manner. For instance, resource inventories should occur before resource monitoring starts.

State of Scientific Information - Is there sufficient information in the scientific and scholarly literature to make informed management decisions and therefore take action; or, do research findings need to be developed before decisions can be made?

Strategic versus Tactical Actions - Parks are to be managed in a fashion that perpetuates their resources. If all efforts are focused on tactical actions, dealing with short-term issues, long-term negative impacts may result. Balance should be sought between tactical and strategic actions to assure long-term preservation of park resources.

Achieving Desired Outcomes - Which actions will be the most effective in resolving problems?

Guiding Principles/Funding/Expertise - While this criteria emphasizes the "how" of actions, it can have implications for which actions are undertaken. For instance, if a proposed research project's costs exceed all available funds, it is unlikely that it will be given consideration for implementation. Similarly if an action does not fall within the scope of agency policy, it will be deemed inappropriate and therefore not be implemented.

Applying these criteria to the actions within the project statements outlined in Table 5 reduces the number of actions that will be taken over a four or five year period to a reasonable number.

Prospectus of Highest Priority Resource Preservation Programs

This sections provides brief narrative descriptions of the highest priority project statements. This section does not provide full descriptions of every action described in the project statements but highlights key actions. Full descriptions can be found in the respective project statements. Furthermore, this section only describes actions beyond what is currently funded or regarded as the park's current resource management operation. Project Statement I-100, N-500, C-100 and S-100 all provide descriptions on current programs.

No priority is intended by the manner in which these summaries are listed. All are regarded as

high priority needs.

Interdisciplinary Resource Programs

I-100 Program Management: The focus of actions contemplated here is on strategic planning (both from a divisional perspective and for major program areas - monitoring, research, and resource inventories), social science program planning and implementation, and on improving dissemination of scientific information.

I-210 Long-Term Ecological Monitoring: Emphasis is to be placed on completion of initial developmental tasks and preliminary implementation of a prototype monitoring program. Park staff will continue to work closely with the Biological Resources Division, USGS.

I-220 Inventories: Numerous project statements within this plan call for various types of resource inventories and condition assessments, which are essential for sound resource management and preservation. This information is called for throughout this document as research projects or special studies. Special effort will be placed on participation in the Servicewide Resource Inventory Initiative and on acquisition of information in anticipation of south slope development.

I-300 Curatorial Management: Elimination of cataloging backlog will continue as will completion of collection condition assessments. Follow-up actions to correct deficiencies identified in the assessments will be taken.

I-500 Land Resources: Primary emphasis will remain on the acquisition of lands in the Kantishna Mining District, including assurance that planning and priority setting is responsive to current land status and acquisition opportunities.

I-610 Frontcountry Management: Numerous resource studies and monitoring efforts will be initiated in anticipation of Road Corridor and South Side Development Concept Plan implementation. Topical areas will include road related studies (see below), VERP application, trails monitoring, south side bear studies and so forth.

I-620 Wilderness/Backcountry Management: The park's Backcountry Management Plan will be updated, and winter use issues will be addressed. The revision process is anticipated to reinforce the need for future studies and monitoring activities that will be initiated once planning is completed.

I-640 Winter Recreation: Emphasis in this project statement is on preparation of a Winter Use Plan and gathering data associated with that planning effort.

I-650 Aircraft Management: Effort will be focused on documenting park aircraft use, visitor attitudes about that use, and resource impacts.

I-660 Mountaineering: Primary focus will be placed on gathering use information and dealing with waste issues.

I-670 Road Use Impacts: Response to the recommendations of the 1997 Road Studies Review will be stressed through scientific review of all past road wildlife and social science studies with the intent of summarizing those and drawing conclusions. Emphasis will also be placed on development of baseline condition information.

I-700 Hazardous Materials and Waste Management: Material inventories and Standard Operating Procedures and Plans will be completed. Underground storage tank (UST) compliance will continue. As funding allows, specific projects will be undertaken to clean up storage and contaminated sites.

I-800 Administrative Use of Resources: Emphasis will be placed on developing a cohesive management program.

Natural Resource Programs

N-110 Air Quality: Near-term emphasis will be concentrated on regional air quality network implementation and data analysis of existing data sets. Cooperative working relations will be maintained with Golden Valley Electric Association staff on the Healy Clean Coal Project (HCCP).

N-120 Meteorology: Initial work will be focused on gathering and archiving historic data and implementing the LTEM program.

N-210 Water Resources: Spill contingency planning will be completed, reclamation and site cleanup will occur, impacts of dust palliatives will be assessed and LTEM program elements will be implemented.

N-240 Aquatic Invertebrates: Biotic diversity will be inventoried, and LTEM program elements will be implemented.

N-313 Minerals Management: Operation plans will be evaluated as necessary, claims will be acquired and reclamation will be undertaken.

N-314 Glacial Resources: Glacier mapping and monitoring will occur.

N-320 Soil Resources: Soils mapping and inventory will occur.

N-330 Terrestrial Vegetation: Landcover mapping and floristic inventories will occur.

N-341 Hazardous Tree Management: Inspection procedures will be completed, and annual monitoring and hazard removal will occur.

N-342 Exotic Plant Management: Eradication and control actions will continue concurrently with investigations to better understand exotic plant ecology and potential control strategies.

N-344 Subsistence Firewood/Cabin Log Management: Primary emphasis will be placed on completion of a forest resource use study to document customary and traditional uses of timber resources as well as current resource conditions.

N-361 Avian Programs: LTEM components for passerines, raptors, ptarmigan and grouse will be implemented.

N-362 Large Mammal Programs: Predator/prey studies will continue, and LTEM components for large mammals will be developed.

N-363 Furbearers: Harvest data will be gathered, and monitoring procedures will be developed.

N-364.2 Bear Management: Multiple initiatives will improve bear management. These will include better coordination of research efforts, automation of historic bear management data, development of closer working relations with Alaska Department of Fish and Game staff, and improved public education efforts.

N-368 Subsistence Trapline Management: Assessments of customs and traditions related to trapping in and around Denali National Park and of the status of Marten will be conducted. Harvest monitoring procedures will be prepared and implemented.

N-369 Subsistence Hunting: Actions will be focused on improving the data available to park staff on species harvest and on developing harvest monitoring procedures in concert with Alaska Department of Fish and Game.

N-520 Wildland Fire: Fire effects monitoring procedures will be developed.

N-530 Ecological Restoration: Reclamation planning will be completed, studies aimed at improving reclamation techniques will continue and restoration/reclamation will occur as funds are made available. Hazardous mine shafts will be closed. Proactive restoration activities (seed collection, preparation of restoration SOPs, and nursery construction/operation) will also take place.

Cultural Resource Programs

C-200 Archeology: Funds will be sought to stabilize the Teklanika Archeological site and to continue more comprehensive surveys.

C-300 Ethnography: The Ethnographic Overview and Assessment, currently underway, will be completed and oral histories will be gathered. Better coordination of the oral history program will be sought.

C-400 Cultural Landscapes: The funded landscape inventory and individual landscape reports (road corridor and headquarters) will be completed. Opportunities to fund other individual landscape reports will be sought.

C-500 Park History: Funds are currently available for preparation of an Administrative History. This project will be completed, and staff will look for opportunities to have topical histories prepared.

C-600 Historic Structures: Attention will be focused on stabilization of Kantishna structures, cabins, Headquarters District Structures and the Stampede Mine. Databases associated with park historic structures will also be improved.

Subsistence Resource Programs

S-100 Subsistence Program Management: Staff will continue to seek information about subsistence communities through oral history efforts and community profile preparation. The Subsistence Management Plan will be completed, and a cabin management program will be developed.

S-110 Traditional Use Patterns: Special attention will be given to dealing with individual use-zone identification and species determinations.

S-120 Traditional Access: Primary emphasis will be placed on resolving issues associated with access to parklands adjacent to Cantwell. Other actions will be taken to better document access patterns, coordinate ATV use with owners of selected lands and to monitor ATV use.

In order to implement many of these proposed actions, numerous logistical and administrative tasks must also be accomplished. Park strategic planning has assumed that these would also be accomplished, but they have not been set forth as specific goals. Without them, the park's resource preservation program would be incomplete.

Table 6 below, summarizes the highest priority individual actions, derived from the project statements, that should be implemented. **Special Note:** Table 6 represents unfunded and partially funded actions. Significant, ongoing research projects are included. Fully funded actions are described elsewhere in the plan.

Table 6.

PARTIALLY OR UNFUNDED RMP ACTION ITEMS OF **HIGHEST PRIORITY**

RMP Project Statements	**Action Items**
I-100 Program Management	.001 Strategic Planning .002 Strategic Research Plan .003 PIO Involvement .004 Training for Interpreters .005 Partnership Training .011 Social Science Program .012 Public Use Reporting .041 Assign Collateral Positions .042 Web Site Improvements
I-210 Long Term Ecological Monitoring	.007 Collections Management .012 Integrate Data .013 Develop New Protocols .014 Identify Thresholds .032 Monitoring Networks .033 Baseline Inventories .041 Interpret Monitoring
I-220 Resource Inventory	.001 Inventory Strategy .003 Information Management .004 GIS Plan .005 Cartographic Technician .006 GIS Training .007 Cooperative Relations .011 Rapid Bioassessment Procedures .012 Complete Inventories .013 Digitization .021 GPS Equipment .022 Aerial Photography/Imagery .031 Document Monitoring

I-300 Curatorial Management	.001 Staffing .002 Training .003 Cataloging .005-.007 Collection Planning .012 Security/Fire Protection .013 Photo Documentation .051 Disaster Planning
I-500 Land Resources	.001 Update LPP .011 Map Park Boundary .012 Research RS2477 .022-.025 Land Exchanges .031 Map Inholdings
I-610 Frontcountry Management	.001 Resource Protection in Planning .002 Implementation Compliance .003 Develop VERP .004 GIS Applications .011 Resource Conditions Research .012 Develop Trails Monitoring .013 South Side Studies .021 Plan Implementation Mitigation .022 Resource Protection Measures .023 Impacted Area Migitation .024 Food Storage/Waste Management .032 Monitor Visitor Satisfaction .034 Implement VERP
I-620 Wilderness/Backcountry	.002 Spec Regs - Snowmachines .005 Clarify Responsibilities .011 Develop Monitoring .012 Impacted Area Inventory .013 Social Study - Wilderness Users .014 Evaluate Education Programs .015 Hiker Disturbance of Dall Sheep .021 Recovery Efforts .022 Improve Information .031 Organize Historic Data .032 Implement Monitoring .043 Provide Public Information
I-640 Winter Recreation	.002 Winter Use Plan .011 Social Study - Winter Users .012 Assess Winter Use Impacts .031 Winter Use Monitoring .051 Spec Regs - Snowmachines

I-650 Aircraft Management	.001 Update Aviation Plan .002 Spec Regs - Aircraft .004 GIS Applications .011 Noise Level Monitoring .012 Visitor Attitudes Study .013 Wildlife Effects Study
I-660 Mountaineering	.011 User Profiles .012 Determine Waste Management Options .031 Organize Historic Data .032 Establish Monitoring
I-670 Road Use Impacts	.001 Transportation System Plan .013 Wildlife Behavior .014 Model Traffic Patterns .015 Sociological Studies .016 Simulation Model .021 Develop Background Data .022 Administrative Histories .023 Road Maintenance .024 Road Use Limits .032 Visitor Use Monitoring .033 Palliative Monitoring
I-700 Hazmat/Waste Management	.002 Complete Hazmat SOPs .003 Hazmat Inventory .004 Solid Waste - Mountaineering .010 Tailings Characterization .021 Soil Remediation .022 Hazmat at Claims .023 Hazmat at Other Sites .024 Response Capabilities .025 UST Compliance .026 Solid Waste Program .031 Hazmat Monitoring
I-800 Administrative Use of Resources	.001 Develop Management Program
N-110 Air Quality	.002 Smoke Management .003 AQRVs Identification .011 Analyze Denali Data .012 Analyze Regional Data .032 Monitoring Data Analysis .041 Interpreting AQ Values
N-120 Meteorology	.021 Organize Historic Data .022 Obtain NWS Records .031 Replace Eielson VC Weather Station .032 Establish RAWS Stations .034 LTEM Implementation

N-210 Water Resources	.002 Develop Spill Contingency Plan .017 Assess Impacts of Dust Palliatives .022 Cleanup of Contaminated Sites .023 Reclamation of Placer Mines .024 Replace USTs .032 LTEM Implementation
N-240 Aquatic Invertebrates	.011 Research Program - Inventory focus .031 LTEM Implementation
N-311 Geologic Resources	.011 McKinley Quad Geology Mapping .012 Major Unit Mapping Refinement
N-313 Minerals Management	.001 Claim Acquisition .002 Complete Restoration Plan .021 Eliminate Hazards
N-314 Glacial Resources	.012 Glacial Mapping .031 Monitoring .041 Public Awareness of Glacier Resources
N-320 Soil Resources	.011 Parkwide Soils Inventory .012 Watershed Soils Mapping .031 Recreational Impacts to Soils
N-330 Terrestrial Vegetation Management	.001 Vegetation Management Planning .003 Acquire Ecological Studies .004 Verify Collections .005 Landcover Mapping .013 Floristic Inventories
N-341 Hazardous Tree Management	.001 Hazard Tree Plan .002 Include in Planning .003 Training .021 Removal Program .022 CR Protection .031 Inspections .032 Track Data .041 Public Notification
N-342 Exotic Plant Management	.001 Exotic Plant Mgmt. Program .002 Revegetation Guidelines .003 Vegetation Technician .011 Exotic Plant Ecology .012 Control Methods Study .021 Control Actions .022 Implement Mgmt. Plan .031 Risk Assessment .032 Monitor Infestations .041 Public Information

N-344 Subsistence Firewood/Cabin Log Management	.001 Firewood/Log Mgmt. Program .011 Forest Resource Use Study .031 Monitor Timber Use
N-361.1 Passerines	.134 National Monitoring Programs
N-361.4 Raptors	.401 Raptor Management Program .411 Gather Historic Nest Data .412 Golden Eagle Research
N-361.5 Ptarmigan and Grouse	.511 Inventory .512 Develop Monitoring Protocols
N-362.1 Dall Sheep	.101 Interagency Management Program .112 Modify Survey Techniques .113 Recover Historic Data
N-362.2 Moose	.201 Interagency Management Program .202 Predator/Prey Study .214 Broad Pass Moose Study
N-362.3 Caribou	.301 Interagency Management Program .311 Predator/Prey Study
N-363 Furbearers	.001 Local Harvest Database Development .102 Interagency Management Program .012 Develop Monitoring Protocols
N-364.1 Wolves	.101 Interagency Management Program .112 Predator/Prey Study
N-364.2 Bear Management	.201 Convert Technicians .202 Cooperative Planning .203 Training .211 Coordinate Bear Research .212 Recover Historic Data .213 Road Use Disturbance .214 Aversive Conditioning .221 Remove Human Foods .224 Interagency Links .232 Bear Monitoring .233 Update Bear Information Mgmt. System .234 Track Interagency Actions .235 Gather South Side Data .236 Predation Database .237 Berry Production Monitoring .238 Monitor Human Use .241 Public Information .251 Regulation Enforcement
N-368 Subsistence Trapline Management	.001 Trapline Management Program .011 Customs/Traditions of Trapping .012 Marten Trapping .031 Furbearer Harvest Monitoring

N-369 Subsistence Hunting	.001 Acquire Harvest/Population Data .002 Cooperative Plans .031 Harvest Monitoring
N-520 Wildland Fire	.014 Develop Fire Effects Monitoring Program
N-530 Ecological Restoration	.001 Reclamation Plan .002 Restoration SOPs .012 Riparian Recovery Studies .013 Tailings Characterization .021 Mine Safing .022 Reclamation .031 Monitor Reclaimed Areas .032 Monitor Ops to Determine Needs
C-200 Archeology	.003 National Register Evaluation .011 Improve Data .012 Stratified Survey .013 Athabascan Landscape .015 Cultural Chronology .021 Teklanika Site Stabilization .031 Monitoring .051 Protection Strategy
C-300 Ethnography	.001 Native Consultation Network .012 Oral History - Natives .013 Oral History - Park Admin .014 Oral History - Miners .015 Oral History - Railroad .016 Oral History - Park Employees .017 Oral History - Native Language .031 Threat Identification
C-400 Cultural Landscapes	.012 Kantishna Landscape .014 Athabaskan Cultural System
C-500 Park History	.012 History of Research .021 Archival Management .041 Dog Mushing Exhibit
C-600 Historic Structures	.001 HQ Site Mgmt. Plan .003 Stampede Site Mgmt. Plan .004 Inventory/Assessment .021 HQ Structure Rehab. .022 HABS - Stampede .023 Preventive Maintenance .026 Stampede Mill Stab. .027 Cabin Preservation .031 Structure Monitoring .032 Stampede Monitoring .041 HQ Interpretation

S-100 Subsistence Program Management	.003 Native Coordination .004 Hunting Plan .005 Cabin Management Plan .006 Training .007 Reference Material .008 GIS Applications .011 Community Profiles .014 Oral History - Sub. Users .031 Resident Zone Monitoring .032 Cabin Monitoring .041 Public Information .042 Community Presence
S-110 Traditional Use Patterns	.001 Use Zone Identification .002 Species Determinations .011 C&T Evolution
S-120 Traditional Access	.001 ATV Mgmt. Program .011 Access Study .021 ATV Use on Selected Lands .031 Monitor ATV Use

B. References

USNPS. 1997. Strategic plan - Denali National Park and Preserve. Denali National Park and Preserve. Denali Park, Alaska.

USNPS. 1997. National Park Service strategic plan. U.S. Department of the Interior, NPS. Washington, DC.

C. Project Statement Organization and Content

Natural and cultural resources of large national parks are inherently complex, reflecting the intricacies of ecological science and human interaction with the landscape. These conditions are further confounded by the presence of visitors engaged in various recreational activities within the park as well by human activities external but adjacent to parklands. Park resources and resource related issues have been grouped into four major categories in this document to facilitate identification of key concerns and formulation of a logical resource management program.

The groups or categories are:

Interdisciplinary: where issues clearly have potential for significant impacts to natural, cultural

and subsistence resources concurrently.

Natural: where issues are primarily focused on the ecological condition of the park. This group has been further divided into major resource types and phylogenetically.

Cultural: where issues are primarily focused on the human history and pre-history of the park. This group has also been divided into major resource types.

Subsistence: where issues are focused on the legislatively mandated administration of use and harvest of park resources by rural residents who have an established pattern of resource use. Issues in this category are largely administrative while issues tied to specific resources can be found in the Natural section of the document.

Distinctions between each of these categories and the individual project statements within them are not always clear. As a result, cross references within the project statements have been provided and should be used to gain a full appreciation of the scope of resource concerns.

Interdisciplinary Program Management

PROJECT CODE: DENA-I-100

SERVICEWIDE ISSUES: N24 Other

STATEMENT OF PROBLEM

Present Condition

Frequently resource management activities tend to be focused on crisis resolution and field operations at the expense of important aspects of program planning and logistical or other types of support. The results are research efforts and operations that are not synchronized, data that is of low value because it was collected improperly, specimens that are not given adequate or any curatorial care, modification of study designs due to scheduling conflicts and inadequate facilities, and so forth. Funds to support research and resource management operations across the National Park Service, including Denali, are limited. It is therefore imperative that those funds are expended in a well planned fashion that will result in useful, scientifically valid information. To achieve this, sufficient attention must be paid to issues such as strategic planning, staffing, facilities, information management, and publications. Improvements could be made in all of these areas currently existing at Denali. Most of these are addressed in various project statements found throughout this document. This project statement is focused on program management issues that are not dealt with elsewhere (i.e., strategic planning).

Furthermore, many of the issues presented in the Interdisciplinary portion of the Resource Management Plan deal with human uses of park resources. Several social science projects are proposed throughout this document, but none of the project statements lends itself to proposals related to broad social science concerns. This project statement fills that void.

project statements similar to this have been prepared for each of the other three resource management program areas (natural resources, cultural resources, and subsistence resources). Those project statements focus specifically on program management deficiencies that are directly related to those programs (see N-500, C-100, and S-100). This project statement deals with generic needs that cut across those program areas and with needs that are unique to the interdisciplinary projects addressed in this section of the Resource Management Plan.

Current Management Actions and Results

Programs

The park's current research and resource preservation program is organized generally around the following categories:

Resource Inventory. Identify and develop understanding of the resources and processes that give meaning to the park. Specific programs include maintenance of various lists (e.g., species lists, List of Classified Structures), preparation of resource theme maps, preservation of objects and specimens in a collection, and archiving records related to park resources. Special emphasis has been placed on gathering resource information on the south slope of the Alaska Range in anticipation of development. Complex geographic information and data management systems are used to store and analyze this information.

Monitoring. Establish and monitor baseline measurements of the resource conditions and processes so impacts can be detected before they cause damage and to provide a standard against which management performance can be measured. Park staff is involved in the development of a prototype monitoring program and in surveys of key wildlife species (e.g., caribou, Dall sheep, wolves, moose, golden eagles).

Research. Identify and conduct quantitative investigations to answer questions about park resources and processes. Emphasis is placed on predator/prey studies, reclamation strategies, park road related resource investigations, and various geologic/glacial process investigations. Staff is also engaged in oral history, ethnographic, and archeological investigations. Park staff supports a research program conducted by cooperators from various educational institutions and agencies and provides administrative or logistical support for those efforts.

Mitigation, Interpretation, Protection. Implement various mitigation, interpretation, and protection actions to resolve resource related problems. This category constitutes one of the areas of greatest emphasis in the resources program and is manifested in projects like mined land reclamation, disturbed land revegetation, exotic plant removal, bear/human conflict management, integrated pest management, mining plans of operation review, land acquisition, hazardous materials management, cyclic repairs to historic structures, subsistence program implementation, and fire management programs. Other important, ongoing activities include compliance, regulation promulgation/review, and permit reviews.

Prediction. Institute a system for predicting potential threats to human values attributed to parks early enough before their occurrence that budgeting and programming are done to accomplish research and/or management to prevent or mitigate them. Information derived from inventory, research, and monitoring efforts is useful in forecasting the threats. Often those efforts focus on gathering data about the resources themselves. Also included are programs that gather data about activities that could lead to adverse resource impacts such as park road traffic, aircraft overflights, and visitor use.

Administrative Programs and Planning. Identify all planning and administrative actions necessary to support a well developed resource preservation program. Substantial portions of the park's resource program are dedicated to plan formulation and review; primarily strategic plans and development concept plans, but also various action plans and special studies (Northern Access Feasibility Study, Backcountry Management Plan, etc.). This category also includes procurement, personnel, budgeting, and property management functions necessary to support all other functions.

The park's resource program may be characterized as robust but some programmatic weaknesses remain. For instance, there is a scarcity of baseline and continuous information about park resources available to park management to aid in decision making, particularly in new park and preserve lands; a lack of information about park users and other stakeholders; and existing information is not always readily available to park management.

Socio-economic information is valuable in park planning efforts and, in fact, is treated extensively in environmental impact statements and may be so treated in environmental assessments. This information is useful in management of park concession operations, and, given the importance of the tourism industry to Alaska and the importance of Denali to that industry, to understanding the relationship of park management decisions to others in the industry. Frequently, socio-economic concerns are inexorably tied to natural, cultural, and subsistence resources. In many cases, socio-economic studies that the park needs are proposed to deal with specific resource issues. Additionally, there is a need for baseline, socio-economic information in the same sense as a need for natural and cultural resource baseline information. Very few socio-economic studies, in either category, have been conducted at Denali (Lichtkoppler 1995, Machlis 1989).

Demand exists for increased access into the park and will continue to exist for the near future. As this demand is accommodated, resources will degrade unless preventive measures are taken. Similarly, recreational use of the park has diversified and is expected to continue. This will expose park resources to new technologies and an anticipated diminishing of park wilderness values unless steps are taken to ensure protection of those values. Resource degradation through past mining, park construction and development, invasion of exotic species, resource harvest, and habituation has and may continue to occur. Current programs will not be able to keep pace

with these threats. Finally, given the foreseeable challenges, it is in the best interest of the park to be aggressive about promoting quality science, including peer review, competition, assessments, and reporting. Efforts in this vein are underway, improvements are needed.

Resource Management Planning and Operational Procedures

In recent years, the National Park Service has engaged in various strategic planning efforts aimed at improving resource programs (National Park Service, no date). In 1992, the Division of Research and Resource Preservation at Denali also initiated a strategic planning effort to deal with staffing, facilities, information management, and communications tiered off of servicewide strategic plans. That planning effort has never been completed because of substantial workloads that have come to the division during the intervening years and because the resource management plan was not completed. The strategic plan needs to be finished to provide vision and direction to the division.

Park level strategic plans are also needed to describe approaches to natural, cultural, subsistence resource, and sociological based research and monitoring programs. Serious attention was turned to strategic planning for monitoring between 1994 and 1995. That effort is still underway and is anticipated to be finished in 1999. Needs related to monitoring program planning are found in Project Statement I-120. Strategic planning for park based research has not yet occurred, but should. Identification and grouping of actions within the Project Statements of the resource management plan in categories of research, monitoring, mitigation, and so forth will aid greatly in the effort to prepare these plans.

During the past 15 to 20 years, park staff has worked on various versions of the park resource management plan. In addition, several action plans, dealing with various resource issues, have been prepared (i.e., Backcountry Management Plan, Bear Management Plan). These have always focused on the highest priority resource programs.

Past efforts have been suitable for previous operating circumstances but current operations and complexity of issues present a situation in which more action plans and standard operating procedures are needed.

Interdivisional Relationships

Mt. McKinley National Park was established in 1917. Early park staffing levels were minuscule, but many changes have occurred in the past two decades. Today the park is managed by approximately 85 permanent employees in seven divisions (Maintenance, Concessions, Interpretation, Visitor Services and Ranger Activities, Planning and Compliance, Administration, and Research and Resource Preservation).

Distribution of resource management responsibilities among divisions has followed "traditional" lines long established within the service. Maintenance employees have primary responsibility for hands-on preservation treatment of historic structures and manage the park's hazardous materials program. Concessions staff influences on park resource conditions through stipulations that are written into concession permits and contracts. Interpretive staff communicates preservation messages and ethics about park resources to park visitors, park neighbors, and area business and schools by presenting programs, preparing publications, and designing wayside exhibits. The ranger activities staff also engages in public education and conducts a variety of patrols aimed at assuring public compliance with regulations intended to protect park resources. The visitor management staff also supports the resource management operation through regulation promulgation and aviation operations. Similarly, park planning staff can influence resource conditions through plan development, compliance, and implementation. Finally, the administrative staff, while not directly engaged in resource preservation, provides support to all other employees in the park in the areas of budgeting, procurement, property management, and personnel management.

Staff in the Division of Research and Resource Preservation handles most day-to-day resource management activities. Major program areas include long term ecological monitoring, resource inventory and mapping, fire management, bear management, reclamation and revegetation, natural science, historical research, and social science administration, exotic and pestiferous species management, minerals management, subsistence program administration, and land resource management.

Staffing

A long-standing tradition of affiliation between earth resource and wildlife scientists exists at Denali. These employees have provided leadership and direction to resource preservation efforts. In 1980, Mt. McKinley was roughly tripled in size with new park and preserve additions. About this same time, the first full-time resource management specialist joined the park staff and progress was made in improving the preservation of park resources. During the past 20 years, the original park and subsequent additions have become subject to increased human influences stemming from transportation system development, increasing visitation, tourism industry development on the park boundary and on park inholdings, as well as proposals for road and powerplant construction and state assertions related to land management. Concurrently there has been a gradual increase in the number of scientists working in the park and augmentation to park staff with specialists working in fields such as minerals management, subsistence use, and wildlife research.

The Division of Research and Resource Preservation, created in 1992, is currently organized as five functional workgroups. Four of these are organized as branches, with each branch focused on disciplines that are closely related. Branches include Wildlife and Vegetation; Subsistence and

Cultural Resources; Information Resources; and Water, Air, Geology and Soils (Physical Sciences). A fifth workgroup, not formally organized as a branch, provides overall direction, supervision and administrative support to the division. Employees in this workgroup deal with interdisciplinary programs such as research administration, planning, long term monitoring oversight, and environmental and historic preservation reviews.

Positions in the division are classified in a variety of professional, technical, and administrative series. The following list summarizes the series for the 19 permanent and term positions found in the division:

Series	Number
General Biologist (GS-401)	6
Ecologist (GS-408)	2
Geologist (GS-1350)	1
Hydraulic Engineer (GS-810)	1
Wildlife Biologist (GS-486)	2
Historian (GS-170)	1
Biological Technician (GS-404)	2
Office Assistant (GS-303)	2
Physical Science Technician (GS-1311)	1
Museum Technician (GS-1016)	1

Most of the general biologists have specialized titles including GIS/Data Manager, Subsistence and Cultural Resource Manager, Staff Natural Resource Specialist, and Fire Management Officer. Biological technician positions also have specialized titles including Wildlife Technician and Air Quality Technician, depending upon the exact nature of responsibilities they are assigned.

These employees are supplemented by seasonal biological and physical science technicians, contractor technicians, volunteers, interns, and a natural resource apprentice (RAPS) position.

Despite the size of the resources management staff compared to most other parks in the system, objective analyses of staffing levels and types (R-MAP, CR-MAP) have identified important opportunities for growth, information dissemination, and improved resource preservation. Opportunities exist to implement the LTEM program, resource interpretation, and some aspects of resource protection with additional personnel. Technological and scientific advances are outstripping the resources of existing staff to stay abreast with those developments. In addition, the loss of park scientists to the National Biological Service (now Biological Resources Division, USGS) resulted in a loss of "in hand" scientific advice and guidance in day-to-day operations. This expertise should be restored in the form of a science advisor position.

The diversity and complexity of resource issues, specialization and sophistication of scientific disciplines, and public expectation of management decisions based on current, accurate, detailed information require a professional, well organized, highly motivated workforce with appropriate skills and tools.

Denali is fortunate to have a core of resource management professionals representing a broad range of disciplines.

Significant programmatic changes probably will unfold in the next few years. These include full implementation of the Long Term Ecological Monitoring Program, possible assumption of responsibilities for subsistence fisheries use, and complete emergence of resource issues such as snowmachine use, aircraft overflights, exotic plant encroachment, reclamation, and increasing visitor use. These developments point to the need for modest increases in professional and technical natural resource personnel.

Specifically, park preservation programs would benefit from establishment of a science advisor position. That person would provide scientific oversight to park programs, maintain close working relations with university and agency scientists, and would provide peer contacts. These are voids that have developed since the move of agency scientists to the Biological Resources Division, USGS. In addition, although the current staff includes a data/GIS manager and a museum technician (STF), additional staffing is needed to support information management needs in the division and for the park at large. GIS development is not occurring as quickly as management and planning needs demand, library and archival material is not being cataloged or properly cared for, data is poorly organized, often unprotected, and not readily accessible, and staff members consistently have questions about the statistical design of data gathering efforts. An additional data manager, a librarian, a biostatistician, and a cartographic technician are needed to fully implement all information management programs and to address the aforementioned problems. The existing museum technician should be converted to a fulltime curator to handle ongoing curatorial management needs. Specifics regarding these recommendations are found in individual project statements.

Funding

Since fiscal year 1992 there has been a gradual but substantial increase in the amount of funding committed to resource preservation at Denali. Comparing FY92 to FY96, nearly $711,000 more funding has been put into resource programs. This increase has been the result of several factors. First, the implementation of LTEM program development efforts resulted in significant increases. Second, the servicewide professionalization initiative and the conversion of a number of seasonal employees to permanent positions, with concurrent funding, improved both the personnel and financial picture. Third, emergence of pressing resource issues, primarily related to the park road and Alaska Range south slope development, focused the need for additional

financial resources to study resource conditions. Finally, a larger staff has permitted better approaches to obtaining funding from special fund sources. Broader diversity in the use of fund sources is apparent in 1996 over 1992.

Some financial setbacks were experienced in the same period. $275,000 was removed from park funds and sent to the BRD in FY94 for management of the LTEM program. While BRD continued to apply most of that funding to Denali, some was lost to BRD administrative overhead costs. Starting in FY95, funds from the Servicewide Monitoring Program were transferred to the park to partially make up for what was transferred to BRD. Similarly, BRD scientists who were working on caribou, bear, and revegetation projects at Denali have lost some of their funding to BRD overhead. FY93 was the last year of special funding for the wolf study. and no base increases were given to carry the monitoring element of the wolf program forward. This had to be absorbed in existing park funds. Fortunately, these losses have been offset by other increases, although some implications remain for those programs.

Table 7. FY92-FY96 RESOURCE MANAGEMENT FUNDING

	FY92	FY93	FY94	FY95	FY96
Park Sources	$812,528	$925,710	$750,398	$1,265,901	$1,329,050
Other NPS	845,900	634,642	520,925	566,910	460,794
Non-NPS Funds	20,500	20,000	554,750	808,063	599,816
Total	$1,678,928	$1,580,352	$1,826,073	$2,640,874	$2,389,660

Financial shortfalls exist primarily in the fields of research and mitigation, wherein many applied scientific questions remain unanswered and restoration/reclamation efforts are delayed.

Facilities and Significant Equipment

With the increases in staffing and general growth of the resource preservation program, support facilities have been severely strained. In the late 1980s and early 1990s, the resource personnel were located in a small park residence. During 1991, the division moved into a series of remodelled garage bays adjacent to the carpenter's shop in the park headquarters complex. As the staff size and operation grew, these offices became inadequate. The temporary solution to the problem has been the purchase of office trailers. One was located behind the Ranger Cache and two others were located in C Camp. Even with the use of those three trailers, offices are particularly cramped and no space is available for visiting investigators. Periodic examinations of administrative space have occurred, leading to identification of some short and long term solutions.

Curatorial storage space, located on the second story of one of the headquarters complex buildings, is particularly limited and does not meet collection preservation standards. Space is so limited that a small room in the Visitor Access Center is being used for that purpose. Other specialized space (laboratory, workshop, etc.) is either nonexistent or very small.

Limited storage space was made available to the division in the park's warehouse. Additional space was needed, so a storage shed was constructed in C Camp adjacent to the office trailers. Supplies and materials continue to overflow from this shed. In 1997, a Connex box was located in C Camp to deal with some of that overflow.

Housing for transient employees has also changed through the years. Originally transient housing consisted of two trailers in C Camp and the East Fork research cabin. As of 1997, several other facilities have been added to the pool. These generally meet the needs of the park, but most of the facilities are in poor condition or are very rustic.

Office and other types of workspace are severely lacking. Staff members share small offices or use temporary trailer facilities. Two of these trailers are located away from most of the division's offices. Neither of these trailers has access to the park's computer network. Priority has been given to office space in efforts to resolve work space shortages. Other types of workspace, including records storage, library storage, wet lab, GIS lab, general equipment and supplies storage, greenhouse, nursery, and seed storage area, and so forth, are very limited or completely non-existent. Curatorial storage and workspace is inadequate; and security for the museum collection, particularly fire protection, is insufficient. Housing and workspace for cooperating investigators is also limited and is often in substandard condition. These conditions result in inefficiencies, poor morale, and reduced productivity. Science programs are hampered from full development because the park can only offer very limited in-kind support to the scientific community. These problems need to be resolved through construction of new facilities and retrofitting of existing buildings.

Unlike office, work, and housing space, the division has done reasonably well at keeping current with technologies as they have evolved. Sufficient numbers and types of computers are available to division staff. A local area network and Internet/email access is available and the park now has an operational Geographic Information System. Software systems are in good condition and office equipment has been upgraded periodically. The single most significant deficiency in this area is the lack of local area network capability in C Camp, a deficiency that is planned to be corrected in FY98.

Training

Effective resource preservation is dependent upon the skills of the staff available to do the work. The training funds within the division have been diminishing in recent years and are insufficient

to provide adequate opportunities for training of personnel. Many aspects of natural resource management are highly technical and require a knowledge of statistics, data processing, sophisticated instrumentation, and legal constraints. Natural resource issues can be controversial and emotionally charged and therefore require political, social, and economic understanding. Training in these fields can be gained through formal courses, conference, seminar, and workshop participation, and through casual contact with peers. More emphasis needs to be placed on employee development to achieve satisfactory resource preservation.

Information Management

In 1994, Denali hired its first data manager and in 1995 its first computer specialist. Since their arrival, significant strides have been made in improving computer systems and data management practices at Denali. A local area network has been established, links to the Internet are in place, a geographic information system has been put in operation, and draft data management procedures have been prepared. The lack of this expertise on the staff for many years has, however, resulted in 1) a substantial backlog of information that has yet to be automated and 2) incomplete use of automation in park operations and information management. These deficiencies can be corrected in part by additional staffing, as well as through staff training on Internet and applications software use, completion of the data management protocols, collection of reference material and development of subject matter bibliographies, and acquisition of specialized software.

Communications and Partnerships

The Division of Research and Resource Preservation currently publishes a series of reports that are used to disseminate current resource information. These include Biweekly Reports, The "Tattler" (an irregular newsletter), the State of Park Resources Report (annual), the Superintendent's Annual Research Report (a collection of Investigator's Annual Reports), as well as miscellaneous reports that reflect survey results, study findings, or activities by staff during a field season. Staff members are also encouraged to give presentations at professional meetings and to write manuscripts for publication in technical and semi-technical outlets. These efforts need to be continued. Staff has also expressed interest in starting a monograph series that would provide in-depth information about park resources. Lack of staff time has prevented preparation of monographs. Preparation of this material is time consuming and frequently would benefit from the skills of a writer/editor/desktop publishing expert. These skills are not readily accessible among the existing resource management staff.

Participation of park interpretive staff members in the resolution of resource issues has been repeatedly acknowledged (Cunningham 1984, USNPS 1994, USNPS 1996, Whatley 1995). The interface between resource management and interpretation at Denali can be characterized as good. Technical review of interpretive media and sales items works well. Opportunities for

park resource staff and investigators to share resource information with interpretive staff and the public are provided, but they occur sporadically. Insufficient time is available to staff to prepare non-technical summaries of resource information and activities and for the full use of the Internet for dissemination of resource information. Particular concern exists regarding the quality and sufficiency of information being provided to concession employees who have extensive contact with the public. These deficiencies should be corrected with designation of liaisons between the Interpretive and Resource Preservation Divisions and by providing additional staffing devoted to these tasks.

Outreach efforts by Resource Preservation Division staff members include such things as preparation of articles for the park newsletter, the Denali Dispatch; cooperation with the park Information Officer; and contribution of information to the park's Web site. This involvement is consistently reactive rather than proactive. This situation should be corrected through additional staffing.

Although the division has developed a broad network of professional contacts including personnel at academic institutions and resource management agencies, additional effort needs to be exerted in this area. Improved communications will enhance program review and decision making.

Very limited attempts at partnering and grantsmanship have been made. Successes with the University of Alaska, the Denali Foundation, and the Alaska Department of Fish and Game are examples. One significant interagency/organizational partnership effort has been undertaken in the development of a framework for research for the south side of the Alaska Range. This was stimulated by the preparation of the South Side Development Concept Plan. Many more opportunities are believed to exist and should be sought out for partnership development and competition for grants. Additional staff time is needed to achieve greater success.

The following table lists all significant project statements and associated actions that park staff members are currently taking to implement the interdisciplinary resource management program. Similar tables for natural, cultural, and subsistence resource management can be located in Project Statements N-500, C-100, and S-100 respectively.

Table 8. CURRENT RESOURCE MANAGEMENT ACTIONS - FULLY OR PARTIALLY FUNDED

RMP Project Statements	Action Items
I-210 Long Term Ecological Monitoring	.001 Conceptual Framework .002 Cooperative Programs .003 Implementation Strategies .006 Report Preparation .007 Collections Management .011 Develop Monitoring Protocols .012 Integrate Data .013 Develop New Protocols .015 Ecosystem Model .031 Monitor Ecosystem .032 Monitoring Networks .033 Baseline Inventories
I-220 Resource Inventory	.002 Data Standards .004 GIS Plan .012 Complete Inventories .013 Digitization .023 Operate GIS/AutoCAD .031 Document Monitoring
I-300 Curatorial Management	.003 Cataloging .005-.007 Collection Planning
I-410 Research Administration	.004 Administrative Guide .008 Library .041 Tattler Publication
I-500 Land Resources	.001 Update LPP
I-610 Frontcountry Management	.001 Resource Protection in Planning .002 Implementation Compliance .003 Develop VERP .004 GIS Applications .012 Develop Trails Monitoring .013 South Side Studies .021 Plan Implementation Mitigation .022 Resource Protection Measures .031 Monitor Road Wildlife .033 Monitor Resource Impacts
I-620 Wilderness/Backcountry	.001 Wilderness Plan .002 Spec Regs - Snowmachines

I-670 Road Use Impacts	.012 Dust/Dust Palliatives Study .013 Wildlife Behavior .023 Road Maintenance .031 Wildlife Monitoring .033 Palliative Monitoring
I-700 Hazmat/Waste Management	.001 Complete Spill Plans .002 Complete Hazmat SOPs .003 Hazmat Inventory .010 Tailings Characterization .021 Soil Remediation .024 Response Capabilities .025 UST Compliance .026 Solid Waste Program .030 Hazmat Recertifications

RECOMMENDED ACTIONS

The actions listed below either apply universally to natural, cultural, and subsistence resource programs or deal with issues contained in the interdisciplinary project statements. In addition program management actions can be found in Project Statements N-500, C-100, and S-100. In numerous cases, specific programmatic needs have been outlined in other project statements. All of these project statements should be consulted to obtain a complete understanding of program management needs.

A. Program Administration and Planning

I-100.001: Conduct Strategic Planning

Park staff would prepare a divisional strategic plan to describe the optimal staffing and logistical support levels necessary to implement an effective resource program. In addition, park staff would prepare strategic plans for monitoring (I-210.001 and I-210.003), baseline inventories (I-220.001), and research (I-410.001).

N-100.002: Provide Consideration for Natural and Cultural Resources in all Land Use Planning

Ensure adequate consideration of natural and cultural resources in all land-use planning and decision-making processes by mitigating impacts to the maximum extent mandated by law or appropriate under existing policy.

I-100.002: Increase Involvement of Public Information Officer

Opportunities will be sought to encourage the involvement of the park's public information officer in resource management and research activities.

I-100.003: Improve Education of Park Interpretive Staff

Opportunities will be sought to improve the understanding of interpretive personnel about the mechanisms for obtaining resource information, its analysis, and application. Actions could include shadow assignments, details, participation in seminars and formal training, and so forth.

I-100.004: Improve Employee Partnering Skills

Provide training opportunities to increase employee skills in grant opportunity identification, grant writing, developing partnerships, and working effectively with partners.

I-100.005: Obtain Training for Park Staff in Various Fields and Support to Participate in Professional Conferences

Funds to cover travel costs and per diem for attendance at professional society meetings, science conferences, and servicewide, regional or other special training sessions that would upgrade the GIS/AutoCAD knowledge and skills of Denali's personnel would be added to the park base.

Wilderness is one of Denali's most important resources and should be considered in all management decisions. The most current principles and practices should be used in wilderness management at Denali. Regular training at all management levels is needed to keep staff up to date on current information.

Collection management is a specialized field that requires a wide variety of skills. Program and provide funding of specialized collection management training for curatorial staff. Recommended training includes the Native American Graves, Protection, and Repatriation Act (NAGPRA) training, archival management training, and object conservation training.

The service would periodically sponsor or participate in international conferences attended by biosphere reserve managers and/or scientists to share state-of-the-art information needed to protect and preserve biosphere reserves worldwide. Increased funding would be made available to park staff for travel to biosphere reserve meetings

and conferences worldwide.

I-100.006: Develop Reference Materials for Under Represented Fields

Incomplete and irregular format bibliographies would be updated and standardized to current resource database requirements. Literature concerning topics such as gravel extraction and pit reclamation, trail construction, restoration, snow machine use studies, ski trail area management plans, winter use impact studies, winter recreation economic reports, river corridor recreation studies, river basin recreation management plans, river use impact studies, recreation economic reports, and others will be collected and made available to resource managers.

B. Research

I-100.011: Develop Social Science Research Themes and Conduct Studies

Park staff will develop social science questions, primarily aimed at issues like understanding visitor needs, visitor demographic and behavioral characteristics, visitor satisfaction and perceptions, visitor expenditures, economic impacts from park visitation, cost benefit analyses, statewide recreational patterns, and so forth. Specific research proposals will be prepared, incorporated into the Strategic Research Plan, funded and completed.

I-100.012: Public Use Reporting

Division staff will participate in decisions regarding mechanisms for public use statistics gathering and reporting to assure compatibility with the park's social science program.

C. Interpretation

I-100.041: Assign Collateral Liaison Positions

The Divisions of Interpretation and Research and Resource Preservation will formally designate liaisons who will facilitate exchange of information between the divisions.

I-100.042: Enhance Use of the Park's Web Site

Division staff will work with park interpretive staff to identify ways of better utilizing the park's web site to distribute resource information to the public.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Div. Strategic Plan	4.0/0.1	4.0/0.1			8.0/0.2
- Interpreter Training	5.0/0.1	5.0/0.1	5.0/0.1	5.0/0.1	20.0/0.4
- Partnering Training	2.5/0.0	2.5/0.0	2.5/0.0	2.5/0.0	10.0/0.0
- General Training					
- Reference Materials	9.0/0.0	9.0/0.0	3.0/0.0	3.0/0.0	24.0/0.0
RESEARCH					
- Social Science Program			30.0/0.0	30.0/0.0	60.0/0.0
INTERPRETATION					
- Web Site Enhancement		2.0/0.0	2.0/0.0	2.0/0.0	6.0/0.0
TOTALS	11.5/0.2	13.5/0.2	39.5/0.1	39.5/0.1	128.0/0.6

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Cunningham, R. L. 1984. Interpretation of Natural Resources Management, Cultural Resources Management, and Visitor Safety in the National Park System. Western Region, National Park Service, San Francisco, CA.

Gordon, J. C. 1989. National Parks: From Vignettes to a Global View - A report from the Commission on Research and Resource Management Policy in the National Park System. Yale University, New Haven, CT.

Lichtkoppler, R. 1995. 1995 Denali visitor survey. Preliminary Report. U.S. Department of the Interior, NPS, Denver Service Center. Denver, Colorado.

Machlis, G. E. and P. Sullivan. No date. A Social Science Research Plan for Delaware Water Gap National Recreation Area. Delaware Water Gap National Recreation Area, National Park Service, Bushkill, PA.

Machlis, G.E. and D.E. Dolsen. 1989. Visitor services project, Denali National Park and Preserve. VSP Report 18, Two Volumes. U.S. Department of the Interior, NPS.

USNPS. 1994. Natural Resource Issues Interpretation in the National Park Service. U.S. Department of the Interior, Washington, DC.

USNPS. 1996. Action Plan - Natural Resource Issues Interpretation in the National Park Service. U.S. Department of the Interior, Denver, CO.

USNPS. No date. Planning for the Future: Strategic Plan for Improving the Natural Resource Program of the National Park Service. U.S. Department of the Interior, Washington, DC.

Whatley, M. E. 1995. Interpreting Critical Natural Resource Issues in Canadian and United States National Park Service Areas. Natural Resources Report NPS/NRCACO/NRR-95/17. U.S. Department of the Interior, Washington, DC.

LONG-TERM ECOLOGICAL MONITORING

PROJECT CODE: DENA-I-210

SERVICEWIDE ISSUES: N17 Biodiversity
N20 Baseline Data

STATEMENT OF PROBLEM

Park management decisions involve a wide variety of issues affecting resources held in trust for the public. The National Park Service has repeatedly identified the need for comprehensive information to help make management decisions. These data sets need to be consistently developed over a long timespan to document the status and trends of park resources and human uses.

Present Condition

Denali National Park and Preserve provides an excellent opportunity to improve our understanding of ecosystem dynamics and the effects of human activities on them. This large, intact and naturally functioning ecosystem surrounds complex and diverse geological features, including Mt. McKinley and extensive glaciers representing two climate regimes. The current wilderness boundary encompasses more than 2 million acres, the largest continuously protected subarctic area in the world. The global significance of the park was recognized with its designation as a biosphere reserve in 1976. The park is also Alaska's only significant Class I air quality area.

Denali is one of three national parks in the subarctic that contain a core area not subject to consumptive use. Additional park and preserve lands created by ANILCA resulted in a gradient of management designations allowing various consumptive human use activities around this core protected zone. This mosaic of pristine and more heavily used lands presents important comparative research opportunities. As a result, monitoring techniques developed at Denali will be applicable to the major land use designations that occur throughout the Alaska Region. At the same time, Denali can provide fertile ground for testing monitoring techniques developed elsewhere in the subarctic and for sharing results with a range of other management agencies.

Alaska's interior is particularly ripe for escalating resource conflicts. The relative accessibility of this region heightens interest in developing or increasing resource-based industries such as

timber production and mineral extraction. The tourism industry is also growing rapidly. Increases in economic activities bring additional settlement, transportation and utility corridors, industrial development, and recreational demands. Despite this, interior Alaska still contains large tracts of pristine land. An increased understanding of subarctic ecosystems would give managers ready access to scientific information and help guide development-related decisions. A monitoring program developed at Denali would have wide application to other lands in Alaska since the same basic array of issues is likely to affect those areas in the future.

Current Management Actions and Results

Substantial research has been conducted in Denali since the park's establishment. U.S. Geological Survey (USGS) and USGS Biological Resources Division (BRD) efforts include bedrock and surficial deposits studies, glaciological studies, long-term large mammal community dynamics research, and development of techniques to restore placer-mined watersheds. Dozens of independent research activities occur each year. This wide array of research efforts provides a firm foundation on which to build a productive complex of monitoring activities.

In 1991, the NPS established a prototype program to test methods of monitoring long-term ecosystem status and trends. Program development began at Denali National Park in 1992. This prototype program is in keeping with the servicewide intent of moving toward a Level II understanding of park resources.

The overall purpose of Denali's Long-Term Ecological Monitoring (LTEM) Program is to develop broadly based, scientifically sound information on the current status and long-term trends in the structure and function of the park's ecosystem. This information will be used to improve management decision making on park resource preservation concerns that are primarily local and regional; provide a source of information for others working on ecosystem-related studies in the subarctic; and enhance national and international monitoring networks by representing a naturally functioning and intact subarctic site.

Thus far the program has been based on the premise that a set of protocols to monitor basic resource attributes in one watershed can be replicated in other watersheds to represent the park overall. Fieldwork has largely focused on intensive watershed studies on Rock Creek, a small second order stream in the eastern end of the park. Protocols are completed for the following parameters: air quality, meteorology, stream hydrology, surface water chemistry, vegetation, aquatic macroinvertebrates, passerine birds, and small mammals. A soils monitoring protocol will be completed in 1998.

Some attributes do not lend themselves well to a sampling design based on a small watershed (less than 1,000 hectares). Certain program elements (i.e., meteorology, glaciers and passerine birds) have been expanded to areas beyond Rock Creek. Stream hydrology, surface water chemistry, and aquatic macroinvertebrate sampling have occurred extensively throughout the

park to gain information that will be used to stratify aquatic systems into representative categories.

Park staff and cooperating investigators are developing a variety of monitoring programs that also transcend watershed boundaries. These projects measure the status and trends of significant park resources and should eventually be linked to the LTEM program. These include raptors, large mammals, wildland fires, and various vegetation variables.

Funding for the LTEM program was initially added to Denali's base budget. NPS staff initiated protocol development or contracted services from independent researchers. With creation of the National Biological Service (now USGS-BRD), program funding was transferred to NBS along with responsibility to develop monitoring protocols for biotic attributes. Some funding has been transferred back to the NPS each year to assist with logistical support, technicians' salaries and development of physical resources protocols. These funding arrangements preclude efficient program implementation. Lack of NPS base funding has prevented resolution of staffing issues such as conversion of important temporary positions to long-term appointments before key personnel are lost.

Transfer of NPS scientists to USGS-BRD has also hampered effective data synthesis and interpretation. Trends in resource conditions, which should trigger management action, must be identified by a group of qualified scientists. Without this capability, the immediate usefulness of information gained through the LTEM program is limited.

Although Geographic Information System capabilities were established in 1995, some data backlog problems exist. Historic data from other significant research efforts await integration into the program database (Project Statement I-220).

The Denali LTEM program underwent an extensive review in 1995. As a result, a full-time LTEM coordinator was appointed and two workshops were held in 1996 to strengthen the conceptual framework of the program. Immediate needs include staffing additional permanent positions, implementing completed protocols, forging strong links with scientists at USGS and elsewhere to interpret existing data, charting future program directions and strategies, expanding monitoring activities to additional watersheds, and initiating research to develop new protocols.

RECOMMENDED ACTIONS

A. Program Administration and Planning

I-210.001: Strengthen Conceptual Framework of LTEM Program

The program design through 1996 focused on intensive monitoring within a limited spatial area to detect trends and better understand ecosystem processes. Program elements also included participation in national and international monitoring networks, such as the National Atmospheric Deposition Program and the Monitoring Avian Productivity and Survivorship (MAPS) Program. Further conceptual development will emphasize a more holistic model to 1) address ecosystem processes on a more extensive, landscape scale and 2) include attributes helpful in detecting human-caused changes that could be addressed through management action.

The LTEM coordinator will develop a plan clearly documenting the objectives of the program, the decision-making process employed to select what to monitor, specific objectives for monitoring each attribute, and proposed timelines for developing and implementing monitoring protocols.

I-210.002: Develop Cooperative Monitoring Programs

The service would cooperate with the University of Alaska, state and federal agencies, and other institutions in the development of inventory and monitoring programs for the Denali region. Standardized formats and techniques among these groups would expedite the sharing of information vital to sound planning and management throughout the region.

I-210.003: Develop Implementation Strategies

Strategies for implementing completed protocols will be developed concurrent with further development of the conceptual design of the LTEM program. NPS staff will develop lists of potential monitoring attributes based on well-articulated priorities. Work teams of subject matter experts will evaluate the current monitoring strategy against program goals and the prioritized attribute list. Implementation strategies will need to address such issues as: which existing protocols adequately meet monitoring objectives and which require further development; what specific variables should be measured for each attribute; what are the most appropriate scales and locations for monitoring each attribute; and how to scale up from a local sampling level to a landscape level within funding and logistical constraints without sacrificing statistical robustness.

The LTEM coordinator will work closely with park and USGS-BRD staff to develop an implementation plan that clearly outlines appropriate strategies for the next five years.

I-210.004: Develop, Equip, and Manage Denali Field Research Facilities

Critical to the success of a long-term ecological monitoring program at Denali would be the planning, developing, equipping, and managing of a field research station at several

road accessible sites in the park (Research Administration, DENA-I-410). The capacity of existing permanent and seasonal housing and local resorts to accommodate the diverse needs of scores of field investigators is currently fully utilized during the peak summer season.

I-210.005: Construct Offices for Monitoring Staff

Due to the severe shortage of office space in the park headquarters area, the service would construct offices to accommodate all computer hardware, office furniture, and equipment needed by a permanent and seasonal monitoring staff.

I-210.006: Provide Regular Technical and Popular Reports

Parks developing prototype programs have an important responsibility to share information about the successes and pitfalls of program development with other resource management professionals. Peer-reviewed monitoring protocols and publications are important tangible products of the LTEM program. Reports will be prepared that target different audiences including park managers, congressional staff, the research community, and the public.

The LTEM coordinator will work with principal investigators, park staff, and USGS-BRD to produce:

- an annual administrative report focusing on programmatic information,
- technical reports that include data summaries and interpretation,
- protocol manuals, and
- fact sheets to provide concise program updates.

Investigators and park personnel responsible for carrying out monitoring activities will be encouraged to publish their findings in peer-reviewed technical journals.

B. Research

I-210.011: Complete Field Studies and Publish Monitoring Protocols

Fieldwork has been completed for four biological and six physical resource attributes. Draft protocols will be peer reviewed and published. The need for additional studies to refine existing protocols will be evaluated against the need to establish a basic level of information for other significant attributes where no work has been conducted to date.

NPS staff will require an additional year of fieldwork to complete a glacier monitoring

protocol (Project Statement N-314). BRD will also require another year to complete fieldwork and produce a protocol for monitoring soils.

I-210.012: Integrate Existing Data from Rock Creek Studies

Early program development has emphasized good data management; however, considerable data still reside with various investigators. A data management protocol, already in draft form, will undergo peer review and be published. Park staff and/or contracted personnel will undertake an intensive effort to correct data management deficiencies, centralize data, and establish reliable, consistent data handling procedures.

Actions will continue to be taken to secure all current data and study sites. This includes re-marking field sites, using Global Positioning System technology to provide accurate and precise site locations for GIS mapping, preparing narrative site descriptions, archiving data and reports, and establishing procedures for long-term protection of data.

Analysis and interpretation of raw field data for attributes currently being monitored has varied considerably depending on the time, commitment and objectives of personnel responsible for protocol development. At best, principal investigators have provided annual summary reports specific to their topic of study. The strategy of co-locating multidisciplinary study sites within a single watershed loses much of its value without constant collaboration between scientists, as well as easy availability of refined data.

Resource management and research professionals will use a team approach to integrate monitoring data derived from Rock Creek and other studies. NPS staff will generate quality-assured data using approved subject area and data management protocols. Qualified personnel, if not available in-house, will be contracted to provide interpretations of data in an interdisciplinary context. Desirable products include determinations of the range of natural variation, identification of important ecological relationships, recognition of cause and effect relationships, and predictions of undesirable changes. Information will be integrated in a format suitable for a variety of uses, including park management and information exchange with the research community and public. A symposium will be held at least every five years to communicate results.

I-210.013: Initiate Protocol Development for High-Priority Attributes

Identifying key resource attributes that are currently absent from the LTEM program is a critical step in strengthening its conceptual framework. Additional protocols will be developed to address high priority attributes. Program areas that are not receiving any attention would be emphasized before embarking on more intensive research on existing program components. Potential subjects include terrestrial invertebrates, amphibians (wood frogs), small herbivores (hares, ground squirrels, red squirrels, ptarmigan, and

marmots), small carnivores, and lacustrine environments. See Project Statements DENA-N-210, DENA-N-240, DENA-N-361, and DENA-N-363.

I-210.014: Identify Threshold Limits that Indicate Unacceptable Changes

The overall value of the LTEM program for managing the park lies in our ability to recognize human-caused resource trends that exceed the expected range of natural variation. For each attribute, scientists and NPS managers will collaborate to determine what level of change is acceptable to accomplish park mandates and what actions will be taken when that level of change is exceeded. Extensive literature reviews, consultations with subject matter experts, interpretation of existing data and collection of additional information will be required to determine quantifiable threshold limits for most attributes. This will be a continuing process as knowledge of ecosystem processes increases through time. Threshold limits, their basis for establishment, and potential management or research actions will be incorporated into appropriate planning and park management documents.

I-210.015: Develop Ecosystem Model

An aquatic and terrestrial ecosystem model would be prepared for the park to provide context and justification for park monitoring programs.

I-210.016: Support Independently Funded Inventory and Monitoring Research Projects

The service would support independently funded inventory and monitoring research projects in Denali National Park and Preserve by private and public organizations, agencies and universities. The park would provide temporary housing and logistical support for field and laboratory work (Research Administration, DENA-I-410).

C. Monitoring

I-210.031: Monitor Baseline Ecosystem Processes

The LTEM program will continue to be integrated into daily park operations. Denali staff will be responsible for carrying out approved sampling and data management protocols for current components of the program including surface water chemistry, stream hydrology, aquatic macroinvertebrates, small mammals, vegetation, soils, and meteorology. Staff currently available to conduct this work include a program coordinator, a wildlife biologist, a geologist, a hydrologist, a fire management specialist, and data manager, and seasonal technicians. Additional necessary positions (plant ecologist, ornithologist, physical scientist (meteorology), geologist, and seasonal

technicians) have been identified throughout this document.

Impacts to Rock Creek watershed will be evaluated so that an appropriate level of monitoring activity can be sustained there long-term without adversely affecting the resources being studied. Incremental changes in scale, monitoring intensity or spatial scope would occur in response to further conceptual development of the program or at the direction of scientific advisors and program managers. Opportunities will be sought to collect data in common with or form linkages with other park monitoring programs, such as large mammals (caribou, wolves, moose, Dall sheep and bears) and raptors (golden eagles, gyrfalcons, and merlins).

I-210.032: Participate in National and International Monitoring Networks

As a biosphere reserve, the park plays an important role in understanding and protecting ecosystem processes on a scale transcending local or regional boundaries. Several national and international monitoring networks include Denali to represent various components of the subarctic ecosystem. Park staff will continue to carry out established monitoring activities that contribute information to the following efforts: Biosphere Reserve Inventory and Monitoring Network, Global Terrestrial Observing System, MAPS Program, Breeding Bird Surveys, North American Bird Migration Counts, National Atmospheric Deposition Program, NPS Gaseous Pollutant Monitoring Network, Interagency Monitoring for Protected Visual Environments, National Weather Service Cooperative System, World Glacier Monitoring Service, and Snow Surveys.

Denali was recently chosen as a Demonstration Index Project site by the Environmental Protection Agency in an initiative to assess national ecosystem "health." Under this program, the park's air quality monitoring program was expanded in 1997 to include ultraviolet-B. Other program components will be determined by a national steering committee based on recommendations from NPS staff. Funding for additional infrastructure, logistics and staff will allow the park to participate in this effort. The LTEM coordinator will seek additional partnerships and opportunities to leverage funds in order to increase Denali's participation in large scale monitoring efforts.

I-210.033: Complete Resource Inventories Required to Expand Program Scope

Spatial expansion of the LTEM program relies on knowledge of the distribution of park resources in relation to the topographic, atmospheric, and geochemical properties that influence them. Decisions about where to locate new monitoring sites depend on the completion of several key resource inventories. Accurate and timely inventories also provide basic information for other research and mitigation activities.

Servicewide efforts to construct baseline maps will continue to be the source for most of

the information needed to stratify the park into representative categories. High priority data layers will be incorporated into GIS through the national program augmented by local GIS staff, where possible. Immediate data needs include soils, vegetative cover, surficial geology, bedrock geology, and hydrography (Inventory-Mapping, I-220).

Analysis of existing monitoring data will also help determine strategies for expanding the LTEM program. Maps will be developed that reflect large scale climate differences, prevailing weather patterns, and precipitation and temperature gradients. Current data layers include elevation, slope and aspect of ground surfaces. Interpretation of water chemistry data, combined with hydrological information and aquatic macroinvertebrate distribution, will be used to define watershed categories.

All inventory efforts will be coordinated as much as possible to enable cost sharing with other agencies and provide the most effective logistical and data management support.

D. Interpretation

I-210.041: Provide Information for Interpretive Activities and Popular Literature

The LTEM coordinator will work closely with interpretive staff to provide information for park literature and interpretive programs. Whenever possible, resource management staff carrying out monitoring activities will be partnered with interpretive staff on specific projects to develop information for interpretive programs and activities. A biennial popular report written in an informative style will also be published for interested members of the public and park staff.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION AND PLANNING					
- Strengthen Conceptual Framework of LTEM Program	7.5/0.0	5.0/0.0	0.0/0.0	0.0/0.0	12.5/0.0
- Develop Cooperative Monitoring Programs	2.5/0.0	2.5/0.0	2.5/0.0	2.5/0.0	10.0/0.0

- Develop Implementation Strategies	5.0/0.0	5.0/0.0	5.0/0.0	5.0/0.0	20.0/0.0
- Equip, Staff and Manage Field Research Facilities	See I-300	See I-300	See I-300	See I-300	See I-300
- Construct Offices/Quarters	See I-300	See I-300	See I-300	See I-300	See I-300
- Provide Regular Reports	1.0/0.0	1.0/0.0	1.0/0.0	1.0/0.0	4.0/0.0
RESEARCH					
- Complete/Publish Monitoring Protocols	75.0/2.0	35.0/0.5	0.0/0.0	0.0/0.0	110.0/2.5
- Integrate Existing Data	60.0/1.0	30.0/0.5	40.0/0.8	50.0/1.0	180.0/3.3
- Initiate Protocol Development	100.0/2.0	80.0/2.0	80.0/2.0	80.0/2.0	340.0/8.0
- Identify Threshold Limits	30.0/0.5	0.0/0.0	30.0/0.5	0.0/0.0	60.0/1.0
- Ecosystem Model	50.0/0.0	50.0/0.0	0.0/0.0	0.0/0.0	100.0/0.0
- Support Independent I & M Research Programs	See I-410	See I-410	See I-410	See I-410	See I-410
MONITORING					
- Monitor Baseline Ecosystem Processes	175.0/3.0	175.0/3.0	175.0/3.0	175.0/3.0	700.0/12.0
- Participate in National & International Networks	175.0/3.0	175.0/3.0	175.0/3.0	175.0/3.0	700.0/12.0
- Complete Resource Inventories	300.0/5.0	300.0/5.0	200.0/4.0	200.0/4.0	1000.0/18.0
INTERPRETATION					
- Provide Information for Interpretive Programs	2.0/0.1	2.0/0.1	2.0/0.1	2.0/0.1	8.0/0.4
TOTALS	983.0/16.6	860.5/14.1	710.5/13.4	690.5/13.1	3244.5/57.2

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Evison, B. 1987. Natural resources inventory and monitoring initiative. USNPS, Alaska Regional Office, Anchorage, AK. 13 pp.

National Biological Service. 1995. Inventory and monitoring program: prototype monitoring, Denali National Park and Preserve. USDI National Biological Service, Anchorage, AK. 75 pp.

National Biological Survey and National Park Service. 1994. Inventory and monitoring program. Alaska Science Center, Anchorage, AK. 51 pp.

Peale, M. et al. 1993. Strategies for sustained monitoring in arctic and subarctic National Park Service units and reserved areas. Workshop proceedings. Natural Resources Report NPS/AR/NRR-93/20.

Peterson, D., D. Silsbee, and D. Schmoldt. 1995. A planning approach for developing inventory and monitoring programs in national parks. USDI National Park Service, Natural Resources Report NPS/NRUW/NRR-95/16, Denver, CO. 49 pp.

Silsbee, D.G. and D.L. Peterson. 1991. Designing and implementing comprehensive long-term inventory and monitoring programs for National Park System lands. USDI National Park Service, Natural Resources Report NPS/NRUW/NRR-91/04, Denver, CO. 13 pp.

Taylor, D. L. and R. Meehan. 1990. Inventory and monitoring plan for terrestrial ecosystems. U.S. National Park Service, Alaska Regional Office, Natural Resource Division, Anchorage, AK. 47 pp.

USNPS. 1992. Inventory and monitoring program. USDI National Park Service, Alaska Regional Office, Anchorage, AK. 47 pp.

USNPS. 1995a. Long term ecological monitoring program strategy, Denali National Park and Preserve. Unpublished, Denali NP&P, AK.

USNPS. 1995b. Long term ecological monitoring summary, Denali National Park and Preserve. Unpublished, Denali NP&P, AK.

USNPS. 1996. Conceptual design of Denali long term ecological monitoring program. Unpublished draft, Denali NP&P, Alaska.

Van Horn, J., J. Benedict, D. Taylor, R. Densmore, K. Karle, P. Brease, and J. Keay. 1991. Long-term ecological monitoring in Denali National Park and Preserve, Denali Park, Alaska: A research proposal. USNPS, Denali NP&P, AK. 36 pp.

RESOURCE INVENTORY AND MAPPING

PROJECT CODE: DENA-I-220

SERVICEWIDE ISSUES:
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
- C26 Other Issues: Lack of Basic Data - Insufficient Understanding of Park Cultural Resources and Threats to Them

STATEMENT OF PROBLEM

Present Condition

Denali National Park and Preserve is without a comprehensive, systematic program for acquiring, storing, and analyzing resource information. The lack of such a system precludes timely retrieval and analysis of resource information essential to sound planning and management of the park. The integrity of management decisions is a direct reflection of the scope, accuracy, and currency of the information available for analysis. It is, therefore, important for baseline information to be complete, readily accessible, and in a form that can be easily manipulated and analyzed for specific resource management issues. In the absence of adequate information for planning and management decisions, NPS Management Policies (USNPS 1988) state that its acquisition is a prerequisite to action.

A significant amount of high-quality baseline resource information exists for Denali National Park and Preserve, but much of that information focuses on relatively few species and is limited geographically to the original Mt. McKinley National Park. Resources in major portions of the park remain undocumented, as do certain types of resources throughout the entire park. Inventory voids exist for invertebrates, fungi, soils, ground and surface waters, and geology. Additions to federal land holdings, made in 1980, are woefully under-documented. Furthermore, what information is available is disorganized, prepared in different forms, mapped at different scales, and stored at different physical locations. Limited automated systems for information storage and retrieval exist, and progress has been made to enhance those systems; but manual methods are frequently used, resulting in handling that can be extremely cumbersome and time consuming. The quantity of information contained on maps often exceeds the ability to effectively manage and analyze it.

Current Management Actions and Results

Data Management Practices - In recent years, the information explosion has hit Denali. Each year, more and more resource information is being gathered. Current systems for archiving, retrieving, and analyzing that information are nonexistent at worst and haphazard at best. Some recent efforts have been made to correct this situation. Within the Research and Resource Preservation Division, a position has been dedicated to data management issues, and management of the museum and archives has been transferred to this division. Park staff has acquired fireproof file cabinets to safeguard paper and magnetic records, a uniform filing system is being developed within the division, data security procedures are being enforced on major projects, and a draft Data Management Protocol has been prepared.

Further improvements need to be made by providing adequate space for long-term storage of files, maps, photographs, and drawings. Magnetic data management procedures need to be finalized and a relational database system needs to be put in place.

Natural Resource Baseline Inventories - To date, the service has supported very few projects at Denali specifically aimed at documenting the presence of species or general resource conditions. Most investigations and documentation have focused on specific issues like predation, wildlife population declines, and human disturbance of wildlife, or have been severely limited in geographic scope. Certainly partial inventories can be and have been byproducts of these studies. Where baseline information can be gleaned from existing sources, staff time needs to be made available to accomplish that task and data need to be synthesized in an organized manner.

Some baseline information can certainly be derived from studies with objectives that do not include inventories, but some cannot be. In those cases, funds need to be sought to allow contracting for inventories. The park staff has supported inventory efforts on fungi of the park and anticipates significant inventory efforts stemming from the Servicewide Inventory Program.

Beyond what is proposed in the Servicewide Inventory Program, it is unclear exactly how park staff will conduct baseline inventory projects. Strategic planning needs to be done. Given the vastness of the park/preserve, it is also imperative that biorapid resource assessment techniques be established for the park.

Cultural Resource Baseline Inventories - Several archeological investigations have been completed that document the status of those resources (Griffin 1990).

"Archeological research in DENA has consisted of limited reconnaissance survey and compliance actions in selected development areas . . . A stratified archeological survey, a survey which samples a number of carefully selected geographic features or subunits, could lead to a more

accurate representation of DENA's prehistoric and historic cultural patterns." (Griffin 1990)

Historic structures have been documented on national register forms, in the Denali Cabin Inventory, and in the List of Classified Structures for the park. Both historic and prehistoric sites have been documented by the Cultural Resource Mining Inventory and Monitoring Program. While most of this documentation is thorough, regular updates need to be prepared that reflect new discoveries and new condition assessments.

Long-Term Ecological Monitoring - In October 1991, Denali and three other national parks (Channel Islands, Great Smoky Mountains and Shenandoah) were selected as prototype long-term ecological monitoring (LTEM) parks under an agency special initiative for monitoring (Long Term Ecological Monitoring I-210). The proposal for Denali's LTEM program included a discussion about the application of geographic information systems (GIS) technology. When reviewing Denali's proposal, the selecting committee members strongly questioned Denali's use of an offsite GIS (located in the Alaska Regional Office in Anchorage) without any in-park GIS capability. The lack of an in-park GIS almost eliminated Denali as a prototype long-term monitoring park; only assurances from the Alaska Regional Office committee member that this critical weakness would be quickly rectified saved Denali's proposal. Field operations of the LTEM initiative began in 1992. Those activities have generated enormous quantities of data, all of which needs organization and archival protection. Additionally, park staff and investigators associated with the program are now seeking means of displaying geographic information related to this project.

GIS/AutoCAD - GIS technology has been applied at Denali for more than 10 years. Dean and Heebner (1982) used remote sensing technology to map vegetation types in the Denali National Park region. Heebner's (1982) master's thesis was part of a study to develop baseline descriptive information on plant communities in the park, to provide reference data for interpreting Landsat spectral class information, and to assist in calibrating the resultant maps. Sample plots were chosen to represent a broad continuum of conditions from the complex terrain and vegetative cover types present on the study area. Both the north and south sides of the Alaska Range were represented, and cover types ranged from alpine scree to taiga. The study area included descriptions of 59 community types, ranging from black spruce bogs to open mat and cushion tundra.

From the early 1980s until its transfer to the National Biological Service in 1994, the NPS Geographic Information System Division (GISD), located in Denver, was charged with providing GIS support to parks, regional offices, and service centers (Denver Service Center and Harpers Ferry Center). GISD was responsible for policy formulation, program development and implementation, data base development and application, training, and technical expertise in GIS and remote sensing technologies. By the end of the decade, regional office GIS branches were established to provide technical support, assistance, database construction, and training for park and regional office employees while GISD focused attention on policy, program development,

and technological innovation. Both of these offices have provided various levels of support to Denali through the years.

The GIS Branch, Alaska Support Office, has been involved in GIS development since 1983. An Alaska Region GIS Plan (USNPS 1991) was developed, which describes the course of action regional staff intended to pursue with the GIS program and its growth in Alaska parks. The primary regional goal for the GIS program is to assist in making this tool available to all park managers and regional office division personnel who wish to employ the technology.

A major project that the regional GIS branch has supported has been the development of a landcover map from satellite imagery for the park. FIREPRO crews have been an integral part of this task by collecting field data on intensive mapping units (IMUs) and performing accuracy assessments on preliminary land cover maps. Although Denali's land cover map was tentatively scheduled for completion in 1993 or 1994, this has not occurred because poor quality thematic mapper (TM) scenes have prevented analysis. The support office also provides significant assistance to the park in the form of data acquisition and technical support and is greatly increasing the availability of GIS technology at the personal computer (PC) level through the development of customized ArcView browsers.

Resource data, largely in AutoCAD format, was assembled and used in preparation of the Cumulative Impacts of Mining Environmental Impact Statement for Denali (USNPS 1990). Approximately 20 different themes were developed to determine existing and potential impacts related to mining in the Kantishna Hills. Periodic updates to this information have been made as regional office staff has had time and as specific projects have forced the need. Once minerals management staff was transferred to Denali (1986), it became apparent that AutoCAD technology needed to be available locally. Presently, three computer workstations are running AutoCAD. While this information is critical to managing the park's minerals program, it is limited in geographic scope.

More recent data development efforts have occurred in conjunction with the preparation of the Front Country and South Slope Development Concept Plans (landcover and land use), the National Biological Service Grizzly Bear Study (bear observations), the Servicewide Baseline Water Quality Inventory and Analysis Project (hydrography, stream gauge locations, discharge locations, etc.), and the Servicewide Inventory Program (base cartography).

The number of available GIS themes for Denali has greatly increased in the last two years, but a strategy for spatial data acquisition needs to be prepared. It seems logical that this would be included in the park's GIS Plan.

A preliminary draft GIS Plan for Denali was prepared in 1988 (USNPS 1988). This plan needs to be completed.

In late 1994, a position was added to the Research and Resource Preservation staff to function as data manager and GIS specialist. GIS hardware was acquired and space devoted to a GIS lab. Arc/Info was installed on a Unix-based workstation and a number of copies of PC-based ArcView were acquired and installed. With this development, the park now has an on-site GIS and AutoCAD system that is fully capable of performing the storage, manipulation, updating, management, analysis, and display of mapped resource information critical to both the sound planning and management of the park and preserve.

Miscellaneous - Although the resource inventories described above would be critical to decision making for specific resource management problems, additional data are required to build a complete geographic information system. Additional data needs include procurement of current, high-quality satellite imagery of Denali and vicinity and acquisition of existing aerial photographs and those to be taken in the future.

Use of Global Positioning System (GPS) technology for ground-truthing when collecting resource information dramatically increases the precision of the park's spatial data, the geographic information system, and AutoCAD. The park has recently acquired a number of GPS units with greatly enhanced real-time positional accuracy. These units have provided a capability to accurately locate resource observations that did not exist before. The park needs to investigate options for increasing the level of accuracy further through the use of base stations or other technology.

RECOMMENDED ACTIONS

A. Program Administration and Planning

I-220.001 Develop Strategy for Conducting Baseline Inventories

Park staff would develop a systematic program to obtain all the basic information on Denali National Park and Preserve's natural, cultural, and subsistence resources needed to most effectively manage the park. Information deficiencies would be identified and corrected through additional inventories. These resource inventories could come from: (1) a synthesis of existing resource data; (2) research studies, proposed in this resource management plan, that call for field inventories and documentation; and (3) participation in the Servicewide Inventory Program.

Resource inventories can be conducted in a variety of ways. Species lists can be developed to indicate presence/absence, seasonality, and/or relative abundance. Voucher specimens, photographs, or narrative descriptions of observations can be accumulated. Phenological descriptions and behavioral observations can be recorded. Site drawings as well as Historic American Building Survey quality plans of structures can be

developed. The park will develop inventory information which will meet the minimum recommendations as outlined in NPS-75, Natural Resources Inventory and Monitoring Guideline, and NPS-28, Cultural Resources Management Guideline. As circumstances allow, more detailed inventory information will be accumulated. These various levels of intensity would be discussed in the strategic plan contemplated here.

I-220.002: Develop Data Management Standards and Protocols

To facilitate organization of baseline information, park staff will develop a metadata management system for organizing all other databases within the Division of Research and Resources Preservation. A compendium or digest of those databases will be produced and available to park staff and cooperators. Data sets that might be included are the List of Classified Structures, the Automated National Catalog System, and the Cultural Resource Mining Inventory and Monitoring System.

A Data Management Protocol has undergone peer review as part of the LTEM program. This document includes information on data file structuring, entry and editing procedures, archiving, and so forth. Among other things, geo-referencing of all study sites will be required. This protocol will be supplemented by a standardized Data Dictionary, which will be used in all projects sponsored by the park.

I-220.003: Support Professional Information Management Practices

Sufficient space will be provided for information storage. Storage facilities such as fireproof file cabinets will be acquired. Collections of maps, files, photographs, and so forth will be catalogued using automated systems. Security systems will be established through controlled access, storage in multiple locations, and use of multiple media.

I-220.004: Develop a Geographic Information System Plan

A GIS Plan would be prepared to provide overall direction for the management of the GIS and AutoCAD system for Denali National Park and Preserve. The plan would identify park issues and park expectations for GIS/AutoCAD applicability. The plan would also identify trained personnel to operate these systems; needs for office space for GIS/AutoCAD personnel and equipment; computer hardware and software requirements of park staff; the types of resource information needed by these systems; how that information would be obtained and input into the computer system.

I-220.005: Establish Cartographic Technician Position

A full-time GS-7 Cartographic Technician would be recruited and hired. This individual would acquire all existing digitized resource themes. This individual would also have

primary responsibility for digitizing historic and newly acquired information. Occasionally, assistance with complex, time-consuming digitizing jobs would be sought through the AKSO Information Resources Team.

I-220.006: Develop Cooperative Relations with Academic Institutions and Other Agencies

The National Park Service would coordinate and cooperate with the University of Alaska, state and federal agencies, and/or other institutions in the development of geographic information and AutoCAD systems for the Denali region. A goal of developing these relationships would be to standardize formats and techniques between these groups to expedite the sharing of geographically referenced information vital to sound planning and management throughout the region.

B. Research

I-220.011: Rapid Bioassessment Procedures

Additions to the park and creation of the National Preserve in 1980, under ANILCA, brought approximately four million acres into the conservation unit. Our knowledge about resources in these additions is minimal. While it is hoped that this void will be filled eventually, it is doubtful that detailed inventories will ever occur throughout the entire unit. Furthermore, decisions are currently being made regarding park development, resource use, and recreation without the most rudimentary information.

It has been suggested that development and application of rapid bioassessment procedures, which have direct application to Alaska ecosystems, would be extremely useful in compiling resource information that could be used in decision making. Initially this effort should be all inclusive (all ecosystem components), but eventually should be refined to significant parameters, such as keystone species or significant processes.

I-220.012: Complete Baseline Inventories

Fundamental to the development of a comprehensive information management system is completion of basic inventories of the park's natural, cultural, subsistence, and social resources. These resource inventories need to be based on the strategy developed as a result of implementation of project I-220.001, and information must be collected according to data management standards set by project I-220.002.

Although somewhat limited, some resource data does exist for the following themes: weather and climate, air quality, water quality, geology, hydrology, mining claims and impacts, topography, vegetation, fire history, wildlife and fisheries distribution and

abundance, disease and insect infestations, archeological and historic sites, subsistence use patterns, land ownership, cabin sites, campsites, roads and trails, developed facilities, recreational use patterns, and boundaries. Most of this information is in paper form (maps and narrative reports).

A number of monitoring and research studies are proposed in this resource management plan that will supplement and expand Denali's existing resource database. Some specific, but not all-inclusive, examples are geological and soil mapping of the park (N-311 and N-320); inventories of aquatic invertebrates (N-240); reconnaissance of paleontological resources (N-400); and shorebird research (N-361.2). Funding will be sought to accomplish the full scope of this work.

Environmental gradients, such as climatic conditions, lightning frequency, length of time since last disturbance, and type of disturbance are vital to understanding ecosystem processes. It is therefore imperative that monitoring and research studies be conducted that document these conditions as well as the more traditional resource inventory information. Funding will be sought to accomplish this work as well.

I-220.013: Develop Digital Data Themes

The National Park Service would conduct a comprehensive research program that would develop or update themes for Denali's GIS/AutoCAD system that are critical for resource planning and management. Emphasis will be placed on obtaining existing digital data. Once that is acquired, work will focus on digitizing data that exists in other formats. Finally, newly acquired information will be digitized. Project Statements N-500, C-100, and S-100 provide descriptions of general resource themes that need to be digitized. In some cases, where digital cartographic data is particularly important, individual Project Statements identify those needs. Park staff will also seek to develop themes such as base topography, political boundaries, trails, roads, utilities, and other facilities.

I-220.014: Support Independently Funded Geographic Information System/ AutoCAD Research Projects

The service would support independently funded geographic information system/ AutoCAD research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities.

I-220.015: Organize Historical Information

Significant amounts of historical resource data exist but are poorly organized and not readily available to park managers. This should be organized, and where feasible, synthesized.

C. Mitigation

I-220.021: Obtain Global Positioning System (GPS) Equipment

In order to enhance the current capability to geographically reference spatial data collected in the field, the park will investigate the availability of new GPS technology as well as the feasibility of incorporating the use of a base station with the current park-owned receivers. Use of such technology would permit a variety of users to geographically reference points in the park better than the current four-to-six-meter precision.

I-220.022: Aerial Photographs and Satellite Imagery

Every five years, low and high altitude aerial photographs and satellite imagery of Denali would be obtained. Low altitude photographic efforts would focus on areas with particular resource concerns or which are targeted for potential development. Ground control would be established for those photographs. Coordination and cooperation between the park, Alaska Support Office, adjacent land management agencies, and university researchers in scheduling and contracting for aerial photography could significantly reduce costs per square mile of coverage.

I-220.023: Operate a GIS/AutoCAD System

The GIS and AutoCAD systems are applied for several purposes: to determine alternative locations for facilities and services that provide visitor opportunities while protecting the resource and the quality of visitor experiences; to display wildlife population distribution and abundance; to assess wildlife-human conflicts (traffic-wildlife conflicts and human-bear encounters); to plan reclamation of placer mined watersheds; to model air pollution impacts on visibility; to predict susceptibility of trails and campsites to degradation; to predict the size, shape, and intensity of wildfires and prescribed burns; to estimate locations of sensitive resources; and so forth.

The system is operated and maintained by the park's data manager/GIS specialist. End users will be responsible for data editing and use of the systems in the PC environment.

D. Monitoring

I-220.031: Document Monitoring Results

Geographically referenced information from long-term monitoring of Denali's resources would be input into the park's GIS/AutoCAD system routinely (Long-Term Ecological Monitoring I-210). Resource data will be collected based on park standards.

E. Interpretation

I-220.041: Provide for Public Distribution of Information

Resource inventory information should be made available to the public through various publications and the park web site.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Inventory Strategy		5.0/0.1	5.0/0.1		10.0/0.2
- Data Standards		2.0/0.0	2.0/0.0		4.0/0.0
- GIS Plan		2.0/0.0	2.0/0.0		4.0/0.0
- Cartographic Technician				35.0/1.0	35.0/1.0
RESEARCH					
- Rapid Bioassessments		40.0/0.0	40.0/0.0	40.0/0.0	120.0/0.0
- Digital Themes		20.0/0.2	20.0/0.2	20.0/0.2	60.0/0.6
- Information Synthesis			35.0/0.0	35.0/0.0	70.0/0.0
MITIGATION					
- GPS Hardware	20.0/0.0				20.0/0.0
- Aerial Photos		30.0/0.0	20.0/0.0	20.0/0.0	70.0/0.0
TOTALS	20.0/0.0	99.0/0.3	124.0/0.3	150.0/1.2	393.0/1.8

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Dean, F. C., and D. K. Heebner. 1982. Landsat-based vegetation mapping of Mount McKinley National Park region, Alaska. Alaska Cooperative Park Studies Unit, Final Report NPS Contract No. CX-9000-6-E084, University of Alaska Fairbanks. Fairbanks, AK. 198 pp.

Griffin, K. 1990. An overview and assessment of archeological resources, Denali National Park and Preserve, Alaska. USNPS Alaska Regional Office, Cultural Resources Division, Anchorage. 327 pp.

Heebner, D. K. 1982. The numerical analysis of vegetation plots in Denali National Park and Preserve. MS Thesis, Alaska Cooperative Park Studies Unit, University of Alaska, Fairbanks. 243 pp.

USNPS. 1988. Geographic Information System Plan for Denali (draft). Denali NP&P, Denali Park, AK. 10 pp.

USNPS. 1991. Alaska Region Geographic Information System Plan. USNPS Alaska Regional Office, Natural Resources Division, Anchorage. 6 pp.

CURATION

PROJECT CODE: DENA-I-300

SERVICEWIDE ISSUES:
N20 Baseline Data
N24 Other
C40 Scope of Collections Statement
C42 Collection Storage Plan
C43 Collection Condition Survey
C44 Historic Furnishings
C45 Housekeeping Plan
C46 Museum Accountability
C47 Museum Storage
C48 Conservation Treatment
C49 Museum Environment
C50 Security and Fire Protection
C81 Museum Collections (Staffing Needs)
C91 Archives Management Training
C97 Museum Management Training

STATEMENT OF PROBLEM

Present Condition

Denali National Park and Preserve has a collection of approximately 251,376 museum objects. For a breakdown of objects by type and condition, refer to "Summary Chart for Objects", Appendix E. Collection management is under the direction of the Branch of Information Resources Management. The park's current Collection Management Plan (USDI 1995), describes the collection as including:

> ...natural history specimens, prehistoric and historic objects, as well as archives. The Park's purpose of protecting and interpreting its resources has resulted in an extensive research study collection. Early naturalists built up an extensive herbarium collection (including nonvascular plants), mammal, bird, insect, invertebrate, geologic and paleontologic specimens. Cultural collections include prehistoric archeological, historic and ethnographic materials, photographs, and associated archives.

Of the items in the collection, an estimated 239,904 are classified as archival materials, important documentary materials recording the history of the park. By far the largest segment of the total collection, archival materials also represent the most severe backlog to be cataloged, an estimated 200,000 items.

Current Management Actions and Results

The collection must be documented, protected, and preserved to Department of Interior (DOI) and National Park Service (NPS) standards for museum objects, as stated in the DOI "Checklist for Preservation, Protection, and Documentation of Museum Property," the NPS "Museum Handbook, Parts I & II," and NPS-28, "Cultural Resources Management Guideline." Mandated responsibilities include

* monitoring and controlling the collection storage environment on a regular basis;
* inspecting and maintaining objects on exhibit and in storage;
* implementing appropriate preservation treatments;
* maintaining museum spaces;
* identifying program deficiencies;
* securing funding for staff, supplies, and equipment needed to manage museum collections to appropriate standards;
* and preparing and submitting appropriate mandated collection documentation, including the annual inventory of museum property, the collections management report, and the annual submission of completed museum catalog records.

The existing museum facility, as well as present staffing and funding levels, are inadequate to meet mandated responsibilities and maintain the collection to DOI and NPS standards. Specific areas of concern are security and emergency preparedness, preventive conservation, collection storage, backlog cataloging, and archival record management.

A collection management plan (CMP) assessing the status of the collection and collection management program was completed 1995. The CMP noted that significant improvements to collection management had been made in the past 10 years. These improvements include establishing appropriate administrative responsibility for the collection, assigning permanent staff to care for the collection, and dedicating space for the collection and working to improve that space. One deficiency noted in the CMP was the exclusion of collection needs and concerns in basic park planning documents (GMP, RMP, SFM). The CMP particularly identified the need to address the collection in the park emergency operating plan (EOP) in order to prevent or minimize impacts to the collection in emergency situations.

A scope of collections (SOC) defining the purpose, limits, and use of the museum collection was completed 10 years ago, in 1988. The CMP found the SOC complete, but recommended that it be reviewed in accordance with newer NPS guidelines to ensure that the collection continues

to meet park needs.

Until recently, funding for museum collection management was not tied to base funding, making it difficult to plan a stable, long-term program. Although the park added a permanent subject-to-furlough museum technician position in 1995 (base funded for 6 months), the level of staffing remains inadequate to meet the long-term needs of a collection of this size and complexity. The current level of staffing is adequate to maintain the collection to prescribed federal/NPS standards; but correcting specific deficiencies, such as conservation and backlog cataloging, or developing recommended uses for the collection, such as interpretive exhibits, will require additional staffing and funding (Long-Term Ecological Monitoring, I-210).

Several improvements to the collection storage facility have been made in recent years. These include a locked storage area, locked storage cabinets, and the installation of smoke alarms. Although additional improvements in the areas of security and fire protection were suggested in the CMP, park staff have identified the need for adequate appropriate space as the parks most pressing curatorial need. The current facility is severely inadequate, providing virtually no space for work, research, or conservation. Space limitations have made it necessary to store the collection at two facilities; some skeletal collections have been moved to a second floor room at the Visitor Center. Remaining items, including archival materials, are housed in the main storage room on the second floor in Building 101. A natural resource interpretive collection (not part of the museum collection) presently occupies part of the work area outside the collection room. The park Interpretive Prospectus (IP) and draft Entrance Area and Road Corridor DCP both incorporate construction of a museum facility.

In response to concerns expressed by staff and a recommendation of the CMP, a collection assessment and condition Survey was conducted in 1997 (USNPS 1997a, USNPS 1997b). Recommendations from the assessment and condition survey have been incorportated as actions below. The 1997 effort focused on anthropological, historical, and archival material. An assessment and condition survey is still needed for natural science specimens.

Care of park archival materials is another area of concern. Of the 251,376 items in the collection, an estimated 239,904 items are classified as archival materials, important documentary materials recording the history of the park. By far the largest segment of the total collection, archival materials also represent the most severe backlog to be cataloged, an estimated 200,000 items. As a strategy for improving the handling of archival materials, the CMP recommended developing an action plan for the organization and administration of park archives, establishing a suitable archival work and storage area, and developing in-park procedures for archival collection management (for example, identifying which materials need to be taken out of general circulation and added to the archival collection).

Complying with the Native American Graves Protection and Repatriation Act (NAGPRA), has not been a major responsibility for park staff at this point. Initial evaluation of the collection

for potentially repatriable objects was made by AKSO staff (no relevant items were identified), and staff have not received requests for inventories or additional information concerning the collection. The park should anticipate that additional park-level responsibility for NAGPRA compliance could expand as Native groups get more involved with this relatively new mandate. Collection research geared toward determining the cultural affiliation of specific artifacts may be required in the future, and NAGPRA training for park curatorial staff is recommended.

RECOMMENDED ACTIONS

A. Program Administration and Planning

I-300.001: Develop Adequate Staff to Achieve Mandated Actions

Implement staffing and funding recommendations of the collection management plan. Specifically: Establish base funding for full-time museum and archival collection management. Salary and support costs to be base funded for the full year in the park budget. Also, establish additional seasonal, term or temporary position(s), as required, to ensure proper museum collection management. This additional staffing is to be defined by, and run the term of, individual project funding (backlog cataloging, for example).

I-300.002: Collection Cataloging

Address current backlog cataloging. Currently approximately 10% of the total collection has been cataloged and entered in the NPS Automated National Catalog System database (ANCS). This leaves a 90% cataloging backlog. Staffing and funding are needed to process the catalog backlog.

I-300.003: NAGPRA Compliance Program

Provide NAGPRA training for park collection manager and establish a clear path of appropriate consultation for Native groups. This training is necessary to develop an understanding of the law and how it relates to the collection and allow the park to anticipate and respond to requests for information about objects that may be subject to claims of repatriation under NAGPRA.

I-300.004: Complete Collection Condition Survey

The natural history collection has never been surveyed by a professional conservator.

A collection condition survey (CCS) is a planning tool that evaluates the condition of all or part of a collection, creates a baseline reference for future assessment of object deterioration, and identifies objects in need of conservation by degree of urgency (NPS-28).

I-300.006: Review Scope of Collection Statement

The park collection scope of collections statement was completed in 1988. The more recent collection management plan reviewed the park's SOC and found it adequate, but recommended that the collection itself be evaluated for appropriateness with respect to the SOC (pg 10 CMP).

I-300.007: Prepare Collection Storage Plan

Given cited deficiencies with the present collection storage facility, a collection storage plan (CSP) is warranted to address problems and present solutions. The CSP should address specific, identified problems (such as inadequate space, improved security and fire protection) and provide a comparison of alternative approaches to correcting current deficiencies. Full resolution of problems is anticipated upon completion of new museum facility. (I-300.021 below)

I-300.008: Archival Management Program

Conduct an archival assessment with a future action plan for organizing and administering the archival collection. Implement recommendations. Inventory and consolidate archival collection (survey administrative units and other collections for materials that should be added to archive). Provide space for collection and adequate work/research area. Develop standard operating procedures for use, care, and collection of archival materials.

I-300.009: Natural History Specimen Inventory

Inventory the park's natural history specimens collection and identify unrepresented species. During approved research and management actions, acquire noted deficiencies. Particular focus is anticipated in botany, geology, paleontology, and invertebrate zoology. (Project Statements I-210, N-240, N-311, N-330, N-400)

B. Mitigation

I-300.021: New Museum Facility

Pursue planning in support of design and construction of a complete museum with

adequate space for collection and archival research, conservation and exhibit construction workshop space, and appropriate collection storage. The current museum facility limits the curatorial and collection research program due to a lack of space for research, conservation, or consolidation of the collection. The Denali Frontcountry Development Concept Plan includes discussion of a new museum facility as part of an interpretive and science center.

I-300.022: Implement Security/Fire Protection Survey Recommendations

Implement recommendations of the 1993 security and fire protection survey. These deficiencies include the lack of fire suppression system and an intrusion alarm in the headquarters facility.

I-300.023: Photo Document Collection

As identified in the collection management plan, a photographic record of museum objects provides important information about an object's appearance, condition, and technique of manufacture. It can also provide an important record of lost or stolen objects. All cultural material should be photographed, especially those items that are controlled property, such as objects over $1,000, and those on loan or on exhibit. Photographs should be placed in a separate photograph file, stored in an insulated media file drawer, with the negatives in a file stored separately from the prints.

I-300.024: Curation of Records and Specimens Generated by NPS Activities

The Division of Research and Resource Preservation has numerous ongoing research and management activities. Develop a program to systematically track and incorporate files and specimens into the museum collection.

I-300.025: Implement Recommendations of Collection Condition Survey

As recommended in the 1997 condition survey reports, individual object treatment actions and general collection preservation activities would be implemented. Actions include things such as installing cabinet/case risers, installation of restraining bars, improvements to rare book storage, and installation of a humidification system.

C. Monitoring

I-300.031: Pest Management

As identified and recommended in the collection management plan, monitoring for pest infestation should continue. Both museum storage areas need to be monitored on a

weekly and a monthly basis, at a minimum.

D. Protection

I-300.051: Emergency and Disaster Planning

As identified and recommended in the collection condition survey and the collection management plan, the park emergency operation plan should include procedures for protecting museum collections at both sites (Building 101 and the Visitor Center). Implement the recommendation of the security and fire protection survey (1993). Incorporate the needs of the museum storage spaces into the park's emergency action plans.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Staffing	80.0/0.5	90.0/1.5	95.0/1.5	95.0/1.5	360.0/5.0
- Cataloging	30.0/0.7	30.0/0.7	35.0/0.7	35.0/0.7	130.0/2.8
- CCS,SOC, CSP, AMP	15.0/0.3	15.0/0.3	15.0/0.3	15.0/0.3	60.0/1.2
MITIGATION					
- Security and fire protection	50.0/0.0	50.0/0.0			100.0/0.0
- Photo documentation	20.0/0.5	20.0/0.5	20.0/0.5		60.0/1.5
PROTECTION					
- Emergency and disaster plan		20.0/0.5	20.0/0.5	20.0/0.5	60.0/1.5
TOTALS	201.1/3.2	231.0/3.7	206.0/3.2	171.0/3.2	794.0/12.0

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve

headquarters.

REFERENCES

USNPS. 1988. Scope of collection statement. U.S. Department of the Interior, NPS, Denali National Park and Preserve. Denali Park, Alaska. 20pp.

USNPS. 1995. Collection management plan. U.S. Department of the Interior, NPS, Denali National Park and Preserve. Denali Park, Alaska. 37pp.

Raphael, T.J. 1997a. Collection condition survey and conservation assessment (anthropology/history). U.S. Department of the Interior, NPS, Division of Conservation. Harpers Ferry, West Virginia.

Purinton, N. 1997b. Collection condition survey and conservation assessment (paper). U.S. Department of the Interior, NPS, Division of Conservation. Harpers Ferry, West Virginia.

RESEARCH ADMINISTRATION AND MANAGEMENT

PROJECT CODE: DENA-I-410

SERVICEWIDE ISSUES:
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
- C26 Other Issues: Lack of Basic Data - Insufficient Understanding of Park Cultural Resources and Threats to Them

STATEMENT OF PROBLEM

Present Condition

National Park Service Management Policies (USNPS 1988) state that "a program of natural, cultural, subsistence and social science research will be conducted to support park staff in carrying out the mission of the National Park Service ... The science program will focus on applied research, pursuit of new facts and principles, baseline inventories and monitoring, and interpretation of resources whose function and significance are not already known ... In recognition of the scientific value of parks ... investigators will be encouraged to use the parks for scientific studies when such use is consistent with NPS policies."

Well-founded scientific information is a requirement for sound park management. Research results are critical tools needed by park managers to understand natural conditions and processes without which managers cannot determine the effects of human impacts and make appropriate decisions. Failure to have adequate knowledge has resulted in many examples of park management decisions causing ecosystem damage (Stottlemyer 1981). Development and visitor use activities should be endorsed only with a clear understanding of the effects on natural conditions and cultural resources. Yet such conditions and processes are exceedingly complex, and cause-effect relationships can be difficult to detect because of the many variables involved. Only systematic, and sometimes long-term, natural history, sociological, archeological, and historical studies can hope to provide the needed understanding.

Denali presents favorable conditions under which research can be conducted due to its significant natural, cultural, and subsistence resources and its ready accessibility. The park is the only area in interior Alaska and, in fact, all of Alaska, besides the original Katmai and Glacier Bay National Parks, to have a long history of resource protection from significant human

exploitation. As such, it is a relatively pristine area where natural processes largely occur unimpeded by human interference, thus providing a situation ideally suited for comparative studies.

The former Mt. McKinley National Park was designated a biosphere reserve in 1976. The 1980 ANILCA park and preserve additions were included in the designation in 1982. A primary reason for Denali's selection as a biosphere reserve is its representativeness of natural subarctic ecosystem processes and thus its ability to provide for benchmark research against which human-impacted areas could be compared. The Natural Resources Guideline NPS-77 (USNPS 1991c) states "Superintendents of Biosphere Reserve parks are responsible, in cooperation with the regional chief scientist, for developing and operating a program of interdisciplinary research that includes studies on regional and global issues, for using the resulting information in developing cooperative approaches to management, and for communicating the results of these studies to the public." A lack of funding and facilities for inventory, monitoring, research and education has prevented the Denali Biosphere Reserve from fulfilling its objectives for long-term monitoring, research, and education.

Despite policy endorsement of research, managerial acceptance of the function is mixed. Research can be costly, like other management activities, but, because its results are not always immediate and sometimes complex and indefinite, it is not always fully embraced or funded relative to other management activities.

Current Management Actions and Results

In comparison to many other national park system units, a substantial year-round natural, cultural, subsistence, and social science research program is conducted in Denali National Park and Preserve by a variety of NPS and contract personnel, as well as independently funded cooperating researchers. In 1996 alone nearly 100 studies were supported by the park.

Despite the size of the research program at Denali, serious shortcomings related to the breadth of the program exist. In a survey of NPS biosphere reserves, Mack et al. (1981) rated the Denali research body on a scale of 1 to 100 (1 being a poor score) as follows: baseline inventory, 32; long-term environmental monitoring, 21; and long-term ecological research, 5. Clearly significant voids exist in the program as it pertains to the former Mt. McKinley National Park, and even less is known about the 1980 additions to the park.

No doubt a multitude of factors contribute to this shortcoming. These include the inability of park staff to aggressively seek involvement of investigators due to other workload commitments, a lack of strategic planning to assure proper avenues of investigation are followed, a failure to consistently communicate research needs and market the park as a study site, remoteness from many investigators and scientific institutions (a handicap experienced throughout Alaska),

remoteness of park resources themselves once an investigator has reached park headquarters, and a paucity of facilities that can be offered to support investigators in their efforts. Even NPS funded researchers often do not have adequate facilities available. Some of these shortcomings can be corrected, while others will remain beyond the ability of the service to influence or are inappropriate for the service to deal with.

Administrative Control - In 1980 park staff prepared a package that was used to guide the conduct of research in the park. Much of the focus of this package was on collecting permits and road access permits (USNPS 1980). Subsequently, in 1991 the service issued additional guidance on research administration (USNPS 1991b). Park staff is now in the process of developing a far more extensive guideline, which will address topics such as proposal standards, report expectations, permit requirements, logistics, and so forth. A formal permitting process was put in place starting in 1994.

A research administrator position has been established in the Division of Research and Resource Preservation. This individual has primary responsibility for coordinating research activities in the park.

Research Planning - Denali has been blessed with the consistent presence of representatives from the scientific community. Several agency scientists have worked in the park at various times and in some instances for extended periods. In most cases, these scientists focused their efforts on pertinent wildlife studies (some of which were quite broad) but little effort was made to lay out a comprehensive research program. The first such look at research came with the preparation of the park's resource management plan in 1982.

In 1993, the National Biological Survey (NBS) was created. This resulted in some philosophical shift away from biological research being conducted by National Park Service staff. With the creation of the new agency came the establishment of a field station at Denali. The creation of NBS combined with the 10 years that have now passed since the preparation of the last version of the RMP makes the time ripe to prepare a strategic research plan tiered off of this update to the resource management plan. Most of the projects in this resource management plan contain research components. It is imperative that this group of research projects be examined to determine common themes, logical groupings, and appropriate sequencing.

Collaborative Efforts - Park staff have developed working relationships with numerous investigators and entered into a variety of agreements and contracts for completion of investigations. Several of these are worthy of specific mention.

Following passage of ANILCA, mineral interests in the Stampede Mine, owned by Stampede Mine Ltd., were donated to the School of Mineral Industry, University of Alaska Fairbanks, for educational purposes, while real estate interests were donated to the service. In 1980, the university entered into a memorandum of understanding (MOU) with the service and dedicated

the mine as a research and education station. A shortage of funding and the relative remoteness of the site have hampered fruition of the station. Although the main emphasis was on mining related research and education, including environmental impact mitigation, all disciplines are welcome to work there to the extent facilities are available. The MOU was renewed in 1987, but expired in 1992. Between 1995 and 1996, the university rekindled its interest in Stampede Mine. During 1996, a revised MOU was signed, and the university conducted one class on the site. In 1998, following legislative permission, the NPS bought out the mineral interests of the university.

National Park Service personnel are currently collaborating with staff from various state agencies, the Mat-Su Borough, and others in the development of a research needs list for resource and social science studies that are needed to aid in the implementation of the South Side Development Concept Plan. This list will be used to set priorities and to generate needed funding.

The Denali Foundation, a non-profit organization, was created to forge links between environmental, political, and economic interests in order to find practical solutions to environmental problems. The foundation's special emphasis is research and education on arctic and subarctic wildlands, activities that the foundation believes have profound implications for the global biosphere. The foundation intends to seek out and sponsor scientists to engage in research that takes advantage of the park's unique qualities. The foundation also sponsors educational programs that use the Denali region and its wealth of human and natural resources as a wilderness university. Its initial educational enterprise is the sponsorship of Elderhostel, an ongoing education program for adults over the age of 60. A memorandum of understanding was signed by the NPS and the Denali Foundation in March 1992. This document lays out the long-term relationship between the service and the foundation.

In the fall of 1993, the National Biological Survey (NBS) was established within the Department of the Interior. The park's research wildlife biologist was reassigned to the new agency, and steps were taken to create a field station of the survey in the park. Formal relationships with the NBS were established via a written agreement that was prepared between 1994 and 1995. In 1996 the NBS was absorbed into the USGS as the Biological Resources Division (BRD). In-park presence and field activities of BRD scientists has not changed significantly during these changes.

Park staff has worked jointly with state personnel on a number of research questions. Most of this effort has been with the Alaska Department of Fish and Game.

Additional agreements and cooperative efforts are to be encouraged.

Facilities - Recently some improvements have been made to NPS facilities available to individuals conducting studies in Denali. A new resource management office has been

established in the headquarters complex. One room in this facility has been dedicated for occupancy by a National Biological Survey employee and a technician working with him. The resource management offices include a small wet lab, but do not include sufficient space for investigator work or storage, freezer space, or room for data management. Investigators end up using vacant offices when employees are working in the field. Additional storage and seasonal employee office space has also been installed in C-Camp (a seasonal employee housing area), but is completely consumed by park operations. Once again, scientists are forced to wait for employee absences if they wish to use this office space.

In the interest of resolving some of these workspace problems, the Denali Foundation began a fund raising campaign, in 1991, for the development of a research center on land they own outside the park at McKinley Village. The current (1996) status of this effort is not clear to park personnel.

Various housing, excess to regular seasonal needs, has been used at C-Camp, in an effort to alleviate shortages in housing. With the initiation of the Long Term Ecological Monitoring Program in 1992, all of these facilities have been completely booked. In addition, administrative control of modest housing, elsewhere in the park, has been turned over to the Division of Research and Resource Preservation. This includes a small cabin on the East Fork River, and a four-bunk bunkhouse at Wonder Lake, both of which are used extensively by transient investigators. Most of these facilities are booked solidly throughout the summer season. Occasionally more immediate management needs can take precedence and the researchers may be moved out. Because of the size of Denali, it's impractical for research personnel to commute up to 180 miles each day. Personnel often must be able to stay out in the park rather than commute each day. Other park cabins and facilities can be used if available, but they are seldom available in summer. The number of permanent and temporary employees and volunteers exceed the park's existing housing capacities.

Although most studies are conducted during the summer months, some are conducted during the winter and thus require the use of winterized quarters. Winterized quarters are in even shorter supply than summer housing although the demand for them has been significantly less.

Glen Creek Camp, a temporary, remote field camp created to support the Kantishna Mining Claim Acquisition and Reclamation Program, has been used on a limited basis by various investigators. Partial demobilization of this camp began in 1994 coincident to a declining need related to claim acquisition. Through mutual agreement with regional office staff, who purchased much of the equipment at the camp, a substantial amount of that equipment was turned over to the park for use as park staff saw fit. A smaller scale Glen Creek Camp has remained as a base camp for use by various scientists. Similar remote camps on a smaller scale are being proposed for use in Denali's long-term ecological monitoring program (USNPS 1991a) and should be contemplated for other studies. No funds are available to purchase the equipment and supplies needed to establish these field camps.

The division does maintain a modest cache of backcountry camping gear, which can be used to support spike camps in particularly remote locations. Backcountry patrol cabins are also available for use when they are not occupied by patrol staff.

Records and Data Management - The amount of information collected, filed, archived, analyzed, and published annually by NPS resource management, inventory, monitoring, and research projects is staggering. Information is deposited in research files and maintained by the Research and Resource Preservation Division, in the park library, or archives. However, no uniform records handling or disposition procedures are in place. This results in unnecessary duplication and inefficient use of storage space, a lack of security on sensitive information, and inefficiencies in information recovery. Inadvertently it also assures, in some instances, record security from catastrophic events. Existing space in park offices, the library, and the archives is very limited and will not accommodate expansion in future years.

Automated information is also being generated at a dizzying pace. Draft data management procedures have been prepared, but these are incomplete; and appropriate computer hardware is unavailable in the park to implement the procedures efficiently.

A comprehensive spatial database program was initiated in the park in 1994. GIS and AUTOCAD technologies are being applied on selected projects in the park but substantial basic inventory and mapping needs still exist. (Resource Inventory and Mapping I-220).

Although there have been hundreds of scientific studies undertaken in the park and preserve area, few of the records and data sets generated by these studies meet a minimum set of standards to allow comparability and future analysis. This can be corrected through formalization of data management procedures and by encouraging collaboration on various investigations.

Natural history specimens have been regularly, though not religiously, accesssioned into the park's museum collection or other suitable repository (Curation I-300). Further strengthening of this system is appropriate.

RECOMMENDED ACTIONS

A. Program Administration and Planning

I-410.001: Develop a Strategic Research Plan

Numerous research projects are proposed throughout this document. These are proposed in numerous forms, including relatively simple literature searches, more complex studies

aimed at techniques development, and sophisticated social, ethnographic, and ecological studies. This research agenda is ambitious and will take years to complete. Research is a cornerstone of the biosphere reserve program and should be aggressively supported by park staff. Order needs to be brought to these research suggestions via development of a strategic research plan. This will facilitate communication of research directions, will point to opportunities to coordinate investigations for scientific and financial benefit, and may help with data management and integration. This plan will probably consist of three major components: natural science, social science, and history/prehistory. Subsistence research needs will be blended into these three components.

I-410.002: Encourage Establishment of Cooperative Research Relationships

Park staff will agressively seek opportunities to work jointly with investigators from academic institutions and resource agencies.

Prior to project initiation, all proposed research to be conducted in the park and preserve must be approved by the superintendent and meet the criteria established in the aforementioned strategic plan and the research administration guideline.

I-410.003: Strengthen Relations with and Evaluate and Prioritize Denali Foundation Research Proposals

The Service would seek to clarify its working relationship the Denali Foundation in science and environmental education arenas.

The Service, Denali Foundation, and the University of Alaska and/or other institutions would set up a working committee composed of NPS, Denali Foundation, and university representatives. The working committee would be set up to evaluate and prioritize proposals for the use of Denali Foundation science program funds for research in the park, and make recommendations to the superintendent. The procedures used by the Service for allocating Yosemite Fund donations for research and resource management projects in Yosemite National Park could serve as a model for Denali's program.

Once projects are undertaken, service staff would monitor their progress.

I-410.004: Complete Preparation of Research Administration Guideline

The guideline would address funding sources, study proposal standards, permitting procedures, logistics, reporting requirements, data management, coordination, and ethics. It would be distributed to investigators who are potentially interested in working in the park and would provide the administrative framework for conducting scientific

investigations.

I-410.005: Expand Research Facilities as Circumstances Permit

Modest increases in funding will be sought to support recurring maintenance needs associated with research housing, and the Maintenance Division will be encouraged to fund building repairs as needed.

Existing space will be utilized until such time that additional space is identified. When the carpenter, sign and electrical shops, and the Building and Utilities Foreman's Office are relocated to the auto shop area, additional office and laboratory space may be made available for science use.

The need for additional residential and office space should be considered in the current Front Country Development Concept Plan implementation. Particular needs include more equipment and records storage, a larger lab, data processing facilities, a garage bay, and a greenhouse.

Additional needs for housing and office space need to be considered in planning for Toklat and Wonder Lake/Kantishna to assure adequate facilities in future years.

I-410.006: Increase Use of Temporary Remote Field Camps and Provide for Their Maintenance

For maximum flexibility, ease of transport and setup, and cost effectiveness, the Service would increase use of temporary research facilities at remote, off-road locations in the park. Funding will be sought to maintain a supply of Weatherports and related support equipment that can be deployed to the field as necessary.

Funding will be necessary to maintain field camp and research facility equipment.

I-410.007: Develop Data Management and Information Archiving Procedures - Acquire Statistical Software - Establish Internet Link

A data management protocol will be written and applied to all research activities conducted in the park to assure the integrity of research data. The Service would also acquire and maintain a suite of statistical software programs that could be applied to research projects.

The park has been placed on line with the Internet to improve access to information and enhance communications with the scientific community, but staff needs to be encouraged to utilize this capability. Workloads need to be adjusted to allow time for Internet use.

I-410.008: Develop Scientific Literature Library - Micrographic and Digital Reproduction of Research Records -Coordinate Research Activities with Curatorial Functions

Division staff will routinely gather scientific literature to be cataloged and housed in the division's technical library. A scope of holdings statement will be prepared, which will provide guidance to park staff on the nature of material that is appropriate for collection.

Funding will be sought to create micrographic and digital copies of research reports, data sets, maps, and diagrams. This will aid in improving the security of that information and will enhance the ability of the park to store it. Refer also to the Curatorial Management project statement I-300.

I-410.009: Hire Key Staff to Support Research Functions

The Service would hire a science advisor to provide oversight to park resource preservation programs, establish close working relationships with scientists in other agencies and at universities, and generally assure that park programs are credible.

The Service would also hire a data manager, a research librarian, and a biostatistician to assist on various aspects of research projects and to support park resource operations; particularly the Long-Term Ecological Monitoring Program.

B. Research

I-410.011: Conduct Natural, Cultural, Subsistence and Social Science Research Programs Based on the Strategic Research Plan

In recognition of the scientific value of the park as a natural, cultural, subsistence and social science laboratory, the service will engage in funding a research program. Projects will be handled by service staff, in cooperation with other agencies or contracted to private firms. Specific proposed projects can be located in other project statements throughout this plan. Funding requests for each project are also reflected in each of those project statements. Resource management plan software will allow preparation of a spreadsheet that will outline the scope of these projects.

I-410.012: Prepare a Compendium or Digest of Scientific Information

A compendium of scientific information would be prepared to provide managers and scientists with factual information for identifying knowledge gaps and future research directions and needs for natural, cultural, subsistence, and social science research at Denali National Park and Preserve. The objectives for this project are: 1) inventory the

natural, cultural and subsistence resource data (numeric, bibliographic, and mapped) for the park; 2) organize and synthesize this information in a catalog called a data directory, which lists the important attributes of each data set; 3) evaluate the significance of each data set in terms of its relevance to current park management problems; and 4) develop a computerized data management system for Denali, and use it to store the significant data sets.

The final report would provide a narrative description and overall assessment of scientific studies (both research and monitoring) in the park and a bibliography citing scientific studies in the biosphere reserve and vicinity. Similar reports done for Isle Royale National Park Biosphere Reserve, Michigan (Bick et al. 1985) and Glacier National Park, Montana (Heyward et al. 1984) would serve as models for Denali's history of scientific studies.

I-410.013: Prepare a History of Scientific Studies

Write a supplement to the park's administrative history that deals exclusively with scientific investigations.

I-410.014: Support Independently Funded Research Projects Based on the Strategic Research Plan

The Service would support independently funded research projects by private and public organizations, agencies, and universities when deemed appropriate by park management. The park would provide temporary housing and logistical support for field and laboratory work as circumstances allow.

I-410.015: Establish a Fellowship Program to Support Invited Scientists

The Service would work to establish partnerships with appropriate groups to support invitational travel by specialists to deal with resource issues beyond the capabilities of park staff but which do not require large research programs. Seed money would be needed from the service.

C. Interpretation

I-410.041: Continue Publication of "The Tattler"

"The Tattler," the park's research newsletter, would continue to be published on a regular basis.

I-410.042: Establish Investigator Lecture Series

Formalize the program of investigator lectures as an element of the park's interpretive program.

I-410.043: Establish a Scientific Monograph Series

The Service would work cooperatively with the Alaska Natural History Association or the Denali Foundation in the publication of scientific monographs on park resource topics.

I-410.044: Sponsor Public Scientific Conferences

The Service would work cooperatively to establish partnerships for sponsorship of science conferences to provide a forum for dissemination of research findings. (see also Biosphere Reserve Management I-420)

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Strategic Res. Plan	10.0/0.1	10.0/0.1			20.0/0.2
- Working Committee	10.0	10.0	10.0	10.0	40.0
- Res. Admin. Guideline	10.0/0.1	10.0/0.1			20.0/0.2
- Facility Expansion			400.0	200.0	600.0
- Field Camps			30.0	10.0	40.0
- Information Services	20.0	20.0	20.0	20.0	80.0
- Library	10.0	10.0	10.0	10.0	40.0
- Science Advisor	70.0/1.0	70.0/1.0	70.0/1.0	70.0/1.0	280.0/4.0
- Librarian/Statistician	120.0/2.0	120.0/2.0	120.0/2.0	120.0/2.0	480.0/8.0
RESEARCH					
- Science Operations	150.0	150.0	150.0	150.0	600.0
- Compendium		30.0	30.0	10.0	70.0
- History of Scientific Studies		40.0/0.2	40.0/0.2	40.0/0.2	120.0/0.6

- Fellowship Program	15.0	15.0	15.0	15.0	60.0
INTERPRETATION					
- Tattler Publication	10.0	10.0	10.0	10.0	40.0
- Lecture Series	5.0	5.0	5.0	5.0	20.0
- Scientific Monographs	15.0	15.0	15.0	15.0	60.0
- Public Conferences		30.0		30.0	60.0
TOTALS	445.0/3.2	545.0/3.4	925.0/3.2	715.0/3.2	2630.0/13.0

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Bick, K., R.A. Janke, R.M. Linn, R.O. Peterson, D. Rutkowski, and J.R. Sottlemyer. 1985. Isle Royale Biosphere Reserve: Volume I, History of Scientific Studies; Volume II, A Bilbliography of Scientific Studies. U. S. MAB Report No. 11. USNPS, Atlanta, Georgia.

Heyward, P., R. G. Wright, and E. E. Krumpe. 1984. Glacier National Park Biosphere Reserve: A History of Scientific Studies. Volume 1. A Narrative Description of Scientific Studies. U. S. MAB Report No. 9, Cooperative Park Studies Unit, University of Idaho, Moscow, Idaho.

Mack, A., W. Gregg, Jr., S. Bratton, and P. White. 1981. A survey of ecological inventory, monitoring, and research in U. S. National Park Service Biosphere Reserves. Research/Resources Management Report No. 49. USNPS, Southeast Region, Atlanta, GA. 23 pp.

Stottlemyer, J. R. 1981. Evolution of management policy and research in the National Parks. J. of Forestry, January 1981:1620.

USNPS. 1979. Statement for Management, Mount McKinley National Park, Alaska. 15 pp.

USNPS. 1980. Policy for evaluating research proposals, Denali National Park & Preserve, Alaska. USNPS, Denali NP&P, Denali Park, AK. 5 pp.

USNPS. 1987. Addendum to the 1983 Development Concept Plan/Environmental Assessment for the Park Road Corridor, Denali National Park and Preserve. USNPS, Denver Service Center, Denver, CO. 13 pp.

USNPS. 1990. Cumulative Impacts of Mining Final Environmental Impact Statement, Denali National Park and Preserve: Volumes 1 and 2. USNPS, Denver Service Center, Denver, CO. 364 and 307 pages, respectively.

USNPS. 1991a. Camp Plan: Glen Creek Camp Operations. USNPS, Alaska Regional Office, Mining and Minerals Division, Anchorage, AK. 24 pp.

USNPS. 1991b. Guidelines for Scientific Research in Denali National Park and Preserve. Denali NP&P, Denali Park, AK. 6 pp.

USNPS. 1991c. NPS-77 Natural Resources Management Guideline. U. S. Department of the Interior, Washington, DC.

USNPS. 1997. South Side Development Concept Plan and Environmental Impact Statement, Denali National Park and Preserve. USNPS, Denver Service Center, Denver, Colorado.

BIOSPHERE RESERVE MANAGEMENT

PROJECT CODE: DENA-I-420

SERVICEWIDE ISSUES:

- N16 Visual and Biological Impacts of Urbanization and Other Near-Park Development on Park Resources
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
- C23 Conflicting Park Management and Development Activities
- C26 Other Issues: Lack of Basic Data - Insufficient Understanding of Park Cultural Resources and Threats to Them

STATEMENT OF PROBLEM

Present Condition

In 1971, the United Nations Education, Scientific and Cultural Organization (UNESCO) launched a worldwide program of international scientific cooperation dealing with people-environment interactions in a whole range of bioclimatic and geographic situations known as the Man in the Biosphere Program (MAB)(UNESCO 1984).

The International Coordinating Council, which supervises the MAB Program, at its first session in 1971, decided that one of the primary projects of this program would be the conservation of natural areas and the genetic material they contain (UNESCO 1984). Thus the concept of the Biosphere Reserve System was spawned. The Biosphere Reserve System is founded on two principal ideas. First, it is a scientific program for the designation of representative ecosystems, including well-preserved natural systems, to be managed for the protection of their biological diversity and integrity and the maintenance of the variety of species they contain, including their genetic diversity. Second, it contemplates management of nearby areas on an economically viable, sustained-yield basis. This dual aspiration apparently arose from concern about less developed countries, where people sometimes destroy the very resource base that sustains them. Successful biosphere reserves constitute models of the harmonious marriage of conservation and development.

The goals of the program are as attractive as they are all-encompassing: identifying representative ecosystems; maintaining their biological diversity; promoting research and environmental education; and providing for the well-being of nearby human populations. The program was innovative because of this network character and because it combined nature conservation with scientific research, environmental monitoring, training, demonstration, environmental education, and local participation. Since 1976, the reserve system has formed the geographic focus for implementing MAB programs.

Criteria for selection of biosphere reserves were formalized in 1974 (UNESCO 1974) and designation of reserves began in 1976 (UNESCO 1984). By 1984, 243 designations had been made in 65 countries (UNESCO 1984). Shortly thereafter, UNESCO entered a period of fiscal austerity, and many MAB projects were not implemented. In 1990, the Scientific Committee on Problems on the Environment (SCOPE) initiated an evaluation of MAB programs and determined that the Biosphere Reserve system was "the single most important element of MAB" (UNESCO 1992) and called for renewed attention to the project.

The former Mt. McKinley National Park met the criteria for designation and was named a biosphere reserve in 1976. When the park was expanded to six million acres by ANILCA in 1980, the new park and preserve additions extended significantly beyond the 1976 Reserve designation. A memorandum dated August 11, 1981, to the Alaska regional director from Superintendent Cunningham requested adjustment of the boundaries of this Biosphere Reserve to coincide with the boundaries of the new park and preserve. At its meeting on June 24-25, 1982, the Bureau of the International Coordinating Council of the Programme on Man and the Biosphere approved the change of boundaries of Mt. McKinley National Park Biosphere Reserve and its new name, the Denali National Park Biosphere Reserve. A bronze display plaque commemorating this designation is located at the park's Visitor Access Center.

Designation bestows international status and importance on the park. The program also states a scientific agenda. Research under the MAB Program is designed to solve practical problems of resource management. It also aims to fill the still significant gaps in the understanding of the structure and function of ecosystems and of the impact of different types of human intervention. Key ingredients in the MAB Program are the involvement of decision-makers and local people in research projects, training and demonstration in the field and the pooling of disciplines from the social, biological, and physical sciences in addressing complex environmental problems (UNESCO 1984).

A biosphere reserve also offers an opportunity for regional land use planning and management aspiring both to resource preservation and to community sustenance (Sax and Keiter 1988). In fact, regional cooperation is pivotal to the success of the program. Unless the much larger area outside of such a reserve is subject to sound land use policies and practices, resource values of the core may not be sustained over the longer term. In the final analysis, the biosphere reserve is a relatively new, overarching concept aimed at welding a combination of land uses to the

common purpose of conserving representative ecological areas.

Current Management Actions and Results

Biosphere reserve designation is not a legal mandate, but simply a United Nations program in which the United States participates; designation does not create any legal obligations at present (Sax and Keiter 1988). By policy, the National Park Service has fully embraced this program and strives to implement its elements.

National park and biosphere reserve management objectives have many similarities. Protection of natural ecological processes, research, inventory of resources, monitoring, interpretation, and coordinated regional planning, done in Denali, have application to both programs.

The legislative and regulatory framework within which the park operates is aimed at assuring long-term preservation of park resources and processes. Operationally, many of the activities of park staff members focus on resource preservation. As a result, the park remains in a largely pristine condition.

Denali has a substantial history of cooperation with and sponsorship of scientific investigations. Park and support office staff have maintained involvement with the Northern Science Network, a caucus of scientists from circumpolar biosphere reserves. This forum facilitates exchange of scientific information. Mack et al. (1981) has given an index rating to the comprehensiveness of scientific activities for Denali, based on a scale of 1 to 100, as baseline inventory, 32; long-term environmental monitoring, 21; and long-term ecological research, 5. It is obvious that, despite the park's existence for 75 years, there is significant scientific work still to be accomplished in order to adequately understand the resources that are being managed and to implement park and biosphere reserve purposes.

Because of Denali's large size, it is difficult to conduct research here without facilities for living and working. The lack of research facilities has prevented some scientists from conducting projects here even though they had their own funding sources, and it has made it difficult and expensive for NPS scientists to work (Research Administration and Facilities I-410).

Among the many studies initiated, a few have focused on development and implementation of resource monitoring procedures. Until recent years, no clearly defined, cohesive monitoring program has existed in the park. In 1992, Denali was selected to participate as a prototype park in the development of a comprehensive monitoring program. Early conceptual thinking about this program limited it to the confines of individual watersheds; and, therefore, it was largely implemented in a single watershed (Rock Creek). More recent work on the program has resulted in an expansion of the spatial design, and future years will continue to bring further evolution to the program. This monitoring program is interdisciplinary (Long Term Ecological Monitoring Program I-210). This program and other monitoring efforts need to be fully

developed and implemented.

Environmental education on the conservation, ecology, and economics of wildlands is of critical importance if quality of life is to be maintained. Such education must be offered in a spirit of objectivity, balancing needs and wants, rather than promoting a single perspective. Denali supports an excellent interpretive program and an outstanding relationship with the Alaska Natural History Association, but a lack of funding for facilities and staff has severely limited Denali's environmental education program. A severe shortage of classroom, office, workroom, laboratory, storage, library and museum space, quarters for staff, and dormitory space for students has resulted in a limited environmental education effort. Starting in FY 91, roughly two weeks of staff time in the Division of Interpretation was dedicated to environmental education outreach to local schools. The Denali Foundation has been sponsoring an Elderhostel program for adults over the age of 60 each summer since 1990; their facilities are located at McKinley Village, just south of the entrance to the park. Affiliated with the national Elderhostel organization, this program offers low cost, week-long, residential academic experiences; six hundred participants can be accommodated over a 14-week season. The National Park Service should develop an environmental education program that complements the Elderhostel program.

The biosphere reserve concept, however evocative an idea, remains a vague one and is still at the conceptual stage. There is, so far, no concrete notion of how biological preservation in a core reserve area is to be integrated with sustainable productive uses of resources for the people in the peripheral areas. Consequently, there is presently little local or regional understanding of the concept and suspicion that this is another lockup program under a different name. The service needs to bring the biosphere reserve idea to life within the Denali region.

RECOMMENDED ACTIONS

The 1984 Action Plan for Biosphere Reserves (UNESCO 1984) outlines a series of minimum activities in which program participants are expected to engage themselves. In 1994, the U. S. MAB program adopted a Strategic Plan for the U. S. Biosphere Reserve Program (U. S. Department of State, 1994) which further outlines activities of U. S. Biosphere Reserves. In addition, the Program for the Conservation of Arctic Flora and Fauna (CAFF) prepared a draft plan for the conservation of arctic biodiversity that has been presented to U.S. MAB for consideration. The actions described below are designed to identify the tasks park staff need to accomplish to meet standards set in these plans.

A. Program Administration and Planning

I-420.001: Prepare a Management Plan for Reserve Functions

An action plan tiered off the general management plan would be written outlining specific steps the park will take to achieve biosphere reserve management objectives. The focus of this plan would be cooperation and joint decision-making among the various land managers.

I-420.002: Promote Increased Local and Interagency Participation in the Management of the Reserve

The National Park Service would encourage increased participation of local residents in planning for the management of the Denali National Park Biosphere Reserve. Where possible, local people would also participate in the scientific research, monitoring, and other activities taking place in the reserve. This would perhaps be best accomplished through active involvement in the Circumpolar Biosphere Reserve Managers Working Group.

The National Park Service would promote increased interagency coordination and cooperation with federal, state, and local agencies to develop land use practices that protect natural, cultural, and subsistence resources in the park and preserve from incompatible human developments and activities.

I-420.003: Review Biosphere Reserve Programs Periodically

Biennial reviews of programs should be conducted by park staff to assure accomplishment of biosphere reserve management objectives.

I-420.004: Improve Networking with Other Biosphere Reserves

Improve correspondence with other biosphere reserves through the use of the Internet (Research Administration and Management I-410).

B. Research

Because of the close tie between the research function and biosphere reserve management objectives, most details regarding recommended research actions are located in the Research Administration and Management (I-410) Project Statement. Specific research projects are identified throughout this document.

I-420.011: Increase Natural, Cultural, Subsistence, and Social Science Research Programs

In recognition of the scientific value of the park as a natural, cultural, subsistence, and social laboratory, investigators would be encouraged to use the park for scientific studies

when such use is consistent with National Park Service policies and guidelines. NPS facilities and assistance would be made available to qualified scholars conducting authorized research as long as park operations would not be impeded or park resources impaired. See Research Administration and Facilities, DENA-I-410.

I-420.012: Promote Coordinated Research Projects on Conservation Science and Ecology

The development of the research function within the Denali National Park Biosphere Reserve by the service would command high priority. The service would set up cooperative, bilateral, or multi-lateral projects involving (1) basic and applied research; (2) comparative research involving managed and natural ecosystems; (3) comparative research involving biosphere reserves with analogous ecological characteristics or similar ecological problems; (4) application of new technologies (e.g., remote sensing, modeling, GIS) in such research; and (5) development and expansion of northern-southern hemisphere and intra-northern hemisphere linkages for research and educational purposes. (UNESCO 1984) Effort would also be placed on development of integrated sampling within different scales, as well as integrated data management. Workshops would be promoted.

I-420.013: Prepare a History of Scientific Studies

A problem-oriented research project would provide managers and scientists with factual information for identifying knowledge gaps and future research directions and needs for natural, cultural, subsistence, and social science research at Denali National Park and Preserve. The objectives for this project are (1) inventory the natural, cultural, and subsistence resource data (numeric, bibliographic, and mapped) for the park; (2) organize and synthesize this information in a catalog called a data directory, which lists the important attributes of each data set; (3) evaluate the significance of each data set in terms of its relevance to current park management problems; and (4) develop a computerized data management system for Denali, and use it to store the significant data sets.

The final report would provide a narrative description and overall assessment of scientific studies (both research and monitoring) in the park and a bibliography citing scientific studies in the biosphere reserve and vicinity. Similar reports done for Isle Royale National Park Biosphere Reserve, Michigan (Bick et al. 1985), and Glacier National Park, Montana (Heyward et al. 1984), would serve as models for Denali's history of scientific studies.

I-420.014: Translate Abstracts of Final Reports into Circumpolar Languages

Abstracts from scientific papers developed at Denali would be translated into foreign languages to facilitate the exchange of this information with other scientists working in similar environments.

I-420.015: Support Independently Funded Research Projects

The service would support independently funded research projects in Denali National Park and Preserve by private and public organizations, agencies, and universities when deemed appropriate by park management. The park would provide temporary housing and logistical support for field and laboratory work (Research Administration and Facilities I-410).

C. Mitigation

I-420.021: Increase Facilities for Scientific Research

The service will plan, construct, furnish and equip a modest field research station. Satellite facilities (housing and spike camp provisions) would also be maintained in more remote locations (Research Administration and Facilities I-410). These facilities should be linked to those recommended in the Frontcountry and Road Corridor Development Concept Plan.

D. Monitoring

I-420.031: Increase Monitoring of Developments and Activities in the Region Surrounding the Reserve

Support office and park staff, would increase monitoring of developments and activities in the region around Denali; resulting in our keeping better informed and able to have timely input on many situations that potentially might affect the reserve. Many developments and land use changes, however, now occur before park staff finds out. Better methods of keeping informed need to be developed.

I-420.032: Increase Development and Implementation of Inventory and Long-term Ecological Monitoring Activities

The service must develop more baseline information and monitoring programs to understand the structure and functioning of the Denali ecosystem. At that point, we might be able to determine if and when human alterations are happening from local and regional developments and activities, so prevention and mitigation actions could be taken. The service will seek to develop baseline information regarding park resources based on standards set by the Inventory and Monitoring Guideline NPS-75 (USNPS 1992) and

international programs such as the Global Terrestrial Observing System (GTOS) (Heal 1993) and the Biosphere Reserve Integrated Monitoring (BRIM) program (Resource Inventory and Mapping I-220). The service would also develop and implement monitoring activities within the Denali National Park Biosphere Reserve to provide a basis for scientific research and management activities and contribute to the understanding of environmental change. It would (1) develop standardized, reliable, and widely applicable methods for collecting and comparing data and assuring quality control; and (2) seek support for the monitoring of different ecosystem components (e.g., vegetation, soil, air, water, etc.), including indicators of biological change (Long Term Ecological Monitoring Program I-210).

E. Interpretation

I-420.041: Promote Increased Environmental Education and Training

An important purpose of a biosphere reserve is the generation and dissemination of knowledge, environmental education, and training of specialists and practitioners. The service would increase the environmental education, training, and information dissemination functions of the reserve. Planning for this initiative would be meshed with regular interpretive programming, but would be aimed at heightening the awareness of public school children, local residents, and visitors on environmental matters. Information derived from monitoring and research would be widely publicized, using the print and/or electronic media in an appropriate format.

The park would sponsor field training of specialists in ecology, life sciences, and park management periodically. This could be accomplished through internships, invitational travel, and short seminars.

I-420.042: Plan, Construct, Furnish and Equip Interpretive Facilities to Accommodate Environmental Education

The service would plan, construct, furnish and equip interpretive facilities that can accommodate environmental education activities and that would be accessible year-round by road. The facilities need to accommodate lecture space, laboratory space, storage facilities, and perhaps limited lodging. This facility is recommended in the Entrance Area and Road Corridor Development Concept Plan.

I-420.043: Staff and Manage the Environmental Education Function

The service would be responsible for overseeing the day-to-day management of the environmental education activities. An onsite education specialist would be recruited and hired to coordinate activities and train local teachers, agency personnel, docents, and

volunteers in environmental education philosophy and techniques.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Reserve Mgmt Plan		10.0/0.1	10.0/0.1		20.0/0.2
- Conference Support		2.0/0.0	2.0/0.0	2.0/0.0	6.0/0.0
RESEARCH					
- Science Operations	150.0	150.0	150.0	150.0	600.0
- History of Scientific Studies		40.0/0.2	40.0/0.2	40.0/0.2	120.0/0.6
- Abstract Translation		1.5/0.0	1.5/0.0	1.5/0.0	4.5/0.0
MONITORING					
- Monitor Adjacent Land Use	10.0/0.1	10.0/0.1	10.0/0.1	10.0/0.1	40.0/0.4
INTERPRETATION					
- EE Program & Training		10.0/0.2	10.0/0.2	10.0/0.2	30.0/0.6
- EE Facilities		30.0	30.0	5.0	65.0
- EE Specialist			45.0/1.0	45.0/1.0	90.0/2.0
TOTALS	160.0/0.1	253.5/0.6	298.5/1.6	263.5/1.5	975.5/3.8

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Bick, K., R.A. Janke, R.M. Linn, R.O. Peterson, D. Rutkowski, and J.R. Sottlemyer. 1985. Isle Royale Biosphere Reserve: Volume I, History of scientific studies; Volume II, A Bibliography of Scientific Studies. U. S. MAB Report No. 11. USNPS, Atlanta, Georgia.

Franklin, J. F., and S. L. Krugman. 1979. Selection, management and utilization of Biosphere Reserves - Proceedings of the Symposium on Biosphere Reserves, May 1976. General Technical Report PNW-82. U. S. Forest Service, Pacific Northwest Forest Experiment Station, Corvallis, Oregon.

Heal, O. W., ed. 1993. Towards a global terrestrial observing system (GTOS). MAB Digest 14, IGBP Global Change Report 26. UNESCO, Paris, France.

Heyward, P., R. G. Wright, and E. E. Krumpe. 1984. Glacier National Park Biosphere Reserve: A history of scientific studies. Volume 1. A narrative description of scientific studies. U. S. MAB Report No. 9, Cooperative Park Studies Unit, University of Idaho, Moscow, Idaho.

Heyward, P., R. G. Wright, and E. E. Krumpe. 1984. Glacier National Park Biosphere Reserve: A history of scientific studies. Volume 2. Bibliography, subject annotations, tabular data summaries, and appendices. U. S. MAB Report No. 9, Cooperative Park Studies Unit, University of Idaho, Moscow, Idaho.

Mack, A.; W. P. Gregg, Jr.; S. P. Bratton; P. S. White. 1981. A survey of ecological inventory, monitoring and research in U. S. National Park Service Biosphere Reserves. Research/Resource Management Report No. 49, Uplands Field Research Laboratory, Great Smoky Mountains National Park. Gatlinburg, Tennessee.

Peine, J. D. ed. 1985. Proceedings of the conference on the management of Biosphere Reserves, November, 1984. Great Smoky Mountains National Park, USNPS, Gatlinburg, Tennessee.

Sax, J. L., and R. B. Keiter. 1988. Glacier National Park and its neighbors: A study of federal interagency relations. In: Simon, D. J. (ed.) Our Common Lands: Defending the National Parks. National Parks and Conservation Association, Island Press, Covelo, California.

Taylor, D.L. and P. Haertel. 1993. Circumpolar biosphere reserve network for monitoring change. 5th World Wilderness Congress, Tromso, Norway.

UNESCO. 1974. Task force on: criteria and guidelines for the choice and establishment of biosphere reserves. UNESCO, Paris, France.

UNESCO. 1984. Action plan for biosphere reserves. Nature and Resources 20(4):1-12. UNESCO, Paris, France.

UNESCO. 1992. Report of the first meeting of the advisory committee for biosphere reserves. UNESCO, Paris, France.

U. S. MAB Biosphere Reserve Action Plan Committee. 1993. Draft Biosphere Reserve action plan. National Science Foundation, Arlington, Virginia.

U. S. MAB Coordinating Committee. 1990. Bibliography on the international network of Biosphere Reserves. Publication 9799. U. S. Department of State, Bureau of Oceans and International Environmental Science and Technology, Washington, D.C.

LANDS MANAGEMENT

PROJECT CODE: DENA-I-500

SERVICEWIDE ISSUES:

N18	Visitor Use Impacts on Backcountry Park Resources
N22	Impacts to Recreation (Development) Zones
N20	Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them
C17	Control of Environmental Impacts

STATEMENT OF PROBLEM

Present Condition

Denali National Park and Preserve has an external boundary containing approximately 6,059,263 acres. Two-thirds of this acreage was added to Mt. McKinley National Park by ANILCA in 1980. Within this boundary are 2,442.72 acres of patented inholdings, 2,555.59 acres of unpatented mining claims, 38,266 acres of Native corporation selections, and 5,663 acres of state selections. Four major right-of-way easements include the Alaska Railroad at 200 feet wide for 36 miles, the George Parks Highway (Alaska Highway #3) at 300 feet wide for 7 miles, the 4.5-mile Kantishna section of the Park Road at 200 feet wide, and 7 miles of the Golden Zone/Dunkle road, at 100 feet wide. Each group of inholdings presents management challenges. Submerged lands under navigable waterways total an estimated 417.5 acres and are owned by the state of Alaska.

Current Management Actions and Results

The NPS has had a land acquisition program for patented and unpatented mining claims in the Kantishna Hills since 1990. The Record of Decision for the Cumulative Effects of Mining in Denali Environmental Impact Statement steered a course to purchase all mining claims in the park because the impacts from mining were in derogation of park values and because the patented properties were available for uncontrolled conversion into recreation properties with resultant vehicular traffic pressures on the park road wildlife experience. Twenty-one patented claims and eight unpatented claims and significant parts of five other patented claims have been purchased through this program. At the same time, 20-30 unpatented claims have been abandoned for failure to pay the rental fees initiated nationwide in 1992 or declared null and

void for failure to prove validity (discovery). Approximately $2,000,000 is budgeted for Kantishna land acquisition in FY98. Only three mining Plans of Operations have been approved since 1985, and mining has not been conducted on those properties.

The Native corporation selections are in two areas. Doyon has selected 25,251 acres near Lake Minchumina. Selection of 3,185 acres by a group identifying itself as Minchumina Natives, Inc. is under court challenge. While the selections do not present near-term land management changes, natural resource harvesting and mineral exploration would be possible under corporate ownership. The Cantwell Village Corporation and AHTNA, Inc. have selected 9,720 acres on the west-facing slopes above Cantwell Creek. The area is open for subsistence harvest now and harvest levels would not likely increase in the near future if ownership were to change. Long term options, should the land become private, are unknown.

The state of Alaska owns one section of land within the southwest preserve boundary. No management implications are significant. The state has selected 5,663 acres southwest of Cantwell. Most of the land is too steep for development, but the potential exists for significant impacts to wildlife management.

Twelve individual Alaska Native Claims Settlement Act (ANCSA) Native allotments, totaling 910 acres, are in the northwest preserve. Should land development take place on these allotments, there would be potential for significant impacts due to (1)improved access, (2)requests for permitted resource harvesting, and (3) increased subsistence uses. No development or use occurs on an AHTNA, Inc. inholding of 375 acres on slopes high above Cantwell Creek, and none is anticipated in the near future.

The Entrance Area and Road Corridor Development Concept Plan (USNPS 1997a) proposes to explore partnering with the State and Denali Borough should opportunities develop for outside park seasonal housing, office space, and visitor facilities. No specific sites have been proposed for development, and it is unknown what impacts to park or outside park lands might result from these considerations.

Cooperative planning with the state of Alaska and local governments is stressed in the South Side Development Concept Plan. Use by hikers and snowmachiners of park areas near the Peters Hills/Dutch Hills and the Dunkle Hills is expected to increase with implementation of this plan. The state right of way (ROW) into the Dunkle Hills will remain open as access to the Golden Zone Mine outside the park and for use as a hiking and biking trail. Facility recommendations are expected in a future planning document after title questions are settled concerning the ROW.

Four inholdings totalling 131 acres near the Tokositna River are in an area that received approval in 1990 for a land exchange with the state. The boundary at that area follows an unmarked township line and is not conducive to cohesive management.

The most important boundary change identified in the park GMP was a proposal to exchange the 90,000-100,000 acres of the Wolf Townships west of Healy for other park land. A proposal on this issue jointly presented by the state and NPS went to the public in 1987 and met a highly negative reception. Although some discussions have occurred since, no consensus has been reached on ways in which to implement the GMP on this issue.

A 1990 land exchange with the state of Alaska was planned for the Swift Fork area in the western part of the park/preserve additions to utilize the Swift Fork itself as the park boundary. The exchange was halted when concerns were raised that new park acreage was being made available to sport hunting.

A North Access Feasibility Study (USNPS 1997c) was completed in cooperation with the State of Alaska. Recommendations on rights of way would have to wait for the development of an environmental impact statement, should it be decided to further evaluate the impacts of such a project.

The surface estate of the Stampede Mine (5 patented mining claims) was deeded to the United States in 1979. At the same time, mineral interests on these claims were deeded to the University of Alaska. Intended to be used as an educational laboratory, this location was determined to be too inaccessible for the University's needs. In February, 1998, the university consented to a negotiated takings of their mineral interests, via Section 120 of Public Law 105-83. In return the university received $350,000 from the NPS as well as various commitments from the Department of the Army. The university intends to establish their facility at the Golden Zone Mine in the Dunkle Hills.

The Denali Borough is entitled to 50,000 acres from state lands as part of its incorporation. Much of the land selected is in the Wolf Townships, and although direct boundary conflicts may not become significant in the near future, any Borough plans for settlement, leasing, or other types of development could impact park resources such as caribou movements, air and water resources, and wilderness resources. The Tanana Basin Area Plan (updated 1991) designates wildlife habitat and recreation as the primary surface uses for the Wolf Townships. Land disposals are a prohibited use in the subregion, but material sales, land leases and permits that are not specifically prohibited may be allowed. This prohibition on land disposals could disappear should the borough selections be validated.

Denali National Park has more than 300 miles of historic routes identified by the Alaska Department of Natural Resources (DNR) as RS2477 highways. These include routes through the Stampede corridor all the way to Kantishna, within the Kantishna Hills, and radiating out from Kantishna north and northwest. None of these routes has yet been asserted by the state of Alaska, although all have a quantity of documentation on file. Although a moratorium has been twice enacted by Congress on proposed federal regulations dealing with the requirements for this program, the state already has procedures in place. Issues including evidentiary requirements

are moving toward the Supreme Court from the 9th Circuit and other courts. Until those decisions are made, it is unlikely that we will know more about the local RS2477 situation. Significant changes to the park's effort to control vehicle access could result from successful assertions of RS2477 routes so close coordination with DNR staff is essential.

Waterways within Denali National Park and Preserve which have been asserted navigable include a 4 mile section of the Tokositna River, 18 miles of the Kantishna River, about 28 miles of the Muddy River, and the Bearpaw River downstream of Diamond, for about 11 miles.

RECOMMENDED ACTIONS

A. Program Administration and Planning

I-500.001: Update Land Protection Plan

The Denali Land Protection Plan (LPP) was prepared concurrently with the General Management Plan of 1986. The LPP is scheduled to be updated every two years, but only acquisition priority lists have been updated.

B. Research

I-500.011: Map Ideal Boundaries of Park

Create an interdisciplinary team to review the park boundaries and recommend segments that could be moved to be more visible or useful for wildlife and habitat protection.

I-500.012: Research RS2477 Routes

Create files on all RS2477 routes within the park using DNR files as appropriate. Work with the state, BLM, and park and other archives to prepare for court cases.

C. Mitigation

I-500.021: Continue Mining Claim Acquisition Program for Kantishna

The service will implement the 1994 Denali Task Force Report recommendation to acquire development rights and/or property to retain the existing character and approximate level of commercial use at Kantishna. Work in cooperation with the Lands and Physical Resources Teams at the Alaska Support Office to finalize appraisals, make land purchase offers, negotiate purchases, and justify future appropriations.

I-500.022: Pursue Tokositna Land Exchange

Work with the state of Alaska, especially the Division of Parks and Outdoor Recreation, to finalize a Tokositna/Coffee River Land Exchange, as outlined in the 1990 draft environmental assessment.

I-500.023: Pursue Cooperative Agreements with State of Alaska Regarding Wolf Townships

Meet with local legislators and administrators to work out a pro-active approach to protecting wildlife habitat in the Wolf Townships.

I-500.024: Renew Swift Fork Land Exchange Talks with State of Alaska

Work with the state of Alaska and Sierra Club to meet objections to 1990 proposed Swift Fork Land Exchange.

I-500.025: Dutch Creek Boundary Change

Work with the state of Alaska and local miners to create a park boundary in the Dutch Creek area that doesn't place an unnecessary burden on mining claimants and which is more easily used by law enforcement to protect park wildlife populations.

D. Monitoring

I-500.031: Continue to Map and Track Park Inholdings

Keep files on in-park land transactions, and work with the Lands Team at AKSO to update maps. Integrate GIS technology into record-keeping and map production.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Update LPP	35.0/0.5	0/0	7.0/0.1	0/0	42.0/0.6
RESEARCH					

- Research RS2477 Routes	1.0/.02	2.0/.04	7.0/0.1	7.0/0.1	17.0/0.26
- Review Park Boundaries	5.0/0.1	5.0/0.1	2.0/0.1	2.0/0.1	14.0/0.4
MITIGATION					
- Tokositna Land Exchange	2.0/0.1	0/0	0/0	0/0	2.0/0.1
- Wolf Township Discussions	10.0/0.2	10.0/0.2	7.0/0.1	0/0	27.0/0.5
- Swift Fork Land Exchange	2.0/0.1	0/0	0/0	0/0	2.0/0.1
- Dutch Creek Land Exchange	3.0/0.1	0/0	0/0	0/0	3.0/0.1
MONITORING					
- Track and Map Inholdings	1.0/0.1	1.0/0.1	1.0/0.1	1.0/0.1	4.0/0.4
TOTALS	59.0/1.22	18.0/0.44	24.0/0.5	10.0/0.3	111.0/2.46

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

State of Alaska. 1994a. The RS2477 project newsletter #1. Division of Lands, Alaska Department of Natural Resources.

State of Alaska. 1994b. Access in Alaska - newsletter #2. Division of Lands, Alaska Department of Natural Resources.

State of Alaska. 1995. The RS2477 project newsletter #3. Division of Lands, Alaska Department of Natural Resources.

USNPS. 1986. General Management Plan, Denali National Park and Preserve. U.S.

Department of the Interior, NPS, Alaska Regional Office, Anchorage, Alaska.

USNPS. 1990a. Environmental Assessment for a Proposed Swift Fork Land Exchange, Denali National Park and Preserve. U.S. Department of the Interior, NPS, Alaska Regional Office, Anchorage, Alaska.

USNPS. 1990b. Record of Decision for the Final Environmental Impact Statement on the Cumulative Impacts of Mining, Denali National Park and Preserve. U.S. Department of the Interior, NPS, Alaska Regional Office, Anchorage, Alaska.

USNPS. 1990c. Environmental Assessment for a Proposed Coffee River/Tokositna River Land Exchange, Denali National Park and Preserve. U.S. Department of the Interior, NPS, Alaska Regional Office, Anchorage, Alaska.

USNPS. 1997a. Entrance Area and Road Corridor Development Concept Plan and Final Environmental Impact Statement, Denali National Park and Preserve. U.S. Department of the Interior, NPS, Denali National Park and Preserve, Alaska.

USNPS. 1997b. South Side Development Concept Plan, Denali National Park and Preserve. U.S. Department of the Interior, NPS, Denali National Park and Preserve, Alaska.

USNPS. 1997c. North access feasibility study, Denali National Park and Preserve. U.S. Department of the Interior, NPS, Denali National Park and Preserve, Alaska.

FRONTCOUNTRY MANAGEMENT

PROJECT CODE: DENA-I-610

SERVICEWIDE ISSUES:

- N05 Degradation of Park Resources Due to Non-Native Plants
- N07 Disruption of Natural Fire Regimes
- N11 Degradation of Park Water Quality
- N15 Noise, Visual, and Biological Impacts Related to Aircraft Overflights
- N24 Other Issues

STATEMENT OF PROBLEM

Present Condition

The frontcountry of Denali National Park and Preserve includes the entrance area, the road corridor extending approximately 90 miles into the park interior, and the Kantishna area. The park road begins at Alaska State Highway 3. During the summer, the approximately 14-mile paved section extending to the Savage River is open to private vehicles. Beyond the Savage River the road is restricted to buses and permitted traffic. This part of the road extending into the park interior is gravel, relatively narrow, and winding in several areas.

The road corridor exists as a narrow band (150' either side of road centerline) of non-wilderness within the wilderness designated lands of Denali National Park. A series of non-wilderness, developed nodes in the frontcountry include facilities such as airstrips, visitor accommodations, rest areas, employee housing, various maintenance shops, trails, campgrounds, administrative buildings, and utilities. Visitor services are provided by the National Park Service throughout the frontcountry, by concessions operations in the entrance area, and by private businesses in the Kantishna area. Kantishna businesses also provide some visitor services in the park, according to terms of concessions permits.

Development is concentrated near the park entrance, where visitor services inside the park are complemented by private development immediately outside the boundary. This same area is also

bisected by a stretch of the Alaska Railroad linking Anchorage and Fairbanks. Other parts of the park such as the Dunkle Hills and Tokositna areas may be affected by development upon implementation of the South Side Denali Development Concept Plan. Development in these areas would raise similar issues to those in which existing visitor use is concentrated.

The wide variety of administrative and public uses tied to entrance area, road corridor, and other facilities results in a plethora of environmental concerns. Many of the impacts caused by these uses are subtle and incremental and have multiple implications throughout the ecosystem. Impacts are compounded by the high level of visitor use concentrated within these areas.

Significant resource issues associated with frontcountry development and uses include:

- The effects of road maintenance and use on natural resources, especially wildlife (Project Statement DENA-I-670).
- Stormwater runoff from paved and compacted areas, which may carry petroleum products and other pollutants (Project Statement DENA-N-210).
- Soil compaction, social trail development, and impacts of consistent, heavy use of park campgrounds.
- Insufficient funding to maintain trails, leading to erosion and development of multiple tread trails.
- Noise from aircraft, road traffic, and railroad operations (Project Statements DENA-I-650 and DENA-I-670).
- Hazardous trees (Project Statement DENA-N-341).
- Exotic plant encroachment (Project Statement DENA-N-342).
- Air quality degradation from motor vehicles, trains, generator operations, and campfires (Project Statement DENA-N-110).
- Food storage and solid waste management issues affecting wildlife (Project Statement DENA-N-364.2).
- Solid waste management and associated land use and contaminant issues (Project Statement DENA-I-700).
- Pest management (Project Statement DENA-N-510).
- Sewage treatment and effects on water quality (Project Statement DENA-N-210).

- Resources extraction for administrative purposes (Project Statement DENA-I-800).
- Wildlife habituation to people and motor vehicles (Project Statement DENA-I-670).
- Hazardous materials management (Project Statement DENA-I-700).
- Wildland fire hazards (Project Statement DENA-N-520).
- Loss of wildlife habitat and alteration of movement patterns.

Current Management Actions and Results

Frontcountry management actions currently being taken by Research and Resource Preservation Division staff include compliance reviews of all projects in the frontcountry and reviews of concessioner operating plans. A variety of specific resource management projects are also underway (project statements referenced above).

Three recently completed documents provide direction for frontcountry management. The Entrance Area and Road Corridor Development Concept Plan and Environmental Impact Statement outlines development concepts to be implemented during the next 15-20 years along with specific proposals for improving resource protection. Resource protection measures called for include additional monitoring, especially along the park road, and full implementation of the Visitor Experience and Resource Protection (VERP) program.

The South Side Denali Development Concept Plan and Environmental Impact Statement provides for resource-based destination experiences on the south side. The proposed action includes development of a visitor center and other facilities in the Tokositna area, additional visitor facilities along the Parks Highway, and improved visitor access to the Dunkle Hills area. While much of this potential development would be outside the park boundary and generally within Denali State Park, trails in the Tokositna, Chelatna Lake areas, and trailheads in Dunkle Hills area could result in significantly greater visitor use within the national park boundary. Because of limited resource information and uncertainty in predicting impacts from additional use, the south side plan calls for studies of natural and cultural resources as well as human uses before development begins.

The statement for management (1995, with update as a strategic plan completed in 1997) provides overall management direction for park planning as well as for issues not addressed comprehensively in recent planning documents. For example, while the Entrance Area and Road Corridor DCP/EIS affects both concessions and aircraft operations, the statement for management provides the overall direction on these issues, including the needs for concessions management and aviation management plans.

Implementing the Entrance Area and Road Corridor and the South Side development concept plans and following the management direction in the statement for management will require the following resource protection activities:

- Plan review: for adequacy of mitigation measures and to determine whether site selection and design of new facilities, including trails, is appropriate.

- Completion of additional site-specific environmental compliance: several components of the development concept plans require additional compliance such as review for the appropriate categorical exclusion that may apply, completing an environmental assessment tiering from the overall EIS, or completing a statement of findings.

- Review of additional planning needs: to ensure that updated statements for management address fully the need for planning in areas not covered by the 1986 general management plan, the Entrance Area and Road Corridor DCP/EIS, or the South Side DCP/EIS. For example, a development concept plan for the Kantishna Hills area will need to be prepared once additional land ownership issues are resolved.

- Resource studies: the South Side Denali DCP/EIS calls for studies of natural and cultural resources and human uses in the planning area prior to development. Areas affected within Denali National Park include the Tokositna, Dunkle Hills, and Chelatna Lake areas.

- Resource monitoring: to implement fully the requirements of the 1986 GMP, the Entrance Area and Road Corridor DCP/EIS, and the South Side DCP/EIS. Monitoring of resource conditions is an essential component of new development, changes in road use, and implementing the Visitor Experience and Resource Protection (VERP) program called for in the Entrance Area and Road Corridor DCP/EIS.

RECOMMENDED ACTIONS

Recognizing the complexity of frontcountry management according to the plans mentioned above, individual project statements have been prepared with detailed discussions of and recommendations for the various issues. These include:

- DENA-I-650 Aircraft Management
- DENA-I-670 Road Use Impacts to Natural Resources
- DENA-I-700 Hazardous Materials and Waste Management
- DENA-I-800 Administrative Use of Resources
- DENA-N-110 Air Quality Management
- DENA-N-210 Water Resources Management

- DENA-N-341 Hazardous Tree Management
- DENA-N-342 Exotic Plant Management
- DENA-N-364.2 Grizzly and Black Bear Management
- DENA-N-510 Integrated Pest Management
- DENA-N-520 Wildland Fire Ecology and Management

Various other project statements also have minor components relating to frontcountry management.

A. Program Administration and Planning

I-610.001: Ensure That Resource Protection Needs are Met During Implementation of the Entrance Area and Road Corridor Development Concept Plan

Research and Resource Preservation Division personnel will need to continue to participate on park plan implementation teams to ensure that projects address thoroughly the primary resource management issues in the frontcountry. Review of mitigation measures and ensuring that these measures are in place during plan implementation will be critical division contributions to the entrance area and road corridor planning process.

I-610.002: Complete Site-Specific Environmental Compliance Necessary for Implementing the Entrance Area and Road Corridor Development Concept Plan

As mentioned previously, several components of the Entrance Area and Road Corridor DCP/EIS require additional compliance such as review for the appropriate categorical exclusion that may apply, completing an environmental assessment tiering from the overall EIS, or completing a statement of findings. Research and Resource Preservation Division personnel will be responsible for determining the appropriate level of compliance necessary, developing resource information upon which analyses can be based, and for taking a lead role in completing compliance documents.

I-610.003: Develop Standard Operating Procedures for Long-Term Monitoring Efforts Necessary to Implement Fully the Visitor Experience and Resource Protection (VERP) Program

Comprehensive monitoring would be required throughout the frontcountry to implement fully the VERP program. Since monitoring results will be essential to management decisions on resource protection and visitor use levels, it will be important to standardize monitoring methods for all of the prescriptive subzones. These subzones as developed in the Entrance Area and Road Corridor Development Concept Plan define the specific visitor experience and resource conditions desired within the frontcountry. For example, much of the area zoned as "developed" in the 1986 general management plan has now

been zoned with greater restrictions such as "Backcountry Day Use". These specific subzones must first be more clearly defined in terms of resource conditions and the desired visitor experience, and then test monitoring procedures should be implemented. Standard operating procedures can then be developed based on the results of this preliminary monitoring.

I-610.004: Update GIS and Other Databases for Frontcountry Planning and Management

Development concepts in the Entrance Area and Road Corridor DCP/EIS were generated based on recent aerial photography and vegetation mapping. However, additional mapping work, including development of updated, detailed topographic maps, is necessary to produce specific site plans. While most of this could be done by the Information Resources Branch, the park may need to contract for the remainder of the mapping work. (Also see Project Statement DENA-I-220.)

B. Research

I-610.011: Conduct Research to Accurately Define Resource Conditions and Expected Visitor Experience in the Frontcountry

The Entrance Area and Road Corridor DCP/EIS delineates several management subzones. This prescriptive zoning has been based on information available to date. However, additional information on resource conditions and the expected visitor experience is needed to more accurately describe each subzone, in turn facilitating design and implementation of the monitoring called for under the VERP program. Information on resource conditions needed includes effects on wildlife, the level of soil compaction, impacts to vegetation, and the extent of informal trail development in each of the subzones. Information on the visitor experience would need to answer the basic questions of the type of experience visitors expect within the subzones in the frontcountry and whether or not their expectations are met.

I-610.012: Continue Trails and Nodes Monitoring Program Along Road Corridor

Denali National Park began a comprehensive trails and nodes monitoring program in 1995. The monitoring program was designed to provide information needed to consistently assess the impact status of trails and nodes. A monitoring system is being developed to detect unknown impact areas through surveys for new trail-node formation, to quickly and reliably establish the current impact status of trail-nodes through qualitative evaluation, and to track conditions at certain problem or sensitive sites through quantitative monitoring. Because of changing conditions along the road corridor and the need to identify long-term trends, this program must be continued.

I-610.013: Conduct Research on Natural and Cultural Resources and Human Uses in Areas of the Park that could be Affected by Development Called for in the South Side Denali Development Concept Plan

The South Side Denali Development Concept Plan calls for studies of natural and cultural resources and human uses in the planning area before development begins. The objectives of the studies would be to provide broad spectrum resource data useful in environmental analyses and in addressing human use issues; providing site-specific resource information for facility design and siting; and filling voids in existing information on sensitive species and ecosystem functions. Site-specific tasks would include soils mapping and boring, wetland delineation, and wildlife and vegetation surveys.

C. Mitigation

I-610.021: Implement Mitigation Measures for New Development in the Frontcountry

The Entrance Area and Road Corridor DCP/EIS and the South Side Denali DCP/EIS call for a variety of mitigation measures, ranging from controls on visitor use to stipulations on building construction. These mitigation measures have been developed to minimize or avoid resource impacts. Research and resource preservation staff will need to be involved in site design for new facilities and trails and will need to assist in directing plan implementation to ensure that mitigation measures are followed.

I-610.022: Implement Resource Protection Measures Called for in the 1986 General Management Plan and the Entrance Area and Road Corridor Development Concept Plan

These plans include resource protection measures such as removal or relocation of facilities, relocation of trails and subsequent restoration of affected areas (removal of social trails, alleviate soil compaction and damage to vegetation), regulations on traffic on the park road, and conditions governing maintenance and repair of the park road.

I-610.023: Mitigate Effects from Consistent Heavy Use of Park Trails and Campgrounds, Including Soil Compaction, Erosion, and Development of Multiple Tread Trails

Some visitor use areas in the frontcountry receive consistent, heavy use each day during the summer season and are subject to severe soil compaction and to development of multiple tread, informal trails in the general area. Even areas in which use may be relatively light may be prone to development of multiple tread trails. This occurs primarily at popular departure points for hiking into the backcountry. A formal

mitigation program is needed so that these impacts from visitor use can be alleviated before long-term resource damage occurs.

I-610.024: Improve Management of Food Storage and Solid Waste in the Frontcountry to Minimize Impacts to Wildlife

Concentrated visitor use at development nodes within the frontcountry results in wildlife impacts from improper food storage and improper disposal of solid wastes. Upgrades in both operating procedures and equipment are necessary. Upgrades include such things as improved maintenance of the electric fence around the trash transfer station, installation of lockable lids on dumpsters, and removal of non-bear resistant trash cans.

D. Monitoring

I-610.031: Monitor Vehicle-Wildlife Interactions Along the Road Corridor

This need is discussed in both the 1986 GMP and the Entrance Area and Road Corridor DCP/EIS. The latter document calls for wildlife monitoring for a total of five years before considering changing the limits for various types of traffic on the park road. Project Statement DENA-I-670 provides a comprehensive discussion of road use impacts and proposed management actions.

I-610.032: Monitor Visitor Satisfaction Levels Along Road Corridor

The Entrance Area and Road Corridor DCP/EIS calls for monitoring visitor satisfaction levels in addition to monitoring wildlife and other resource conditions. This monitoring will require additional visitor surveys to pursue work done during the 1995 and 1996 seasons. While these surveys will generally be conducted by cooperating social scientists and coordinated by the USGS Biological Resources Division, Research and Resource Preservation Division personnel will continue to have an active role in survey design and analysis as well as in presenting recommendations to park management on road use and traffic levels (DENA-I-670).

I-610.033: Monitor Resource Impacts of New Development

Several elements of the Entrance Area and Road Corridor DCP/EIS include a provision to monitor effects on resources after implementing the initial phases of proposed new development. For example, campground sites along the Nenana River and in the Kantishna Hills would be phased in, starting with 5-10 sites and monitoring resource impacts before determining whether or not to develop additional sites. Similar monitoring would also be necessary in areas affected by south side development such as the Tokositna, Chelatna Lake, and Dunkle Hills areas.

I-610.034: Implement Fully the Visitor Experience and Resource Protection (VERP) Program in the Frontcountry

Implementing the VERP program requires a long-term, intensive monitoring effort throughout the frontcountry. Management subzones prescribed in the Entrance Area and Road Corridor DCP/EIS must first be more clearly defined in terms of resource conditions and the desired visitor experience. This will require gathering and analyzing additional information, much of which will be available based on the monitoring efforts described above. Once these new data are available, a monitoring program will need to be designed and implemented. Recommendations for changes to visitor use levels will need to be made as necessary to park management based on results of continued monitoring.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Env. Compliance	60.0/1.0	60.0/1.0	60.0/1.0	60.0/1.0	240.0/4.0
- SOPs for VERP Program	30.0/1.5	30.0/1.5	30.0/1.5	0.0/0.0	90.0/4.5
- Update GIS/Other Data	30.0/0.5	30.0/0.5	15.0/0.25	0.0/0.0	75.0/1.25
RESEARCH					
- Resource Conditions	30.0/0.5	30.0/0.5	15.0/0.25	0.0/0.0	75.0/1.25
- Trails and Nodes Monit.	15.0/0.3	15.0/0.3	15.0/0.3	15.0/0.3	60.0/1.2
- South Side Studies	50.0/0.6	50.0/0.6	50.0/0.6	30.0/0.5	180.0/2.3
MITIGATION					
- New Development	10.0/0.2	10.0/0.2	10.0/0.2	10.0/0.2	40.0/0.8
- Resource Protection	20.0/0.4	20.0/0.4	20.0/0.4	50.0/0.5	110.0/1.7
- Use Impacts	60.0/1.2	60.0/1.2	60.0/1.2	60.0/1.2	240.0/4.8
- Food Storage/Solid wst.	30.0/0.5	30.0/0.5	30.0/0.5	30.0/0.5	120.0/2.0
MONITORING					
- Vehicle-Wildlife Int.	*	*	*	*	*
- Visitor Satisfaction	*	*	*	*	*
- New Development	10.0/0.2	10.0/0.2	10.0/0.2	10.0/0.2	40.0/0.8

- Implement VERP Prog.	150.0/2.5	150.0/2.5	150.0/2.5	150.0/2.5	600.0/10.0
TOTALS	495.0/9.4	495.0/9.4	465.0/8.9	415.0/6.9	1870.0/34.6

* Refer to Project Statement DENA-I-670 for staffing and funding information.

COMPLIANCE

The 1986 general management plan and the Entrance Area and Road Corridor DCP/EIS include compliance for the monitoring and mitigation actions outlined above. The park will ensure that all appropriate NEPA, NHPA, and ANILCA compliance documents are complete before initiating any project. The documents will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

USNPS. 1986. General Management Plan/Land Protection Plan/Wilderness Suitability Review, Denali National Park and Preserve, Alaska. U.S. Department of the Interior, NPS, Denver Service Center.

USNPS. 1995. Statement for Management, Denali National Park and Preserve. U.S. Department of the Interior, NPS, Denver Service Center.

USNPS. 1996. Trails and Nodes Monitoring Program: Report on Progress at End of 1995 Season. Draft report on file, Denali National Park and Preserve.

USNPS. 1997a. Entrance Area and Road Corridor Development Concept Plan and Environmental Impact Statement, Denali National Park and Preserve. U.S. Department of the Interior, NPS, Denver Service Center.

USNPS. 1997b. South Side Denali Development Concept Plan and Environmental Impact Statement. U.S. Department of the Interior, NPS, Denver Service Center.

USNPS. 1997c. Strategic plan, Denali National Park and Preserve. U.S. Department of the Interior, NPS, Denali National Park and Preserve.

WILDERNESS MANAGEMENT

PROJECT CODE: DENA-I-620

SERVICEWIDE ISSUES:
- N19 Loss of Park Resources Due to Consumptive Practices
- N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Introduction

One of the special values of Denali is that an overpowering feeling of wilderness is still available to all types of users. Visitors of all physical abilities may travel the Park Road and pass through a rugged wilderness area that lacks the visual intrusion of extensive facilities, to observe, at close range, both wildlife in its natural wilderness habitat and world class scenery. The premier vistas and opportunities for solitude in the park are consistent with the wilderness setting that visitors expect of Alaska parks.

For the backcountry traveler, Denali is a very accessible wilderness, by Alaska standards, because of the road corridor and bus transportation. However, the lack of maintained trails, signs, bridges, and designated camps creates a challenging, self-reliant, and exploratory wilderness experience. On a spectrum of opportunities in national park system wilderness areas, Denali lies between the backcountry of parks in the contiguous 48 states where multiple trails, signage, and even shelters exist, and the more remote Alaska parks like Gates of the Arctic that provide little or no road access.

Another important factor that enhances wilderness within Denali is the high quality of lands that surround it. There is still a chance to direct the growth of nonwilderness-dependent wildland recreation activities toward these lands. This means that the wilderness designated lands in Denali, which are limited in quantity in respect to the rest of Alaska, can still be preserved for wilderness dependent uses. These aspects of the outdoor recreation opportunity spectrum can reasonably be accommodated elsewhere. Adjacent landowners and managers should be consulted regarding this perspective and opportunity.

These special resource conditions and opportunities for the protection of wilderness values at a popular, modern national park are a reflection of Denali's administrative history. The park's origins are loosely linked to the "old line" large, western parks established during the first two decades of this century. Because of its early designation within the national park system, Denali evolved to become one of the core parks in the national system. Still, development and use were limited for many years because of the park's remote location and by park plans and management decisions that have reflected a strong wilderness protection philosophy. This combination of factors has protected a type of wilderness opportunity for visitors that has been largely lost in many other areas.

Unfortunately, this long history of protection can also create a false sense of security for future protection of wilderness values at Denali. Alaska wilderness areas are often perceived as being adequately protected by virtue of their remoteness and hugeness. It is true that the legal designation of wilderness under ANILCA did take the first step toward the control of consumptive uses such as logging, new mining claims, or other forms of development. A second tier of uses authorized by ANILCA exist, however, that have the potential of compromising the special qualities of designated areas or potential areas of future wilderness if they are not managed carefully. These include:

-Motorized uses such as snowmachines, ATVs (all terrain vehicles), motorboats, and landings by airplanes for traditional activities
-Commercially guided activities
-Increasing levels of private recreational use as a result of Alaska's growing popularity and population
-Continued mining activity on existing claims
-Significant numbers of private inholdings leading to ANILCA Title IX claims for access routes or development activities on the inholding that are incompatible with wilderness values
-Commercial guiding for big game hunting
-Use of mountain bikes

Similarly the assertion and development of R.S. 2477 rights of way could complicate resource protection efforts.

The impacts from these authorized uses is compounded by the general lack of knowledge on the condition of wilderness resources, the level of human activity, and the effects that activity can have on the resource. Great care will be needed to assure that ANILCA standards (traditional, non-detrimental to resources) are met to truly protect the wilderness resources of Denali for the future.

Historical Context

Before 1972, annual park visitation for the entire park was low, and access to and into the park was difficult. Wilderness hiking was just starting to become popular. There were no limits, permits, official recordkeeping, or regularly maintained trail systems. Open fires were allowed throughout the park. The use of the backcountry and the lack of regulation were not creating significant impacts.

A growing interest in Alaska and wilderness hiking, as well as the completion of the George Parks Highway to the park entrance, in 1971, changed this situation dramatically. The free shuttle bus system into the park was also a significant change. This allowed many travelers from outside Alaska, without vehicles, to easily reach the interior of the park.

Resource impacts were immediately apparent. Conflicts with bears increased. Denning wolves were thought to be disturbed by increasing numbers of hikers. Trails and fire rings left by hikers began to concentrate use and damage vegetation and soils. Between 1972 and 1976, park management quickly responded by requiring permits, setting limits based on a zone system, prohibiting fires, and closing areas to lessen conflicts with wildlife.

These decisions were consolidated in a comprehensive backcountry management plan (USNPS 1976). This plan represents one of the first successful attempts to use the basic concepts of what is now known as the Limits of Acceptable Change (LAC) planning process. The plan set standards for resource and sociological conditions that management wished to maintain, such as the lack of trails and designated camps or a certain number of encounters per day with other users. Use limits were set with the topography of each zone in mind and at a level that would achieve these goals. Studies on vegetation trampling and user attitudes from other wilderness areas were used to both set the goals and to develop the projections for appropriate use levels or management approaches.

The final management program differed significantly from the approach that was being taken in other major parks at the time. It favored low levels of dispersed use instead of concentrating users in specific areas or along designated travel routes. The Denali goal was to provide a hiking experience that encouraged a high degree of self reliance and discovery in a setting that was largely free from visible signs of human use, other users, or an obvious administrative presence. To accomplish this, large zones that hikers were free to move about in were used to allocate use, campfires were eliminated, and facilities such as trails, camps, or bridges were not to be developed.

More specific information about wilderness users and their effect on park resources in Denali was gathered from 1976 to 1980. Four backcountry rangers began to conduct baseline inventories of human impacts. A vegetation trampling study to determine the effects of hikers and horses on vegetation was initiated (Schreiner 1980), and a series of visitor use surveys were conducted by the University of Washington (Womble et al. 1979, Womble et al. 1980). The objective of this work was to help park management determine if the goals of the 1976 plan were

being met, and to provide Denali specific data for future revisions to the management plan.

The passage of the Alaska National Interest Lands Conservation Act (ANILCA) in 1980 added approximately 4 million acres of potential wilderness lands to Denali. It also designated the area of the former Mt. McKinley National Park as wilderness (Denali Wilderness) thus providing additional protection for those lands. However, wilderness designation under ANILCA allows for other uses beyond those permitted under the 1964 Wilderness Act. Motorized access by snowmachine, boat, or plane are all permitted under certain circumstances. So wilderness designation created some new complications related to determination of traditional use. Attempts to clarify this issue in the early 1980s were never realized and the situation still exists today.

The 1986 general management plan (GMP) continued to endorse the goals of the 1976 backcountry management plan. The GMP mentions a 1983 revision of this plan. That revision initially included changes to the 1976 plan, which were rejected during final public comment on the GMP. A final revision of the backcountry management plan that reflected the comments was never completed. As a result, the 1976 backcountry management plan remains the only completed Denali Backcountry Management Plan. Some portions of the 1983 revision were implemented, so a situation exists where all three of these documents must be considered in determining current wilderness management policy for Denali National Park and Preserve.

Recommendations for wilderness designation of portions of the ANILCA additions to Denali were developed in a public planning process that resulted in an environmental impact statement (EIS) (USNPS 1988). The record of decision was signed by NPS Director Mott, but was not forwarded to Congress by the Department of the Interior. Today all areas that were recommended for wilderness study in ANILCA or recommended for wilderness designation in the 1988 EIS are being managed as proposed wilderness per National Park Service Management Policies (USNPS 1988).

Present Condition

It is clear that use patterns on designated and potential wilderness lands in Denali have changed with increasing visitation and the passage of ANILCA in 1980. Several factors, such as overflights and motorized use, are creating rapid alterations in the character of these areas and, therefore, the opportunities that will be available for future visitors. At present, most of these changes are still restricted to areas of easy access or well advertised resources, but the expansion of increased use beyond these areas is the clear trend for the future.

Alaska and Denali currently represent a major growth market for ecotourism. Commercial guiding and private use is increasing significantly in many areas. Popular locations are facing more pressure for increased use, and new destinations are being established all the time. In addition to this national and international interest in Denali's wilderness resources, Alaska's population of outdoor oriented residents is growing. Parks, such as Denali, that are adjacent

to urban areas or road systems are experiencing increased levels of use as a result.

Road Accessible Areas - The Denali wilderness and the ANILCA additions in the Kantishna Hills are the most accessible and most used portions of the park. The seasonal use curve for this area peaks between the middle of July and early August when backcountry zones adjacent to the park road are generally full each night. There is space available earlier and later in the season, but travelers do not take advantage of openings during those periods. As a result, the seasonal use curve and the total number of users per season has remained relatively consistent since ANILCA. The average party size is between two and three people per party and the average length of stay is slightly more than two nights (2.5). These numbers have been very consistent over time. No formal studies have been conducted in recent years, but visitor comments to park staff indicate that visitors still seem to be generally satisfied with their backcountry trip and that they recognize and appreciate the special hiking opportunity available for them at Denali, particularly after they have completed their trip. The single exception to this is an increasing number of complaints about aircraft overflights and associated noise.

While there is currently no comprehensive monitoring program for recreational impacts in the Denali wilderness, field staff observations and periodic surveys indicate that the resource still retains the exceptional wilderness qualities for which it is noted. A rapid increase in impact was observed in the 1970s and early 1980s, but it seems to have reached an equilibrium with the use level that has been consistent for many years. Management actions, such as the establishment of wildlife protection closures, have altered use patterns. This has resulted in periodic new episodes of impact or regeneration, which later reach equilibrium.

Localized areas of impact are present adjacent to the Park Road corridor around bus stop areas and locations where hikers are dropped off to start their backcountry trip. Short trails have developed that lead from the road into the backcountry. They are generally less than 1/4 mile long and disappear when terrain is reached that causes users to disperse.

There is little user-formed campsite impact. It is only present at a few locations where use is concentrated along a travel corridor or at a destination such as a lake or pass. These sites have been present for many years, most before 1972. Illegal campfire use is not a major impact now. A more prevalent problem is the creation of rock cooking windscreens or the use of rocks to anchor tents in the open tundra portions of the park. These features, if not removed, attract other users to the same site and can concentrate impacts unnecessarily.

The most substantial concentrated impacts to vegetation and soils away from the immediate area of the park road corridor are caused by a very limited number of mountaineers, NPS administrative travel to backcountry cabins, and commercially guided hikes. These users are destination oriented or regularly travel the exact same route each time in large numbers. They have caused some of the most significant social trail formation in the backcountry.

ANILCA Additions - A very different situation exists in the ANILCA additions, particularly the south side of Denali. Backcountry use levels are not accurately known because there is no regularly collected information, but it is obvious that major increases have occurred. Instances of significant recent impacts are known. Disturbance of wildlife, soil and vegetation changes, and increased levels of consumptive use have begun to occur at popular or easily accessible sites.

Motorized Use - The most significant change from past conditions in all areas of the park is the increase in motorized use. Commercial aircraft activity has increased dramatically over the entire park. Other uses, such as snowmachines, ATVs, and motorboats, are increasing in the ANILCA additions (DENA-I-630, DENA-I-640, DENA-I-650, and DENA-S-120). Some of the most rapid change, highest use levels, and complex political problems are occurring at Denali because it is the most accessible wilderness park in Alaska and it has a well established pattern of use. Aircraft, snowmachine, and ATV uses have expanded dramatically in the last few years due to the park's proximity to major urban areas in Alaska. Currently, hundreds of snowmachiners access portions of the park on winter weekends where no use occurred at all just five years ago. During the summer months, dozens of helicopter and flightseeing tours traverse portions of the park above the heads of other users who have come to Alaska expecting to experience pristine conditions.

Motorized access facilitates the expansion of commercial activities such as guiding operations that bring larger numbers of users to formerly remote areas. These hikers, climbers, boaters, and hunters create a variety of additional impacts after they have accessed the area. Conflicts between these ANILCA authorized motorized or high volume uses and other non-motorized users appear to be developing.

The park currently operates two small fixed-wing planes and routinely contracts for helicopter services. The fixed wings are flown regularly on a year-round basis. Contract helicopter services are used primarily during the climbing season and the summer visitor season. Missions flown by these aircraft include boundary and hunting patrols, wildlife surveys and radio tracking, snow surveys, search and rescue, wildfire monitoring, hazardous waste and debris removal, point-to-point transportation of scientists, park rangers, maintenance personnel, and smoke jumpers, their equipment and supplies, as well as orientation of staff. Frequently these flights are below 2,000 feet and often involve highly specialized types of missions like aerial wildlife capture. These activities may contribute to disruption of visitor experiences.

New Access Points - New access points such as proposed trails along the Park Road corridor will alter the existing patterns of use in the near future. Additional developments and points of access are also proposed for the southern side of the park where little resource data exists. Efforts are underway to improve that situation with the intent of assuring ecological sensitivity.

Increased Commercial Use - There is unrelenting pressure for expansion of commercial use activities into the wilderness zone because of Denali's international recognition in the travel industry. Currently, only one concessionaire guides hiking within the Denali wilderness, but new ecotourism lodges in Kantishna have requested access to this area. Substantial increases are likely to occur in the southern portion of the park as that area begins to develop.

Current Management Actions and Results

Management actions for the Denali wilderness continue to be based on the same basic goals of the 1976 backcountry management plan and the general management plan and some sections of an unfinished 1983 revision to the 1976 plan. The ANILCA additions that were recommended to be designated as wilderness in the 1988 have been managed as wilderness, but decisions have not been guided by any specific planning document that applies to those areas. Recent park planning documents such as the statement for management, Entrance Area and Road Corridor Development Concept Plan, and the South Side Denali Development Concept Plan all contain decisions that modify the 1986 GMP and previous wilderness management decision. As a result, no single document now provides a concise description of management policy for the designated wilderness and proposed wilderness portions of Denali. Park management must reference at least six documents.

Permits are distributed through the Denali Visitor Center for visitors using the northern portion of Denali. The basic permit data is recorded in a computer database, but it is not regularly analyzed in a useful way for day to day decision making or long-term planning. It is also impossible to compare present day numbers with past use numbers because of very different counting procedures. An accurate year by year profile of use is impossible without a re-evaluation of all the data.

Information for hikers to the northern portion of Denali is provided at the visitor center through personal contact with park staff and by an interactive audiovisual program. The information is primarily focused on safety. Minimum impact hiking techniques for the subarctic environment is a major emphasis during these contacts. No evaluations have been conducted on how effective this information distribution process is at modifying user behavior, increasing trip satisfaction, or promoting resource protection goals. Visitors to the other portions of Denali are not regularly contacted by park staff.

Regular patrols are made into the more heavily used areas of the Denali wilderness. The primary objective is to monitor permit compliance and provide resource protection. The patrols also remove litter, fire rings, and make repairs to administrative use cabins. Patrol staff file trip reports, but this documentation of activities does not represent systematic data collection as part of a comprehensive monitoring plan for visitor use patterns or resource conditions. Patrols do occur in the ANILCA additions and southern portions of the park, but they are sporadic and mostly coincide with hunting regulation enforcement.

Recently, Research and Resource Preservation Division staff began to organize the large number of photos and written reports that document resource conditions through time, but much more work needs to be done. Some of the photopoints have been revisited, accurately mapped, and incorporated into the park's GIS system. An inventory of trails along the Park Road has also been completed. Despite these efforts, a well documented monitoring program still does not exist for Denali's wilderness resource.

Conflicts between hikers and bears are being effectively reduced by the use of bear resistant food storage containers and education. Disturbance of other species such as wolves is controlled by closures around important habitat areas. However, many questions still remain about the need for increased protection for other species, such as Dall sheep. The effects of motorized use on wildlife is not well understood, yet motorized use is occurring and is on the rise.

Visitors are advised to treat, filter, or boil all water. *Giardia lamblia* is naturally present in some park waterbodies. Current education efforts seem to be adequate to prevent major problems as the level of the threat seems to be fairly low overall. See DENA-N-210 for an additional discussion of potable water management.

Human waste disposal does not appear to be a significant issue for most of the backcountry at this time. The policy of dispersed use has minimized the areas where people congregate and therefore lessened the accumulation of waste. Continued education of visitors on minimum impact hiking techniques and the proper disposal of waste by burial is needed. Human waste disposal is a major problem on climbing routes on Mt. McKinley (DENA-I-660) and in the Ruth Amphitheater of the mountain.

Similarly, litter is a minor problem that can be controlled by continued education and some periodic patrols of regular use areas. Some historic problems remain, such as lengths of copper phone wire that pose a threat to animals by entanglement. Abandoned camps and caches are a problem on climbing routes on Mt. McKinley (DENA-I-660).

Winter recreation issues, such as problems with dogsled use or season-specific concerns are discussed in DENA-I-640 and DENA-N-364.1.

There is a history of stock use in the Denali area, and it continues to be a popular activity. The only current commercial operation involving stock in the park are wagon rides sponsored by the Kantishna Roadhouse. As recently as 1996, a private party requested a permit for stock use. Stock use is occurring adjacent to the park and it could become an issue if interest increases because stock use is not specifically prohibited in the park. Limited personal use of stock is occurring out of Cantwell.

Snowmachines are used administratively for winter patrols by park staff, recreationally by the public, and by subsistence users in portions of the park that have been proposed for wilderness

designation. Limited recreational use also occurs in the designated Denali wilderness despite the fact park staff discourages this use.

Several historic patrol cabins exist within the Denali wilderness. These are used by park staff in both the summer and winter for administrative patrols. Two cabins, Lower Savage and Moose Creek, have recently been opened to park staff for recreational use. There is the potential for much higher use of these areas due to this recent policy change. Possible impacts could include increased vegetation and soil damage leading to, and in the area of, these cabins.

The approach routes for several climbs, especially on the north side of the Alaska Range, pass through lowland areas. There is a need to coordinate the monitoring of mountaineering impacts with the monitoring program for backcountry hiker impacts.

RECOMMENDED ACTIONS

A. Program Administration and Planning

I-620.001: Revise Backcountry Management Plan

A revised plan is needed that consolidates decisions in the GMP (which reflects the 1976 Backcountry Management Plan and an unfinished 1983 revision), the statement for management, the Entrance Area and Road Corridor Development Concept Plan and the South Side Denali Development Concept plan. A revised plan should also address the pending wilderness designation for the ANILCA additions and support the concepts and values outlined in the 1995 Interagency Wilderness Strategic Plan.

I-620.002: Consider Special Regulations to Control Snowmachine Use and Aircraft Landings Within the Original Mt. McKinley National Park Boundary

Special regulations may be needed to return the area within the original Mt. McKinley National Park boundary to the pre-ANILCA management condition, which prohibited snowmachine use and aircraft landing within that area. See Project Statement DENA-I-650.

I-620.003: Consider Special Regulation to Control Mountain Bike Use in Denali

ANILCA also permits off road mountain bike use within wilderness in Alaska. A special regulation may be needed to control this use within the original Mt. McKinley National Park.

I-620.004: Clarify Staff Responsibilities for Wilderness Management and Document

Decision-Making Process

An internal operational plan for the wilderness management program is needed to define roles and responsibilities of different divisions and staff members. This plan, in conjunction with or as a subsection of, the overall wilderness management plan would help ensure a comprehensive and efficient program.

I-620.005: Develop GIS Layer for Human Use Impact Monitoring Data and Patrol Activities

Spatial representation of historic and contemporary data would assist management decision making.

I-620.006: Conduct Literature Reviews to Better Understand Wilderness Management Science

Park staff would search literature for studies related to wilderness impacts, monitoring, restoration, visitor management, visitor attitudes and so forth.

B. Research

I-620.011: Develop Monitoring Protocols for Wilderness Use

Many inventory and monitoring techniques in regular use in other wilderness areas are not applicable to the special management situations of low levels of dispersed use and the environmental characteristics found in Denali. New methods will be necessary.

I-620.012: Conduct Human Use Impact Inventories of Current and Projected Use Areas

Some baseline data and sporadic monitoring does exist for the areas of regular use in the Denali wilderness, but the information is still not adequately organized and documented. Very little, if any, information exists for other regions of the park and preserve. Several areas are expected to receive increased use in the near future, due to decisions in recent management plans.

I-620.013: Conduct Sociological Studies on Visitor Use

The last formal surveys of wilderness users were conducted in 1979. New data is needed to evaluate the effectiveness of management actions since that time and to provide current information for future planning.

I-620.014: Evaluate Effectiveness of Current Visitor Education Procedures

A great deal of time and effort is placed on educating wilderness users at Denali, but no evaluation has been done of the effectiveness of the program. Park management needs to determine the most efficient and effective means of communicating important information to these visitors in order to reduce operational costs and resource impacts as well as retain high visitor satisfaction.

I-620.015: Evaluate Hiker Disturbance to Dall Sheep

Previous research indicates that the potential exists for the alteration of Dall sheep habitat use due to hiker activity (Rachlow 1989). Further study is needed to determine if hikers (day hikers primarily) are excluding sheep from important use areas or diminishing their viewability for road based users.

I-620.016: Evaluate the Effects of Various Forms of Motorized Access on Wildlife and Visitors

Increased motorized access is the most significant change in recent years, yet its effect on park visitors has never been studied. The loss of natural quiet and elements of solitude may be significant to visitors. Information is also needed on the impact of noise on wildlife. Current and accurate information is essential for decision making. Also see project statements DENA-I-640 and DENA-I-650 for additional details.

I-620.017: Conduct a Study to Determine Intangible Wilderness Values

An investigation should be completed to document the application of intangible values to Denali's wilderness.

C. Mitigation

I-620.021: Develop and Implement Recovery Plans for Situations That Are Below the Standards Identified in the Wilderness Management Plan and Other Planning Documents

Standards for resource conditions in wilderness portions of Denali have been set in several planning documents. Additional standards will likely be established in the proposed revision of the wilderness management plan. There are or will certainly be some situations that do not meet these standards and will require correction. Issue or site specific planning will be needed because most problems will require a coordinated action that includes all park divisions.

I-620.021: Remove Litter/Debris

Large amounts of road construction material such as timbers or metal items have washed downstream from the Park Road into the wilderness portions of the park. Portions of an old telephone line from park headquarters to Camp Eielsen still remain above ground. Work crews are needed to remove this material.

I-620.022: Provide Additional Information on Minimum Impact Hiking Techniques to Concessionaires Using Wilderness

Impact from commercial hiking groups could be greatly reduced if they followed a few simple minimum impact hiking techniques. Park concessioner staff should be required to attend the National Outdoor Leadership "Leave No Trace" training program.

I-620.023: South Side Backcountry Quota/Permit System

Consider the development and implementation of a backcountry use and permit system, similar to the one operated on the north side of the park to deal with apparent increasing use on the south side.

D. Monitoring

I-620.031: Organize Historic Wilderness Impact Monitoring Data and Visitor Use Statistics into a Database Consistent with Future Monitoring Activities

A large amount of historic data does exist that would be extremely useful for management and future planning if it were organized and more accessible. Much of this information needs to be condensed into computer databases and linked to the park GIS system. More detailed yearly summary reports on visitor use statistics are needed. The data for this is collected, but not yet analyzed intensively.

I-620.032: Implement Monitoring Program in Coordination with Visitor Services Division

New monitoring protocols can be implemented with a better utilization of existing staff. This will require a coordinated use of current Visitor Services Division staff assigned to backcountry management and existing Research and Resource Preservation Division staff. Patrols will need to collect specific types of information, and schedules must be coordinated to improve efficiency and effectiveness. Improvements to patrol reports must also be made. The specific responsibilities for implementing the monitoring program will be included as a part of the operational plan for implementation of the

wilderness management program discussed in action item DENA-I-620.005.

E. Interpretation

I-620.041: Develop a Consistent Message on Wilderness Management Goals for Denali National Park and Preserve and Promote It with a Proactive Program Locally, Nationally, and Internationally

It is extremely important for visitor satisfaction and management support that the NPS at Denali clearly and consistently communicate to visitors what kinds of recreational opportunity the service is trying to provide.

I-620.042: Implement Revisions as Recommended by a Review of Current Information Provided to Public

Action item DENA-I-620.013 calls for an evaluation of the effectiveness of current education activities. Possible recommendations could include the development of additional written information for pre-trip planning or revisions to or development of audio visual programs.

I-620.043: Provide Additional Information on Minimum Impact Hiking Techniques to NPS Employees and the General Public

Impact from hiking groups could be greatly reduced if they followed a few simple, minimum impact hiking techniques.

F. Protection

I-620.051: Revise Patrol Procedures to Reflect New Regulations

Any restrictions on motorized access or mountain biking will require different patrol procedures as well as some specialized equipment.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Training	10.0/0.0	5.0/0.0	5.0/0.0	5.0/0.0	25.0/0.0
- Develop GIS	5.0/0.0	10./0.0	10./0.0	10./0.0	35.0/0.0
RESEARCH					
- Develop Monitoring Protocols	35.0/0.0	35.0/0.0	25.0/0.0		95.0/0.0
- Conduct Inventories	5.0/0.0				5.0/0.0
- Conduct Sociological Surveys	25.0/0.0	25.0/0.0	10./0.0	10./0.0	70.0/0.0
- Evaluate Education Efforts	15.0/0.0	5.0/0.0			20.0/0.0
- Evaluate Hiker Disturbance to Dall Sheep	25.0/0.0	25.0/0.0	10./0.0		60.0/0.0
- Motorized Use Effects	35.0/0.0	35.0/0.0	25.0/0.0		95.0/0.0
- Intangible Values	25.0/0.0				25.0/0.0
MITIGATION					
- Remove Litter/Debris	5.0/0.0	5.0/0.0	1.0/0.0	1.0/0.0	12.0/0.0

MONITORING					
- Organize Historic Data	10.0/0.0	5.0/0.0			15.0/0.0
INTERPRETATION					
- Provide Additional Information to Public	10.0/0.0	5.0/0.0	1.0/0.0	1.0/0.0	17.0/0.0
TOTALS	205.0/0.0	155.0/0.0	87.0/0.0	27.0/0.0	474.0/0.0

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Anon. 1995. Interagency wilderness strategic plan. 6pp.

Bultena, G., D. Field, P. Womble, and D. Albrecht. 1981. Closing the gates: a study of backcountry use-limitation at Mount McKinley National Park. Leisure Sciences. 4(3):249-267.

Cheek, N. H., and D. R. Field. 1979. Animal-human interactions during backcountry hiking (Mount McKinley National Park, Glacier Bay National Monument, Katmai National Monument): In Abstracts: Meanings of animals among backcountry hikers in Alaska. 2nd Conference on Scientific Research in the National Parks, 26-30 Nov. 1979, San Francisco.

Flewelling, B., and D. Johnson. 1981. Wildlife experiences and trip satisfaction in the backcountry: a preliminary summary of the McKinley backcountry survey data. [Seattle, WA]: Unpublished. USNPS. Cooperative Park Studies Unit and College of Forest Resources. University of Washington. 25 pp.

Loder, A., and P. Womble. 1979. Day hiking and day hikers in Mount McKinley National Park: an exploratory study. Seattle: University of Washington. 67 pp.

Plager, A., G. Dix, A. Loder, L. Murray, and P. Womble. 1978. Observations on backcountry management at Mount McKinley National Park. University of Washington, Seattle, WA. College of Forest Resources. 17 pp.

Plager, A. 1982. Backcountry permit compliance in Denali National Park. M.S. thesis. University of Washington, Seattle, WA. 137 pp.

Plager, A., and P. Womble. 1981. Compliance with backcountry permits in Mount McKinley National Park. Journal of Forestry. 79(3):155-156.

Plager, A., and P. Womble. 1979. Summary of findings: survey of backcountry users at Mount McKinley National Park. University of Washington, Seattle, WA. College of Forest Resources. 4 pp.

Rachlow, J. L. 1991. Maternal movement and habitat selection by Dall's Sheep. M.S. thesis. University of Alaska, Institute of Arctic Biology. Fairbanks, AK. 83 pp.

Schreiner, E. 1980. Long term experimental trampling on plant communities in Denali National Park. Progress report. USNPS. Olympic National Park. 86 pp.

USNPS. 1988. Management Policy Guidelines. U.S. Department of Interior.

USNPS. 1982. Backcountry management plan: Denali National Park and Preserve. Draft. Rev. ed. Denali NP&P, AK. Vol. 1.

USNPS. 1976. Backcountry management plan: Mount McKinley National Park. Mt. McKinley National Park, AK. 48 pp.

Womble, P. 1978. Report on backcountry use patterns at Mount McKinley Park: summer 1978. University of Washington, College of Forest Resources. Seattle, WA. 26 pp.

Womble, P., G. Bultena, G. Dix, A. Loder, L. Murray, and A. Plager. 1979. Survey of backcountry users in Mount McKinley National Park, Alaska: a report for management. University of Washington, Cooperative Park Studies Unit. CPSU/UW v. S-79-8. USNPS, Seattle, WA. 222 pp.

Womble, P. B., D. Johnson, D. Fields, and G. Bultena. 1980. The Response of hikers to seeing resource impacts in the backcountry: Unpublished report. CPSU. University of Washington. Seattle, WA.

Womble, P., G. Bultena, and D. Field. 1981. Interpretation and backcountry management. Journal of Interpretation. Sept. pp. 21-23.

RIVER RECREATION

PROJECT CODE: DENA-I-630

SERVICEWIDE ISSUES: N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Present Condition

It is estimated that there are over 2,000 miles of rivers and streams within Denali National Park and Preserve. However, the overwhelming majority of these rivers are not utilized at all for river recreation purposes. Difficulty of access and boating conditions dictate that most rivers within or adjacent to the park are unsuitable for river rafting, canoeing, or other recreational pursuits.

The lack of opportunity for recreation on most of the park's rivers focuses such use on the few rivers and streams that are accessible and floatable. As park visitation grows and capacities are maximized on the park's bus transportation systems, visitors and tour operators will be looking for alternative recreation activities. These rivers may easily become overwhelmed and impacted as park visitors turn to water resources for recreation. For a complete description of the park's water resources, refer to Water Resources Management Project Statement N-210.

The Nenana River corridor, along the park's eastern boundary, represents the greatest recreational opportunity for use of water resources near Denali National Park and Preserve. With close proximity to Fairbanks and Anchorage, outstanding scenery, and easy and plentiful access, the Nenana River represents one of the premier recreational rivers in Alaska. Thirty-six miles of upland frontage along the Nenana River is owned and managed by the national park service. Recreational opportunities and uses in this area include rafting (commercial and private), canoeing, kayaking, powerboating, camping, and fishing. Though no public agency has been collecting use information on the Nenana River as a whole, the National Park Service estimates that 21,500 people floated the river along part or all of the park boundary in 1990 (USNPS 1991).

In addition to the Nenana River, several other rivers within the park are known to be used for recreational purposes. Moose Creek, in the Kantishna Hills area, is the site of recreational

rafting and canoeing, which is generally staged from several of the lodges located in the area. Use is light, with a few trips a season covering approximately 3 miles of stream from the first crossing of the Moose Creek road downstream through the 'canyon' to the Moose Creek bridge. In addition, Moose Creek offers good grayling fishing opportunities, and area lodge guests are invited to fish this part of the river. Nearby Wonder Lake is also utilized by area lodge guests and campers for canoeing and fishing.

Recreational use of rivers on the south side of Denali is increasing significantly, and is focused on the Tokositna River. The Yentna River is also receiving heavier use. Rangers report that private river boats will proceed up the river and float back down, or rafts are flown in and dropped off for a downriver float trip. Commercial trips appear to be increasing in number.

Recreational use of other rivers and streams within the park is believed to be sporadic and non-commercial in nature. Local residents and park employees will occasionally float one of the rivers which bisects the main park road, generally using a small inflatable raft or river kayak. These glacially-fed rivers offer marginal boating conditions, and very limited choices for egress at the completion of the trip. Trips of this nature are so limited in frequency as to be noteworthy when they do occur. Similarly, fishing along these rivers is also extremely limited in nature, due to the lack of fisheries in glacial waters and the abundance of fishing in more productive streams outside of the park.

Several impacts by all types of river users may be noted, including litter, social trail development, trampling, fire ring construction, and wildlife disturbance. Along the Nenana River, impacts have been noted in the form of social trails at popular access points to the river. One such trail exists near Riley Creek, which provides kayakers and rafters easy access from the Parks Highway to the river. The Nenana River bridge area north of the park entrance also receives heavy use from boaters during the summer, with multiple launchings and pull-outs along the banks. Vehicle parking along the bridge approach shoulders also presents occasional problems, especially during the annual kayak races held in July.

Additional impacts specifically from powerboat use could include increased erosion rates, fish mortality due to spawning bed disturbance, fish mortality due to physical contact with propellers or jet units, loss of fish habitat due to channel morphology changes, and deterioration of water quality due to gasoline and oil pollution of water. It is important to note that only anecdotal evidence exists to support these claims, as no studies or monitoring programs have occurred to investigate this situation.

Current Management Actions and Results

Commercial boating activities within the park boundaries are controlled by the National Park Service, which authorizes all business operations in the park. There are currently four

businesses authorized to provide river trip guide services in the park. Incidental business permit restrictions for two of the five allow boating only in limited areas of the preserve, and these operators have not yet begun actual commercial operations. The other three are lodge owners in Kantishna, and are authorized to conduct raft trips on Moose Creek, as described above.

Commercial boating operators utilizing the Nenana and Tokositna Rivers are not required to receive authorization from the national park service, provided they do not launch, stop, or land on park lands during the float trips. As such, NPS conducts little or no monitoring of these boating operations. The State of Alaska has jurisdiction over these rivers up to the ordinary high water mark.

Private boaters inside the park are not regulated by NPS. However, permits are required for any overnight backcountry camping trips which may occur as a result of river trips.

NPS policy on recreational fishing is guided by NPS-77 (USNPS 1991), Fishing is allowed inside the park and preserve; state of Alaska fishing licenses are required only outside of the wilderness areas. Federal and state fishing laws and regulations are enforced. For example, bag limits of 10 grayling per day (total catch not to exceed 10 pounds), and restrictions on types of bait exist for park rivers and streams. For additional information, see Fisheries Project Statement N-250.

RECOMMENDED ACTIONS

A. Program Administration and Planning

I-630.001: Initiate A Program To Assess Impacts From River Recreation

A program to determine the impacts from recreational boating in or near the park would be initiated. Impacts to be assessed would include social trail development at access points, water quality degradation, channel erosion, riparian zone impairment, and fisheries degradation.

B. Research

I-630.011: Conduct Sociological Survey Of People Who Fish

As suggested in NPS-77, a periodic survey should be conducted of park visitors who fish in the park's rivers and streams. This would allow managers to determine how many people are fishing, what their level of effort is, what is most perceived as a quality experience to individual users, and would focus on such factors as the size of fish caught, species caught, number of fish caught, and number of other fishers encountered.

C. Monitoring

I-630.031 Initiate A Monitoring Program For River Recreation Use

A program to systematically monitor all river recreation uses of resources within the park would be initiated. Such a program would attempt to track and separate different use categories, including commercial and private use, and the quantities associated with each category. For example, the quantities of commercial river rafters floating the Nenana River annually would be determined. Special attention would be focused on the Nenana River and south side rivers, where current information on recreation use is incidental and limited. Where appropriate monitoring would be coordinated with the Alaska Department of Fish and Game.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Assess Impacts	3.0/0.25	3.0/0.25	3.0/0.25	3.0/0.25	12.0/1.0
RESEARCH					
- Conduct Survey	3.0/0.25	3.0/0.2	0.0/0.0	0.0/0.0	6.0/0.5
MONITORING					
- Monitor Categories and Quantities	5.0/0.2	5.0/0.3	5.0/0.2	5.0/0.3	20.0/1.0
TOTALS	11.0/0.7	11.0/0.75	8.0/0.45	8.0/0.55	38.0/2.5

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

USNPS. 1991a. Nenana River Corridor Recreation Study. Report prepared in cooperation with the State of Alaska Dept. of Natural Resources. On file at USNPS, Alaska Regional Office, Anchorage, AK.

USNPS. 1991b. NPS-77 Natural resources management guidelines. U. S. Department of the Interior, Washington, D.C.

WINTER RECREATION

PROJECT CODE: DENA-I-640

SERVICEWIDE ISSUES: N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Present Condition

Denali National Park and Preserve presents a vast and snowy expanse to the winter recreational user. Though human-made trails are few, rivers, glaciers, and mountain passes provide traditional routes for ambitious backcountry users. Skiers, dog mushers, mountain climbers, and snowshoers all utilize non-motorized transportation to access and travel through the park during the winter. Though the winter season extends from late September to the end of April, park visitation during this time is relatively low. For example, winter recreational visitation was less than one percent of the annual recreational visitation during 1993.

As the state's population grows, Denali is becoming an increasingly attractive destination to the winter recreationist. This trend is extremely apparent on the south side of the park, where snow machine use has increased dramatically in the past several years. During March and April, weekend snowmobile users take advantage of the easy access at Broad Pass on the Parks Highway to travel into the new Denali National Park additions. Patrols by park staff have also documented use in "old park" areas including on glaciers. Fly-in ski trips to the Ruth Amphitheater and other areas near the Mt. McKinley massif are also becoming more popular. Dog sled trips along the park road and the Stampede Trail are increasing as area mushers find the park an ideal training ground.

As winter recreation is increasingly promoted statewide, visitation to the park during the "off season" continues to grow. However, little is known of potential impacts from this type of use. Resource impact studies generally focus on summer activities, such as road use, trail development, and vegetation trampling. Such impacts and related studies occur during summer, when staff levels are high and backcountry travel is easy. During winter, the ranger and resource management staff levels are significantly reduced. As a result, impacts and problems associated with winter recreation may not be adequately planned for, monitored or mitigated.

The south slope, including the Preserve additions, offers the greatest winter recreational opportunities for visitors to Denali. With close proximity to Fairbanks and Anchorage, outstanding scenery, deep snow, warmer temperatures, and easy and plentiful access, the south slope represents one of the premier backcountry winter recreation areas in Alaska. Recreational opportunities and uses in this area include snowmachining, cross-country skiing, mountain climbing, winter camping, and dog mushing. Snowmachining is by far the most prevalent winter use in this area with activity concentrated in February, March, and April.

Snowmachines are permitted into the park and preserve provided their use was traditional and that resource damage is not occurring, but discouraged in the park areas, predominantly designated wilderness, that existed as Mount McKinley National Park prior to ANILCA. The boundaries between these areas are signed in high-use areas; however, many snowmachine operators often cross into and travel through the wilderness. Known or suspected impacts associated with snowmachine use include disturbance to wildlife, noise intrusion, vegetation damage, litter, air quality degradation, and deterioration of water quality due to gasoline and oil pollution. Another issue associated with recreational snowmachine use in the area south and west of Cantwell is the suspected displacement of subsistence users from traditional hunting areas.

Fly-in ski tours are also a popular activity on the south slope, mainly during March and April. Typically, skiers are dropped off in the Ruth Amphitheater by ski-plane for several days of ski-touring and camping, before being picked back up and flown out. This activity usually occurs in March, April, and May.

In addition to the south slope, winter use is common along the park road, which is generally not plowed beyond park headquarters at Mile 3 from October through March. Recreational use includes cross-country skiing (day and overnight trips), dog mushing, skijoring, and, to a much lesser extent, snowshoeing. Most skiers during the winter months are park employees or local residents; skiers from other areas start appearing as the weather gets warmer in late March and April. Trails originating in this area are popular with skiers and skijorers, including the Triple Lakes trail, the Riley Creek trail, and the Rock Creek trail.

Dog mushing is also popular along the park road. A winter trail from headquarters to Wonder Lake is put in by NPS staff and dog teams, and area mushers take advantage of the trail to travel for pleasure or train for long-distance races. Reliable numbers of visitor dog sled trips are generally not available. Anecdotal data is available in ranger reports; for example, NPS personnel met 7 dog teams (and 15 people) on a dogsled trip from the lower Toklat River to park headquarters along the road corridor trail (USNPS 1994).

Dog sledding is considered a low impact method of travel; in fact, NPS personnel patrol the

park during the winter using sled dog trips. However, some problems do exist. Existing trails lead to patrol cabins. Though visitors are not allowed to use these cabins, they provide good camping spots as they are commonly located near water sources and sheltered areas. This leads to concentrated use and resource impacts, such as dog feces, litter (dog food scraps), and fire rings. Some problems may result from the use of straw or hay as bedding for dogs. These materials often contain seed heads, and can result in the introduction of exotic grasses into the park. Other potential problems include disease transmission from domestic dogs to wildlife through feces.

The Stampede Trail, along the north side of the park, also provides access for winter recreationists. This trail, which begins near the town of Healy, traverses approximately 25 miles before crossing into Denali Park and Preserve lands near the Sushana River. Mushers will commonly travel to Kantishna, or complete a loop trail by accessing the Stampede Trail on the north side of the park. Snowmachine users, as well as dog mushers and skijorers, travel in and through this area, which includes the Wolf Townships. Travelers often use this route to access the lower Toklat, Stampede, and Kantishna. The Healy area is rapidly growing; a lodge was built recently on the Stampede road, and hopes to offer winter activities to its guests.

Several impacts by all types of winter recreationists may be noted, including litter, social trail development, trampling, fire ring construction, and wildlife disturbance. It is important to note that only anecdotal evidence exists to support these claims, as no studies or monitoring programs have occurred to investigate this situation.

Current Management Actions and Results

Commercial activities within the park boundaries are controlled by the national park service, which authorizes all business operations in the park. There is currently one business authorized to provide dogsled freight hauling services in the park, but no authorization for dogsled passenger hauling or guiding. A concession permit for passenger hauling has been issued in the past, and there is perceived to be renewed interest within the dog sledding community of guided passenger tours. A concession permit for this type of activity would need to consider such issues as NPS patrol cabin use, food storage, waste disposal, trail breaking, and firewood cutting.

All overnight campers in the park are required to obtain a free backcountry use permit. In the winter, this permit allows the building of fire rings, with the stipulation that firewood come from dead and down timber only. Campers with dog teams are advised by rangers to camp at least several hundred yards from patrol cabins, to help disperse the impacts from such use.

Barrels are provided at the Riley Creek campground and at the Wonder Lake Ranger Station for the disposal of dog feces. At Wonder Lake, this material is used to activate the septic system each spring. In other areas of concentrated use (patrol cabins), the mushers are advised to

broadcast the feces along the trail corridor.

Snowmachines have been used for backcountry patrols, on both the south slope and Stampede Trail, for several years. Rangers use these patrols to estimate visitor snowmachine use, establish NPS presence, and make wildlife observations. Aircraft overflights are also noted. These snowmachine patrols are often supplemented with information from NPS aircraft overflights.

RECOMMENDED ACTIONS

A. Program Administration and Planning

I-640.001: Prepare a Winter Use Plan

A management plan that deals with various winter use topics such as administrative use of snowmachines, road opening and closing procedures, winter access, and cooperative efforts with staff from Denali State Park should be prepared to guide winter operations.

I-640.002: Apply GIS Technology to Winter Use Issues

GIS technology should be used to depict and track winter use patterns.

B. Research

I-640.011: Conduct Sociological Survey Of Winter Recreational Users

A periodic survey should be conducted of park visitors who recreate in the park during the winter months. This would allow managers to determine what is most perceived as a quality experience to individual users, and would focus on such factors as the type of use, importance of solitude, wildlife encounters, and other user encounters.

I-640.012: Initiate A Program To Assess Impacts From Winter Recreation

A program to determine the nature and extent of impacts from recreational winter use (including snowmachine use) in or near the park would be initiated. This would be achieved, in part, via literature searches. Impacts to be assessed would include social trail development at access points, disturbance to wildlife, disturbance to vegetation, litter accumulation, air quality degradation, noise, expectaions of natural quiet, spills, and others.

C. Mitigation

I-640.021: Winter Use Data Organization

Park files and records should be searched for all winter use data. This should be compiled and synthesized such that it will be useful in designing monitoring efforts and in making management decisions.

D. Monitoring

I-640.031: Initiate A Comprehensive Monitoring Program For Winter Recreation Use

A program to systematically monitor all winter recreation uses of resources within the park would be initiated. Such a program would attempt to track and separate different use categories, including commercial and private use, and the quantities associated with each category. For example, the number of private dog mushing trips traveling along the Park Road corridor would be determined. Additionally, the program should gather information on physical and biological impacts from winter uses and on conflicts between users or with wildlife. Special attention would be focused on the Park Road corridor and south slope, where current information on winter recreation use is incidental and limited.

E. Interpretation

I-640.041: Information Disemination Regarding Winter Use

An agressive public information effort would be initiated to communicate information about minimum impact activities, avoidance of wildlife disturbance, park regulations, and safety.

F. Protection

I-640.051: Snowmachine Regulations

Regulations governing snowmachine use in the original Mt. McKinley National Park would be promulgated consistent with the process outlined in Section 1110(a) of ANILCA.

I-640.052: Improved Winter Protection Program

Additional air and ground patrols would be accomplished during winter months to assure resource protection and visitor safety. A system of winter use signage would be used to

supplement contacts by park staff.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Winter Use Plan	50.0	50.0			100.0
RESEARCH					
- Conduct Survey	3.0/0.25	3.0/0.25	0.0/0.0	0.0/0.0	6.0/0.5
- Assess Impacts	3.0/0.25	3.0/0.25	3.0/0.25	3.0/0.25	12.0/1.0
MONITORING					
- Monitor Categories, Quantities, Impacts	5.0/0.2	5.0/0.3	5.0/0.2	5.0/0.3	20.0/1.0
INTERPRETATION					
- Public Information	20.0/0.5	20.0/0.5	10.0/0.5	10.0/0.5	60.0/2.0
PROTECTION					
- Resource Protection Program	20.0/0.5	20.0/0.5	20.0/0.5	20.0/0.5	80.0/2.0
TOTALS	101.0/1.7	101.0/1.8	38.0/1.45	38.0/1.55	278.0/6.5

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

USNPS. 1994. Winter patrol reports. On file at Headquarters, Denali NP&P, AK.

AIRCRAFT MANAGEMENT

PROJECT CODE: DENA-I-650

SERVICEWIDE ISSUES:
- N15 Noise, Visual, & Biological Impacts Related to Aircraft Overflights
- N18 Visitor Use Impacts on Backcountry Park Resources

STATEMENT OF PROBLEM

Present Condition

Both civilian and military uses of aircraft in Alaska have well established traditions. The strategic geographic location of Alaska has encouraged military use of the state for staging air operations. The expansiveness of the state has necessitated the use of aircraft for access purposes and has provided opportunities for military flight training. In more recent years, a thriving flightseeing and air taxi industry has grown in support of sightseeing that cannot be accommodated through limited ground transportation and remote hunting, fishing, and other recreational interests. Aircraft use, of all types, throughout the state appears to be on the rise. This results in conflicts in park areas where management is striving to provide wilderness experiences and to protect wildlife populations.

Aircraft use at Denali can be grouped into four general categories: private, commercial, military, and administrative. All of these uses have been present at Denali for many years, but a clear trend of increased use exists in all categories. During the 1960s and 1970s, one flightseeing operation existed, three air taxi services provided access to Mt. McKinley, park staff occasionally flew winter patrols and wildlife surveys, and a handful of private pilots flew in and out of the Kantishna and McKinley airstrips.

During the 1980s, significant demographic shifts occurred that resulted in increased air traffic. The state's population grew and tourism grew. These factors contributed to more private and commercial use at Denali. Furthermore, as airspace in the contiguous 48 states became increasingly more crowded, the military saw Alaska as an opportunity for expanded operations. Military use of airspace over certain parks, including Denali, is attractive because these areas are relatively close to military installations, have low population densities, and are often free of major commercial traffic routes. Finally, with the addition of parklands via ANILCA, the

service intensified administrative flying to gather information and provide a minimum amount of protection to lands that were otherwise very difficult to access.

Private - Within the past three years, significant increases in private air traffic in the park have been noted; evidenced by insufficient plane parking space on the McKinley strip. Park airstrips, including the McKinley strip, are typical of rural or bush strips and have no air traffic control. Therefore, no definitive use numbers by private operators are available.

Commercial - Commercial aircraft services operating at Denali are comprised of 15 flightseeing operations (mostly fixed wing but some helicopter use), 20 air taxi operations, and between 80 and 100 passenger jets per day that fly over the park enroute between Anchorage and Fairbanks or bush communities. Most air taxi use occurs during climbing season (April to June) with the heaviest use in a corridor between Talkeetna and Mt. McKinley and less use between May and September in and out of Kantishna. Flightseeing services are concentrated in corridors that link park headquarters and Healy with Mt. McKinley, Talkeetna/Anchorage with Mt. McKinley and adjacent glaciers, and Kantishna with Mt. McKinley. Flightseeing occurs primarily between May and September. Both flightseeing and air taxi operators are flying multiple missions each day and all operations tend to be at altitudes that may have impacts on park visitors and resources.

Commercial passenger services (major carriers) seem to be less of a concern because of the high altitude used, particularly along the two federal airways, V436 and V438, which run over the eastern portion of the park (U. S. Department of the Air Force 1995).

Military - In 1976, the U.S. Air Force, using Special Use Airspace authorities, established Military Operations Areas (MOAs) in a number of locations in Alaska. A number of these MOAs are designated in airspace over national park system units including Denali. In addition, a Military Training Route (MTR 1900) has been designated that appears to be in airspace over the northeastern most portion of the park. Since 1976, the scope and complexity of tasks of Alaska-based Air Force units has increased. In 1993, the Air Force began an environmental assessment process to address a series of changes and additions to MOAs in Alaska. The Susitna MOA lies over the southern reaches of Denali National Park and Preserve and is therefore of concern to park staff. Information from the Air Force indicates that up to three aircraft operations are expected to occur per day, Monday through Friday within the MOA and 12 operations can occur in the MTR per day (U. S. Department of the Air Force 1995). Reports of military aircraft and commercial air taxi conflicts, including near misses, have been received.

Administrative - The park currently operates two small fixed wing planes and routinely contracts for helicopter and fixed-wing services. The fixed wings are flown regularly on a year-round basis. Contract helicopter services are used primarily during the climbing season and the summer visitor season. Missions flown by these aircraft include boundary and hunting patrols, wildlife surveys and radio tracking, snow surveys, search and rescue, wildfire monitoring,

hazardous waste and debris removal, point to point transportation of scientists, park rangers, maintenance personnel, and smoke jumpers, their equipment and supplies, as well as orientation of staff. Frequently these flights are below 2000 feet and often involve highly specialized types of missions like aerial wildlife capture.

Military helicopters and fixed wing aircraft are routinely used during search and rescue missions. Military aircraft are also used to insert and extract a ranger station on Mt. McKinley at 14,200' each year. Under the terms of a memorandum of understanding, military aircraft are permitted to practice limited landings and takeoffs at high altitudes for search and rescue practice.

Recently, a new situation has developed that is a hybrid of administrative and private use of aircraft. In this case, a privately funded, independent investigator is conducting radio tracking of park wildlife.

Current Management Actions and Results

Airspace - The national park service has no legal authority to manage overflights and, in fact, park areas within Alaska have been specifically excluded from recent efforts at resolving aircraft issues elsewhere in the park system (USNPS 1995). Private and commercial aircraft and general airspace are regulated by the Federal Aviation Administration (FAA). It recommends a minimum of 2000 feet above ground level (local weather permitting) for aircraft flying over Denali. Compliance is unlikely due to the nature of flightseeing and air taxi operations but discussions are ongoing between the FAA, the national park service, and the airline industry to improve the situation.

Authority to manage Special Use Airspace (in this case military use) also lies with the Federal Aviation Administration. The FAA participated as a cooperating agency in the preparation of the Alaska Military Operations Areas EIS. Staff from Denali and the Alaska Support Office participated in scoping sessions, supplying environmental and park management concerns with the proposals. Input as the EIS was developed was also provided. Concerns with the 1994 draft EIS from Department of the Interior bureaus were consolidated and forwarded to the Air Force. Staff members at Denali were concerned with swan disturbance, adverse impacts on backcountry and subsistence users, triggering of avalanches by sonic booms, and littering the park with metallic chaff that is used in radar avoidance exercises. Limited accommodations were made to address these issues in the final EIS. One mitigation measure proposed by the EIS is the establishment of Resource Protection Council coordination teams charged with resource protection/mitigation, public information, and research and monitoring. Little progress has been made in implementing the charges of these teams.

During the past five years, one mid-air accident, involving commercial sightseeing aircraft, has occurred in the airspace over Denali. This attests to the crowded and potentially hazardous

nature of the park's airspace. Intuition points to the seriousness of potentially intermingling small private or commercial planes with high speed military aircraft. In addition to the likelihood of human injury or loss of life and property damage, aircraft accidents clearly pose environmental risks including vegetation and ground disturbance, ignition of wildland fires, chemical spills, and scattering of debris across the landscape. Search and rescue or salvage operations may have further environmental implications.

Crash Sites - An undetermined number of aircraft crashes have occurred within the park. Resource damage from those crashes is generally localized but wildland fires can be ignited by the crash and crash debris remains as an aesthetic intrusion. In some cases, hazardous materials are released into the environment.

In-Park Landings and Ground Facilities - Aircraft landings within the park and preserve are addressed in the park's general management plan. In general, fixed-wing airplanes are permitted to land anywhere in the park and preserve for traditional activities, assuming that no vegetative or terrain alterations are made, unless the superintendent has designated a prohibition. Generally these prohibitions have been very limited in nature. Helicopters however, are prohibited from landing anywhere unless a permit is obtained (USNPS 1986).

Some commercial operations within the park are further regulated by virtue of the fact that they land in the park and therefore must have authorization via the park's concessions program. Their permits stipulate such things as locations of landings.

The general management plan calls for an inventory of airstrips for fixed-wing aircraft for the purposes of identifying which strips would be maintained for public use and the potential designation of helicopter landing sites. These actions have not yet been completed although clearly certain strips are maintained as are helipads. In 1996, the park began issuing special use permits to individuals who were parking their aircraft at the McKinley Strip.

Aviation fuels can be a significant resource protection concern if handled improperly. Fueling systems at both the McKinley and Kantishna airstrips are generally in good order. Recent steps have been taken to improve the handling procedures for barrel fuel and its use in spike camps.

Potential Impacts and Concerns - The Alaska National Interest Lands Conservation Act, via Section 1110 and the definition of "conservation system units", which includes units in the wilderness preservation system, allows use of airplanes for traditional purposes in designated wilderness. Very few landings of fixed-wing aircraft occur within the Denali wilderness, however, use in some non-wilderness backcountry areas is common.

The public generally considers low level flight operations to be an unwanted intrusion and negative experience regardless of whether they are in designated wilderness or park backcountry. Written complaints by wilderness and backcountry users have increased recently. Also, some

comments provided during public meetings associated with ongoing planning reinforced public concerns over aircraft use. Aircraft flights and landings in areas that the service is attempting to manage as pristine and free of obvious human presence are clearly a significant issue at Denali that warrants further examination, discussion, assessment, and decisions.

Administrative use of aircraft is controlled via Office of Aircraft Services (USDOI) policies and procedures as well as in-park policies as set forth in the park's aviation management plan. These policies deal primarily with administrative concerns and do not provide much guidance on frequency of flights, avoidance of sensitive areas or time periods, or other issues that are related to visitor use and resource preservation.

Wildlife biologists have suggested that low level flights have adverse effects on wildlife, especially during critical times such as ungulate calving, sheep lambing, or avian egg laying and incubation.

Better information is needed to quantify and characterize airspace use over the park and landings in the park. Once that information is gathered, comprehensive planning should be initiated to establish a vision for aircraft use at Denali and to set forth the agency's philosophies and approaches to aircraft. Planning should also clearly address all aspects of flight operations.

RECOMMENDED ACTIONS

A. Program Administration and Planning

I-650.001: Update the Aviation Management Plan

The park's aviation management plan was updated last in 1989. This document needs to be revised to reflect current operational circumstances, establish policies and philosophies about protection of visitor experiences, and to incorporate information that has come forward during the preparation of the Military Operations Areas EIS and from recent discussions with the FAA. Planning will also include designation of landing sites within the park.

I-650.002: Develop Special Regulations to Manage Aircraft in Denali NP & P

A thorough analysis will be completed to determine what, if any, special regulations are needed to manage aircraft use in the park. Consultation with affected and interested parties will occur. These regulations will be promulgated if appropriate. Staff will track other ongoing efforts to establish regulations.

I-650.003: Maintain involvement with Resource Protection Council

Park staff will stay abreast of the decisions and actions of the Resource Protection Council in their efforts to mitigate impacts from military overflights.

I-650.004: GIS Technology Application to Aviation Management

GIS data layers would be developed for such things as landing sites, flight routes, military operations areas, and resources sensitive to aircraft noise.

I-650.005: Maintain the MOU with the Military Regarding SAR Support

Park staff will update the MOU as needed to sustain the working relationship with the military on search and rescue missions.

B. Research

I-650.011: Develop Monitoring Protocols for Noise Levels

No information on ambient sound levels exists for Denali. In light of increasing air traffic, this information will become more important in determining what measures need to be taken to protect wilderness experiences including natural quiet and solitude.

I-650.012: Conduct Visitor Use Survey

A survey of park visitors will be conducted to assess their attitudes about overflights and to determine the degree of adverse impact to their experiences.

I-650.013: Determine Effects of Overflights on Wildlife

Search existing literature to better understand overflight impacts on wildlife. Complete a study to assess the locations and types of impacts that aircraft use is having on park wildlife.

I-650.014: Determine Effects of Overflights on Neighboring Cabin/Home Owners

A survey of neighboring cabin/home owners would be conducted to assess their attitudes about overflights and to determine the degree of adverse impact.

C. Mitigation

I-650.021: Increase Efforts to get Flightseeing Operators to Comply with Current

Flight Level Advisories

I-650.022: Modify Activities that are not Consistent with Standards Set in Aviation Management Plan or Possible New Regulations

D. Monitoring

I-650.031: Develop and Maintain Database of Information Needed for Aircraft Management Decisions

Park staff would begin gathering aircraft overflight information in a systematic fashion. Concession and park operations would be required to submit annual accounts of numbers of flights, numbers of passengers, and flight paths. Field personnel would gather information regarding overflights observed and visitor and resource impacts.

I-650.032: Implement Monitoring Protocols as Required by Aviation Management Plan

E. Interpretation

I-650.041: Communicate to Public Impacts of Aircraft Activity

Develop interpretive material that can be used to communicate concerns about aircraft use and their impacts on park resources and visitor experiences.

F. Protection

I-650.051: Increase Surveillance Activity of All Types of Aircraft Activity in Park to Insure Compliance with Management Plan Standards

Provide ranger staff to increase surveillance activities. Special emphasis may be appropriate on the south side of the park.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					

- Aviation Management Plan	20.0/0.2	20.0/0.2			40.0/0.4
- Regulations			10.0/0.1	10.0/0.1	20.0/0.1
- Resource Prot. Council	5.0	5.0	5.0	5.0	20.0
RESEARCH					
- Noise Levels		50.0	50.0	50.0	150.0
- Visitor Survey			30.0	30.0	60.0
- Wildlife Effects			75.0	75.0	150.0
- Cabin/Home Owner Effects			15.0	15.0	30.0
MITIGATION					
- Advisory Compliance	5.0	5.0	5.0	5.0	20.0
MONITORING					
- Database Development	10.0/0.1	10.0/0.1	10.0/0.1	10.0/0.1	40.0/0.4
- Implement Monitoring				100.0	100.0
INTERPRETATION					
- Public Information				10.0	10.0
PROTECTION					
- Compliance Monitoring			12.0/0.3	12.0/0.3	24.0/0.6
TOTALS	40.0/0.3	90.0/0.3	212.0/0.5	322.0/0.5	664.0/1.4

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Unruh, J. 1989. Aviation Management Plan. Denali National Park &Preserve, Denali Park, Alaska.

U. S. Department of the Air Force. 1995. Final environmental impact statement Alaska military operations areas. Vols 1 - 4.

USNPS. 1986. General management plan - Denali National Park and Preserve. Denali NP&P, Denali Park, Alaska.

USNPS. 1995. Report on effects of aircraft overflights on the national park system. U. S. Department of the Interior.

USNPS. 1997. Entrance area and road corridor development concept plan and environmental impact statement, Denali National Park and Preserve. Denver Service Center, National Park Service. Denver, Colorado.

MOUNTAINEERING

PROJECT CODE: DENA-I-660

SERVICEWIDE ISSUES: N20 Lack of Basic Data - Insufficient Understanding of Park Ecosystems and Threats to Them

STATEMENT OF PROBLEM

Introduction

Great interest in Mount McKinley throughout the international mountaineering community continues to draw increasing numbers of climbers each year. As one of the "Seven Summits of the World", and having the distinction of being the most accessible, Mount McKinley is now threatened by the inevitable resource and climbing experience degradation that so often accompanies popularity.

In the decades following the 1910 Sourdough Expedition's first successful ascent of the North Peak, only a few stalwart mountaineers attempted the arduous climb to the summit. In recent years, this has changed significantly due to an increase in the popularity of climbing and the ease of aircraft access to the 7,000 foot level on the mountain. The number of climbers has steadily increased from year to year since 1968, when 40 climbers attempted Denali, to 1,277 attempts in 1994. There was a 16% increase in the number of climbers from 1993 to 1994. In 1995, there were over 25,000 user days on Denali alone. Since the institution of fees, numbers have stabilized somewhat. Considering the popularity of climbing, and Denali's status as North America's highest mountain, use is expected to continue to increase, however.

Present Condition

With the average expedition spending 21 days on the mountain, the number of use days has risen to almost 27,000 per year in 1996. Concurrent with that use are serious questions about sanitation, overcrowding, and safety on the popular West Buttress route. Despite numerous attempts at long-term solutions, human waste is commonly visible, especially at the higher elevations. Scores of climbers are often on the fixed ropes above 14,000 feet at one time. Over 80% of all climbers on Mount McKinley use the easier West Buttress route, and well over 100

climbers are often camped at both the 7,200-foot base camp and 14,000-foot camp. The portion of the route below 14,000 feet is fairly spacious and able to accommodate large numbers of climbers. However, above 14,000 feet the route bottle-necks, and the camps and climbing route become overcrowded. Climbers and rangers have reported safety concerns, environmental degradation, and aesthetic degradation in these overcrowded areas.

Human waste disposal is one of the most prominent problems on Denali. Most climbers use pit latrines where provided, and use plastic bags lower on the mountain when necessary. At the lower camps any exposed feces are usually covered by snowfall or are disposed of in crevasses. At high camps, particularly at 16,200 feet and 17,200 feet, climbers are not disposing of feces properly. These small, confined camps are constantly littered with feces that freeze and remain exposed due to high winds not allowing snow to accumulate. It is believed that harsh weather conditions combined with the effects of altitude on climbers is causing this lack of compliance with human waste regulations. At higher elevations, snow is wind swept and hard packed and therefore not easily dug into and crevasses are not easily accessed.

Where pit latrines are used, annual snowfall buries the pit once it has filled with feces. However as the snowpack and glacier move, the areas where pit latrines have been dug will become exposed when they reach the glacier's firn line. There is also a large annual accumulation of plastic bags in many of the Kahiltna Glacier's crevasses. Twenty-seven thousand user days per year accounts for many plastic bags that may some day become exposed in an icefall or at the toe of a glacier.

Litter, including abandoned food, fuel, and equipment, continue to be a problem. Traditional cache areas on the Muldrow Glacier, Denali Pass, and the 17,200-foot camp on the West Buttress accumulate mounds of trash and surplus supplies. NPS regulations require climbers to pack out all litter. Although most climbers comply, many do not. Upon descent, many climbers are unable to carry down everything they carried up. This is due to double carries on ascent, illness, and "the horse heading to the barn syndrome" after having reached the summit. Many foreign climbers do not have strict environmental ethics. Also language barriers may cause a lack of understanding of regulations. Enforcement is difficult given the small number of rangers and the vast area of the mountain.

Fixed climbing hardware such as bolts are not a significant problem at this time, but old abandoned fixed ropes on technical routes such as the West Rib and Cassin Ridge are prevalent. Most known bolting is confined to areas in the Ruth Gorge and Kichatna Spires, and is practiced by only a small number of climbers. This issue, although small at this time, should be addressed before it becomes significant.

The majority of climbers attempting Denali, Mount Foraker, Mount Hunter, and other south district mountaineering objectives use aircraft for access. Along with the increased number of climbers comes an equivalent increase in the number of aircraft overflights and landings in the

park. The large volume of air traffic on the Kahiltna Glacier landing area in recent years has brought up concerns about noise pollution and safety. In past years, climbers have reported discontent with noise and the presence of helicopter traffic around the 14,300-foot camp on the West Buttress. This traffic was frequently associated with rescues but has decreased recently with an improved accident record. Scenic overflights have increased each year with over 25 companies licensed to provide airtaxi services and 12 companies licensed to provide flightseeing.

In 1993 and 1994, one bear-climber encounter and two bear observations were reported high on alpine glaciers in the Alaska Range in Denali. Ravens are common at all altitudes on Denali and frequently raid improperly packaged food caches left by climbers and other species of birds are seen at glacial camps. As wildlife become accustomed to greater numbers of climbers and potential food sources, more encounters are likely, even on high alpine glaciers. Additionally, there are potential climber-wildlife conflicts in the sub-alpine areas used as approach routes for mountaineering objectives.

Current Management Actions and Results

Mountaineers are required to register for climbing on Mount McKinley and Mount Foraker. There are no use, trip length, season, or guided group size restrictions. Registration must be done 60 days in advance, and a $150 fee is now required for climbing either Mount McKinley or Mount Foraker. These requirements were implemented beginning with the 1995 season (although the 60-day requirement was waived for the first year). Revenue from the fees collected help defray the costs of administering the NPS mountaineering program, including the proactive education programs. Because of the significant increases in international climbers attempting Mount McKinley, the service has initiated a variety of international education efforts.

Six commercial guiding operations are authorized for Mt. McKinley. They are managed under the terms of concession permits.

Climbers are required to remove all of their equipment, excess food and fuel, and trash when leaving the park. They are required to dispose of human feces in NPS provided pit latrines dug deeply into the snow on Denali's West Buttress route and in the Ruth Glacier Amphitheater. Where pit latrines are not provided on Denali and other frequently visited areas, climbers must use plastic bags as latrines and dispose of the bags by tossing them into a deep crevasse. On steeper climbing routes climbers may dispose of solid waste by tossing it off the route.

The 7,200-foot base camp is becoming increasingly congested. This camp is used as the starting point for climbs on other mountains, as well as McKinley, and is visited frequently by day users who are brought to the camp by air taxis. Some glacier skiing combined with overnight use has also developed at base camp. Interest in commercial provision of overnight facilities has been proposed but denied by the service thus far.

The majority of the other alpine mountaineering in the park lies in the south district in Backcountry Unit 23. There are presently no permit or registration requirements in this area. There are no human waste or food storage requirements. For those mountaineering objectives that are approached from the north district, climbers must obtain backcountry permits and follow all applicable backcountry regulations, including use restrictions and food storage requirements. The only exception is the approach to McGonagall Pass through Backcountry Unit 20. Mountaineers are required to obtain a backcountry permit, but there are no use restrictions or food storage requirements. No studies have been performed on the impacts of climbers on the glaciers, actual climbing routes, or approach routes.

Experimental latrines have been tried, with limited success, in 1992 and 1994 at Kahiltna basecamp and at the 17,200-foot West Buttress camp. At basecamp, an 85 gallon barrel used to collect feces was flown by helicopter from the glacier to Talkeetna, where it was pumped by a sewage truck. This project had limited success due to the rapid rate the container filled with feces, the expense incurred by the helicopter, and the sewage truck's inability to pump out plastic bags from the barrel. The latrine at 17,200 feet met with limited success due to extremely harsh weather conditions that damaged the latrine and filled it with snow and ice.

RECOMMENDED ACTIONS

A. Program Administration and Planning

I-660.001: Develop Mountaineering Management Plan that Interfaces with Wilderness Management Plan

Update the mountaineering management plan to address impact and capacity issues. Further refine and institutionalize the program for pre-registering climbers and collecting climbing fees for ascents of Mount McKinley and Mount Foraker. Increase coordination with other elements of wilderness management at Denali.

I-660.002: Establish a Public Advisory Group to Assist in Developing and Evaluating Ideas for the Mountaineering Management Program

Develop a task force of climbers, NPS personnel, mountaineering guide concessionaires, alpine clubs, Access Fund representatives, etc., to address issues and help brainstorm solutions.

B. Research

I-660.011: Conduct Visitor Use Surveys to Determine Climber Profiles, Practices, Attitudes, and Expectations

I-660.012: Determine Best Methods for Human Waste Disposal for the Various Route Types

Develop methods for sound disposal of human waste in a high altitude arctic environment.

I-660.013: Develop Monitoring Protocols for Human Use in Alpine Environments

I-660.014: Evaluate Current Education Program for Climbers

A thorough study of the current education efforts might reveal possible improvements in existing material or a need for new approaches.

I-660.015: Develop a Comprehensive Baseline Inventory of Human Use Impacts on Climbing and Approach Routes

Some information is currently available, but many other areas have never been thoroughly inventoried.

C. Mitigation

I-660.021: Remove Caches and Dumps

Provide funding for helicopter flight time in conjunction with special patrols to clean up accumulated debris. Encourage cooperative work efforts with the climbing community.

I-660.022: Remove Outdated Fixed Hardware

Implement special patrols, possibly with the help of volunteers from the climbing community, to remove unsafe or inappropriate ropes and other hardware. Provide funding for helicopter flight time to support these activities.

I-660.023: Remove Human Waste Accumulations from Camp Areas

Provide funding for helicopter flight time to clean up litter and transportation and disposal of fecal collection barrels.

I-660.024: Initiate Program to Provide Biodegradable Bags to Climbers

Obtain biodegradable plastic bags to give/sell to climbers for use as latrines.

D. Monitoring

I-660.031: Organize Historical Use Data and Establish a More Comprehensive Program of Regularly Gathered Statistics

Continue compiling use statistics and search and rescue data for various climbing routes on Mount McKinley. Gather additional information on safety, sanitation, and sociological indicators. Use this information to manage visitor impacts, address capacity issues, expand proactive educational programs, and update the mountaineering management plan. The service will work with guides, mountain climbing associations, and other interested groups during this process.

I-660.032: Establish a Human Use Impact Monitoring Program for Mountaineering that is Coordinated with Other Impact Monitoring Activities

Implement monitoring protocols developed by research. Coordinate monitoring efforts with backcountry monitoring protocols in areas such as approach routes where the two programs overlap.

E. Interpretation

I-660.041: Modify Current Education Program for Climbers as Recommended by Review

Continue to use education as a means to instill environmental ethics and awareness of park regulations. Develop new videos and written material to educate climbers based on recommendations of program reviews.

I-660.042: Expand Information Available to General Public about Complexities of Climbing Management

Continue to make the general public aware of the many issues that must be dealt with in the management program for Mt. McKinley and the Alaska Range within Denali National Park and Preserve perhaps including use of the park's website.

F. Protection

I-660.051: Increase Patrol Presence on other Routes

Increase enforcement through a greater ranger presence on Denali, including routes other than the West Buttress, and other frequently visited climbing areas such as the Ruth Glacier, Little Switzerland, and Kichatna Spires. Target specific types of violations such as illegal commercial guiding, equipment abandonment, and major sanitation guideline violations.

STAFFING & FUNDING

PROJECT/ACTIVITY	YEAR01 ($1000/FTE)	YEAR02	YEAR03	YEAR04	SUBTOTAL
PROGRAM ADMINISTRATION					
- Mountaineering Mgt. Plan	5.0/0.0	5.0/0.0			10.0/0.0
RESEARCH					
- Visitor Use Survey	15.0/0.0	15.0/0.0			30.0/0.0
- Methods for Human Waste Disposal	10.0/0.0	10.0/0.0			20.0/0.0
- Human Use Monitoring Protocol	15.0/0.0	15.0/0.0			30.0/0.0
- Evaluate Education Program	10.0/0.0	5.0/0.0			15.0/0.0
- Inventory of Impacts	10.0/0.33	10.0/.33			20.0/0.66
MITIGATION					
- Remove Caches/Dumps	15.0/0.0	15.0/0.0	5.0/0.0	5.0/0.0	40.0/0.0
- Remove Fixed Hardware	10.0/0.0	10.0/0.0	2.0/0.0	2.0/0.0	24.0/0.0
- Remove Human Waste Accumulations	15.0/0.0	15.0/0.0	5.0/0.0	5.0/0.0	40.0/0.0

- Provide Biodegradable Waste Bags	3.0/0.0	3.0/0.0	3.0/0.0	3.0/0.0	12.0/0.0
MONITORING					
- Establish Human Use Impact Monitoring Program	7.5/0.25	7.5/0.25	7.5/0.25	7.5/0.25	30.0/1.0
INTERPRETATION					
- Improve Current Education Program for Climbers and Visitors	5.0/0.0	5.0/0.0	5.0/0.0	5.0/0.0	20.0/0.0
PROTECTION					
- Increase Patrol Presence on Other Routes	5.0/0.0	5.0/0.0	5.0/0.0	5.0/0.0	20.0/0.0
TOTALS	125.5/0.5	120.5/0.5	32.5/0.25	32.5/0.25	311.0/1.66

COMPLIANCE

All appropriate NEPA, NHPA, and ANILCA compliance documents will be prepared before initiation of any project and will be maintained on file at Denali National Park and Preserve headquarters.

REFERENCES

Anon. 1994. Mountaineering, Denali National Park and Preserve. Alaska Natural History Association. Anchorage, Alaska. 44pp.