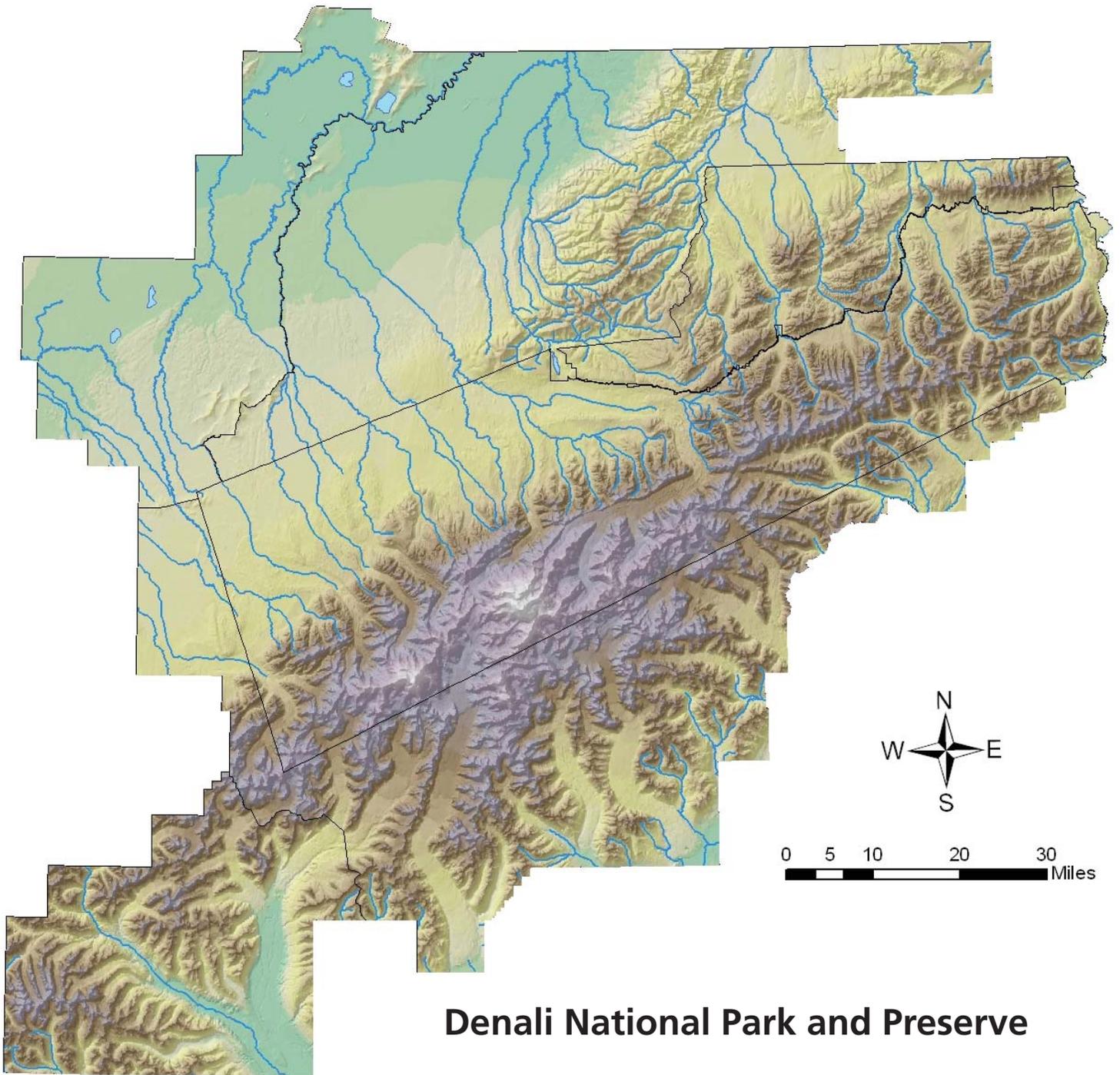


# Denali National Park and Preserve Resource Stewardship Strategy 2008 - 2027 SUMMARY





## Denali National Park and Preserve

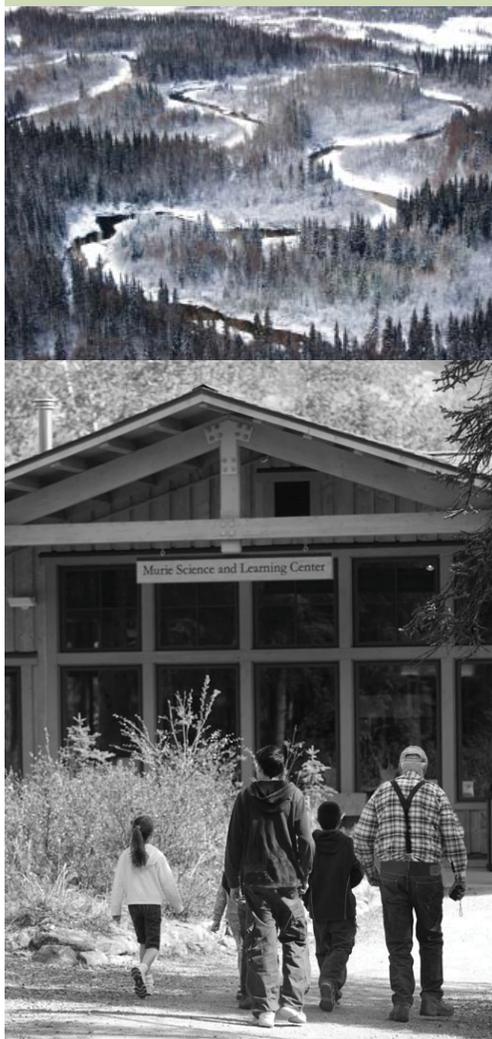
The Resource Stewardship Strategy Summary is an expanded executive summary from Denali's *Resource Stewardship Strategy* (RSS)—a 200-page document created from 2004 to 2009 to serve as a 20-year road map for resources (see [www.nps.gov/dena/naturescience/rss.htm](http://www.nps.gov/dena/naturescience/rss.htm)). The RSS Summary describes both the process and the results of developing the RSS. It lists Denali's *fundamental resources and values* and *other important resources and values*. Park staff compiled the *current status of resource knowledge*, and selected *indicators* to assess current and desired condition for the resources and values. An important part of the RSS was the development of 19 *comprehensive strategies* and 99 *projects* needed to assure the protection of Denali's natural and cultural resources for decades to come. In the RSS Summary, highlights are provided for at least one project in each strategy, in order to showcase ongoing or planned work. Projects are *prioritized* as highest, medium, or lowest priority based on five ranking criteria.

# Resource Stewardship Strategy (RSS) Summary

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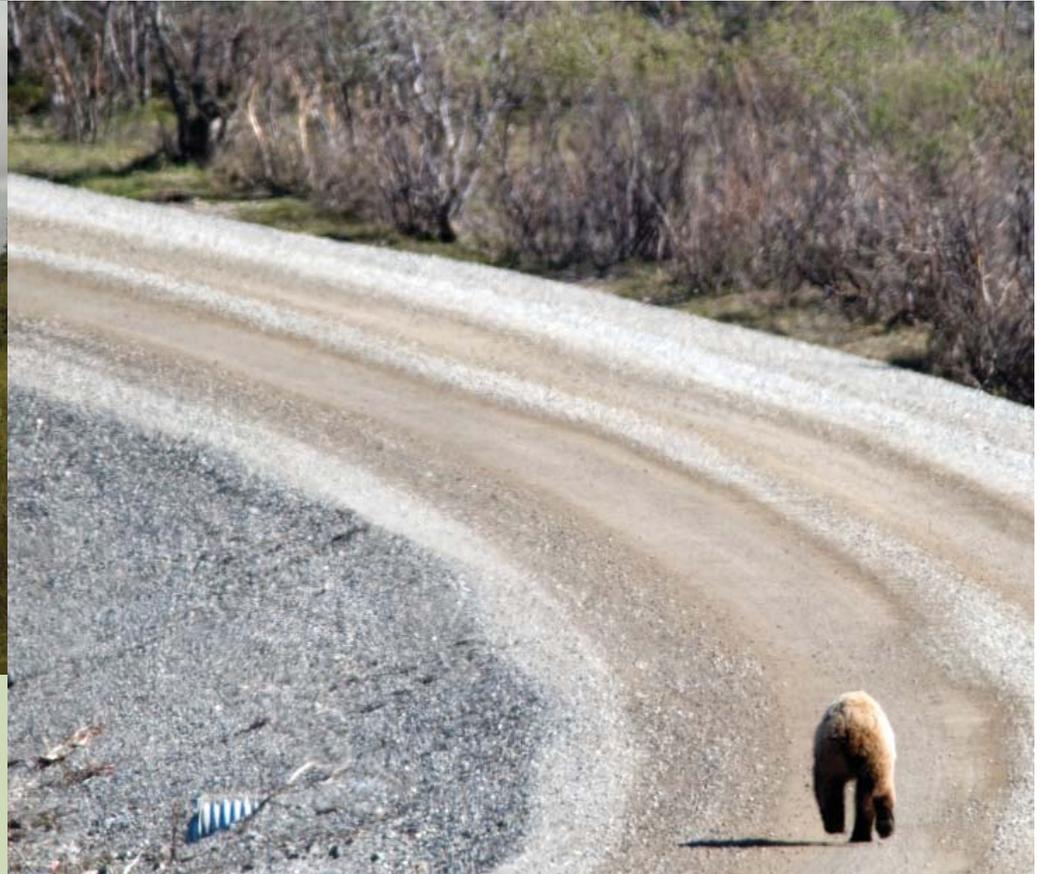


# Introduction

The *Resource Stewardship Strategy 2008 - 2027* (RSS) provides strategic guidance for the research, resource management, and resource education programs of the National Park Service at Denali National Park and Preserve.

The RSS is a program planning document that serves as a bridge between the qualitative statements of desired conditions established in the park General Management Plan (GMP) and the measurable goals and implementation actions determined through park strategic planning. The RSS is not a decision-making document. It is an analytical document that focuses on identifying and tracking indicators of desired conditions, recommending comprehensive strategies to achieve and maintain desired conditions over time, and assessing and updating these comprehensive strategies periodically based on new information and the results of completed activities.

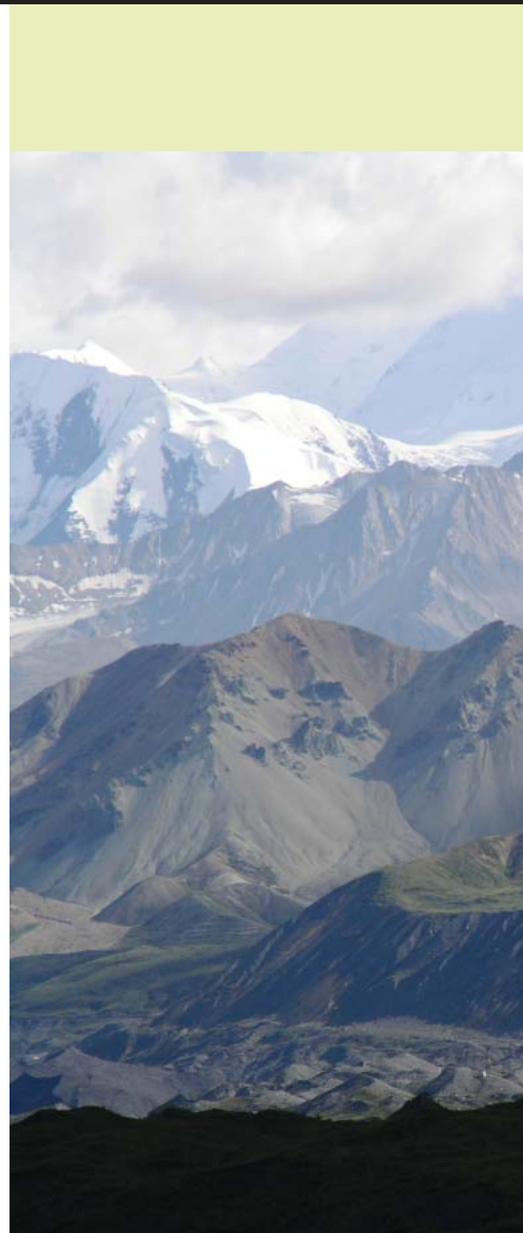
The RSS provides the park with a strategy for investing both human and fiscal resources in the stewardship of natural and cultural resources. It also reports accountability toward progress in attaining and maintaining desired resource conditions at the park.



Denali has long recognized the importance of information-based decision making as well as the need to increase the understanding of the public about park issues through a science- and scholarship-based approach. In 2003, the park included the need for a strategic science plan as a park focus area, in part in response to the development of an integrated resource, education, and research program at Denali (the Center for Resources, Science, and Learning). The Murie Science and Learning Center was established at that time.

Director's Order 2-1 mandating the preparation of a Resource Stewardship Strategy, to replace a Resource Management Plan at parks nationwide, provides a useful approach for developing the science strategy needed at Denali. Denali will be the second unit in the National Park system, and the first park with extensive natural resources, to complete an RSS. Thus, Denali's RSS document may serve as a prototype for other large parks managing natural and cultural resources.

As much as possible, preparers of the document at Denali followed the guidance in the draft *Midwest Region Resource Stewardship Strategy Planner's Manual*. The draft manual was developed during the production of the first RSS for Herbert Hoover National Historic Site. Denali staff adopted new approaches to the RSS preparation where necessary to address the types and extent of natural resources found at Denali.



# Fundamental and Other Important Resources and Values

The first step in developing Denali's Resource Stewardship Strategy was to identify the resources and values that the National Park Service is responsible for preserving at Denali. These resources and values are contained in Congressional direction to the National Park Service through legislation such as the park's enabling statutes, the National Park Service Organic Act of 1916, and the Clean Air Act. This identification is typically accomplished in a park's Foundation Statement.

## Fundamental Resources and Values

*Fundamental resources and values* are the particular systems, processes, experiences, scenery, sounds, and other features that are central to achieving the park's purposes and maintaining its significance. Denali's fundamental resources and values are those that Congress identified specifically for the park through its enabling legislation, including both the Mount McKinley National Park Act of 1917 and the Alaska National Interest Lands Conservation Act of 1980. These resources and values may be synthesized for Denali as follows:

1. Wildlife populations, wildlife habitat, and the processes and components of the park's natural ecosystem.
2. Wilderness character, wilderness resource values, and wilderness recreational opportunities.
3. Scenic and geologic values of Mount McKinley and the surrounding mountain landscape.
4. Visitor enjoyment and inspiration from observing wildlife in its natural habitat and other natural features.

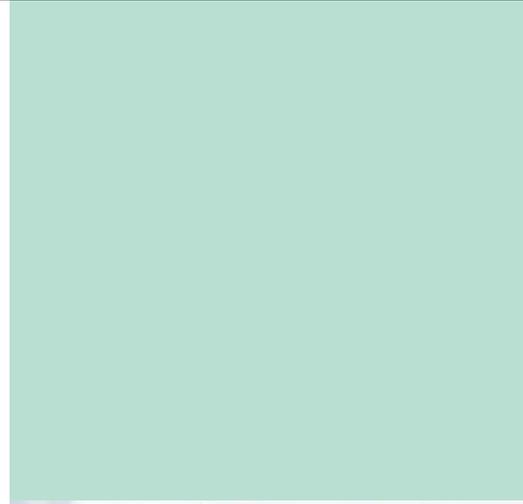


## Other Important Resources and Values

Denali National Park and Preserve has *other important resources and values* that are not primary to the park's purpose and significance, but are important for both park management and visitors. These are resources and values that Denali possesses and has a legal mandate to protect, but which do not account for the establishment of the park and preserve. These other important resources and values include:

5. Historic, archeological, and ethnographic resources.
6. Paleontological resources.
7. Air quality.
8. Subsistence resources and opportunities.
9. Scientific research, education, and interpretation about natural ecosystems and geologic features and processes.

Desired condition statements for each resource or value are provided by the park's General Management Plan. While some desired conditions apply parkwide, others are specific to particular legislatively designated areas (Old Park, Denali Wilderness, park additions, preserve) or to management zones described in the General Management Plan.



# Status of Resource Knowledge

The second step in developing Denali's RSS was reviewing an understanding of the work that has been accomplished relative to *desired condition* for each of the park's fundamental and other resources and values.

The status of knowledge regarding biological, physical, and cultural resources, as well as park visitation and the human environment in and around the park, was assessed to identify available information, research mandates, and data gaps.

## Key Findings:

- The park has completed numerous resource inventories, but many more are needed (e.g., landcover, nonvascular plants, glaciers, water quality, soundscape, lightscape, paleontological resources, fish, amphibians, invertebrates, birds, archeological sites, cultural landscapes, ethnographic resources, and museum objects).
- The patterns of natural variability and the interactions among many park resources are not well understood, making it difficult to define desired resource conditions. Achieving this understanding is complicated by the particularly rapid influence of global climate change on the condition of Subarctic ecosystems.
- The Central Alaska Inventory and Monitoring Network (CAKN), and earlier monitoring efforts, provide information about how to monitor many park resources. However, monitoring protocols still need to be developed and implemented for some CAKN "vital signs" (e.g., grizzly bears and Dall's sheep), and other key resources (e.g., visitor experience and resource conditions in the backcountry).
- Environmental responses to management actions need to be more completely evaluated in some cases (e.g., restoration and recovery of disturbed lands; gravel extraction; and hazardous fuel treatment).
- The consumptive use of park resources by subsistence and other users is not well-documented either historically or in the present.
- While some aspects of the park's history have been



documented, many aspects have not, including scientific and mountaineering histories.

- Visitor carrying capacity needs to be defined in some management zones of the park. Some significant types of park visitation need to be accounted for, and the park's model for estimating visitation needs to be improved.
- The relationship of surrounding human communities and land uses to park visitors and resources is not completely understood.

3. Determine indicators for each resource attribute, i.e., what can be measured about the attribute that best indicates resource condition? Make sure indicators are effective in supporting interpretive themes and resource integrity.
4. Specify a target value for each indicator that represents the desired condition of the resource.
5. Measure current conditions using the indicator.
6. Assess the difference between current condition and desired condition for each indicator.

## Indicator Selection and Condition Assessment

The third stage in the development of the RSS required the following steps to identify indicators of resource condition and to use the indicators to assess resource condition:

1. Identify attributes or characteristics of each significant resource.
2. Consider influences that can impact the condition of resource attributes.

### Key Findings:

- The RSS Team identified 119 indicators of resource condition.
- A research program is needed to identify indicators related to visitor experience.
- Targets were set for 80 indicators.
- Research and planning are needed to identify targets for the remaining indicators, and to assess the current condition for 73 of the 119 indicators.



# Comprehensive Strategies— Overview

The final step in the development of the RSS was the development of comprehensive strategies and associated projects to assure that the National Park Service is attaining and maintaining the desired condition for all park resources and values. To that end, the 19 comprehensive strategies that were developed address one of three needs:

- **Monitoring and managing park resources and visitor activity to assure that targets for each indicator are achieved.**
- **Filling data gaps necessary to define and evaluate indicators and targets for park resources.**
- **Implementing research or resource management activities required by legislation or the park’s General Management Plan.**

The comprehensive strategies identified for Denali are listed in the box at right. The RSS describes 99 specific projects to implement these strategies (see pages 14-52).



## **Base Knowledge of Park Resources**

**Strategy A:** Complete biological, physical, and cultural resource inventories.

**Strategy B:** Develop an understanding of basic ecological relationships necessary for management decision-making.

**Strategy C:** Develop the historic contexts necessary to evaluate resources and generate nominations for National Register significance.

## **Monitoring Resources**

**Strategy D:** Develop and/or implement vital signs monitoring protocols for physical and biological resources to monitor long-term ecological change.

**Strategy E:** Monitor natural resources that may need management response.

## **Management and Mitigation**

**Strategy F:** Develop and implement plans to monitor and manage vulnerable park resources.

**Strategy G:** Restore and monitor disturbed lands.

**Strategy H:** Determine and monitor visitor carrying capacity by management area.

**Strategy I:** Minimize habituation of park wildlife.

**Strategy J:** Detect, monitor, and mitigate environmental influences external to the local natural ecosystem.

**Strategy K:** Mitigate the risk of wildland fire to park infrastructure and cultural resource sites.

**Strategy L:** Preserve the museum collection, and rehabilitate and preserve park historic structures.

**Strategy M:** Monitor and manage consumptive uses of park resources, including subsistence use.

**Strategy N:** Enhance and increase the effectiveness of wildlife protection by deterring illegal activities.

## **Parks and People**

**Strategy O:** Improve estimation of park visitation.

**Strategy P:** Monitor trends in adjacent community populations, land use, and local economy.

## **Data Management**

**Strategy Q:** Develop and implement effective data management strategies for use by managers, specialists, and the public.

## **Education and Communication**

**Strategy R:** Facilitate the education of all audiences (external and internal) about resource issues in and around Denali to gain support for the park's management decisions.

**Strategy S:** Develop staffing and infrastructure to enhance bridges between research and interpretation, and to facilitate higher levels of understanding and preservation of park resources.

# Linking Strategies and Park Resources and Values

Each of the 19 comprehensive strategies (brief titles are in lettered rows) provides a road map for protecting and maintaining one or more of Denali's *Fundamental Resources and Values* and *Other Important*



Comprehensive Strategies		Fundamental Resources and Values			
		1	2	3	4
		<i>Wildlife, Habitat, and Natural Ecosystems</i>	<i>Wilderness Resource Values and Recreational Opportunities</i>	<i>Scenic and Geologic Values of Mountain Landscape</i>	<i>Visitor Enjoyment and Inspiration</i>
A	Inventory	X		X	
B	Ecological Relationships	X		X	
C	Historic Context				
D	Monitor Vital Signs	X	X	X	
E	Monitor/Management	X			X
F	Monitor Vulnerable Resources	X	X	X	
G	Restore Disturbed Lands	X	X		X
H	Determine Visitor Capacity	X			X
I	Minimize Wildlife Habituation	X			
J	Mitigate External Influences	X			
K	Mitigate Risk of Wildland Fire				X
L	Protect Museum Collections and Historic Structures	X			
M	Monitor Park Uses / Subsistence	X	X		
N	Deter Illegal Activities		X		
O	Estimate Visitation				X
P	Adjacent Community Trends				X
Q	Data Management	X	X	X	X
R	Education				X
S	MSLC Staffing and Infrastructure				X

*Resources and Values* (columns headers list numbers and brief titles). For a description of strategies, and a list of projects for each strategy, see pages 14-52.

### Other Important Resources and Values

5	6	7	8	9
<i>Historic, Archeological, and Ethnographic Resources</i>	<i>Paleontological Resources</i>	<i>Air Quality</i>	<i>Subsistence Resources and Opportunities</i>	<i>Scientific Research, Education, and Interpretation</i>
X	X	X		X
			X	X
X			X	X
		X	X	X
				X
X	X			X
				X
				X
X	X		X	X
X	X		X	X
X				X
			X	X
			X	X
				X
X			X	X
X	X	X	X	X
				X
				X



# Comprehensive Strategies— Description and Projects

## Strategy A: Complete physical, biological, and cultural resource inventories

Identifying species, features, and processes where data gaps now exist will allow an improved basic understanding of park resources. The development and implementation of inventories, surveys, and focused research will improve basic information for making science-based management decisions about physical resources (projects 1, 2), biological resources (projects 3, 4, 5, 6), fire ecology (projects 7, 8, 9), and cultural resources (projects 10, 11, 12, 13). The outcome of these projects will be information that can be used to set or adjust indicators and targets for the condition of park resources in relation to the desired condition. Inventory data can be added to the baseline of park resource information used by the research community in site selection and interpretation of data.

### 1. Special Geologic Features Inventory ◀

Identify and photograph the park's rare or unique geological features including possible "type sections" and periodically monitor their condition. Develop a database to document the location and condition of these geological features.

### 2. Paleontological Resources Inventory

Complete a formal park-wide inventory of known paleontological resources and document their location, abundance, ease of access, risk factors and disturbance, baseline condition, fragility, and protection measures needed, if any.



#### Highest and Deepest

Among Denali's special geologic features are Mt. McKinley (Denali), the highest peak in North America; and the Ruth Gorge, the deepest gorge on the continent (as measured through the Ruth Glacier that fills the gorge). Some of Denali's special geologic features may have yet to be found through additional inventories (e.g., the first dinosaur prints were only discovered in 2005), or need to be more fully described and mapped (e.g., carbonate flowstones).



#### Base Knowledge of Park Resources

### 3. Nonvascular Plant Inventory ▶

Conduct a comprehensive park-wide inventory of nonvascular plants (mosses, lichens, and liverworts).

### 4. Inventory of Rare and Endemic Flora ▶

Conduct research to determine the distribution and habitat associations of rare and endemic flora.

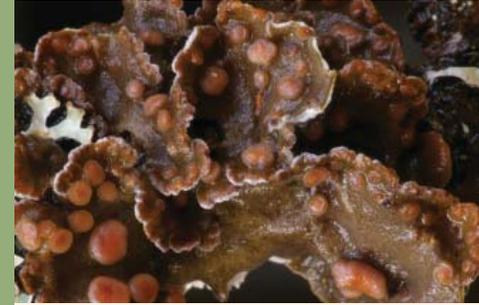
### 5. Inventory of Bird Status and Distribution

Conduct an inventory to determine the park-wide presence, distribution, and breeding status of birds.

### 6. All Taxa Biodiversity Inventory

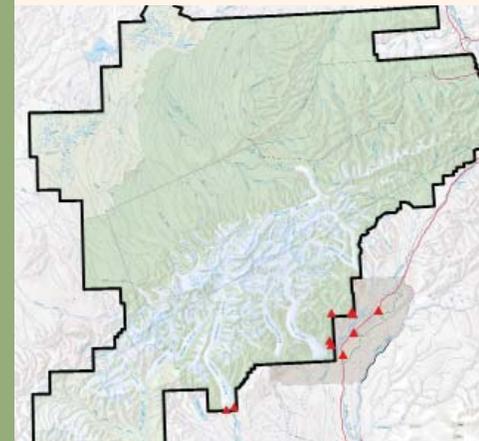
Investigate the feasibility of conducting an All Taxa Biological Inventory (ATBI) in Denali. ATBIs incorporate citizen science, park scientists, and the research community to inventory biodiversity in park ecosystems.

◀ *Note: An arrow beside a project title indicates that some aspect of the project is highlighted in the side column.*



#### Rare Lichen Found in Denali

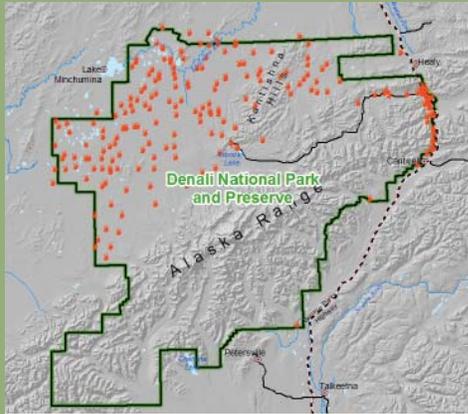
The rare boreal felt lichen (*Erioderma pedicellatum*) was first documented in the park in 2007 as part of an inventory of nonvascular plants. More locales in the park, Denali State Park, and adjacent to roads in the vicinity were documented in 2008 (see map). Previously it was known only from a very narrow range of sites in boreal eastern Canada and northern Europe. This lichen is currently listed as Critically Endangered on the IUCN Red List of Threatened Species.



Base Knowledge of Park Resources



# Strategies and Projects (cont'd)



## Scars of Fire

While the fire record is fairly well known and documented for fires occurring in Denali since 1950, researchers want to sleuth out the record of fires prior to 1950. Using such techniques as dating fire scars and taking tree cores—to find similar-aged cohorts of trees that established after a fire—researchers can learn about the frequency and size of fires that occurred in the vegetation types prone to fire. The goal is to determine if fire parameters are different now than 50 years ago, and what impacts any such changes in wildland fire are having on natural resources.



## Base Knowledge of Park Resources

## Strategy A: (cont'd)

### 7. Wildland Fire History Prior to 1950 ◀

Determine fire size, frequency, duration, and return intervals by vegetation type and geographical area to enable fire managers and resource managers to make more informed decisions about fire management activities.

### 8. Inventory of Smoke Conditions

Determine the natural range of hazy conditions in the park caused by wildfire smoke.

### 9. Burn Severity

Using pre- and post-fire Landsat imagery, develop a robust mapping methodology and consistent data products to evaluate and compare burn severity within individual wildland fires and among fires across different ecosystems. Analyze burn severity every five years.



## 10. Archeological Survey ►

Survey high-probability areas to identify archeological resources for protection. Carry out the requirements of the National Historic Preservation Act.

## 11. Archeological Survey of Sites with Native Place Names

Survey sites identified by Athabaskan elders during the Native place names mapping project. Document traditional use patterns from late historic through contemporary periods.

## 12. Native Place Names Map

Convert into map form a report about Native place names in and around the park.

## 13. Inventory of Cultural Landscapes

Conduct a Cultural Landscape Inventory (CLI) to identify resources to be protected, as mandated by the Cultural Resource Management Guideline.



### Dirt Archeology

In 2009, researchers from the University of Alaska Fairbanks spent three weeks digging at Teklanika West. The group expanded the 1960 excavations of Fred West, hoping to better distinguish and date layers of site use and learn how prehistoric humans used the landscape. Volumes of dirt were troweled, then sifted through screens (below). The dig yielded two hearth-like features, hundreds of lithic (stone) artifacts, and an assortment of bones from hunted prey. An ash layer in the pit wall corresponds to the same ash in Wonder Lake sediments dated to 7,000 years before present. Ironically, during many windy days, the researchers were dusty with the same fine loess, blown up from the river, that covered any abandoned artifacts between occupations at the site.



### Base Knowledge of Park Resources

# Strategies and Projects (cont'd)

## Strategy B:

### Develop an understanding of basic ecological relationships necessary for management decision-making

Climate and natural processes (e.g., fire) play key roles in shaping Denali's landscapes. Many of the indicators selected in the RSS have targets described as needing to remain within the "range of natural variation." In response to climate changes, the "range of natural variation" may be changing. Analyses of how Denali's ecosystems are or may be impacted by climate change (projects 14, 15) will provide information about the existing or expected changes in "range of natural variation," so managers can make informed decisions about what can be managed and what is outside the control of management. New investigations and analyses of historical data about fire behavior, fire return intervals, and ecological impacts of fires (projects 16, 17, 18) will provide a better understanding of fire risk for safe fire management, and of ecological relationships in boreal forest and tundra ecosystems.

## 14. Biological Effects of Climate Change

Develop an understanding of how climate change may affect the distribution of plant and animal communities and animal behavior. Develop methods to understand how climate change affects the spread of exotic species. Identify native species of plants and animals that may be particularly vulnerable to the effects of climate change. Develop protocols to monitor effects of climate change on vulnerable species. Develop methods to predict the effects of climate change on the park's fire regime based on weather, fire perimeter, burn severity, and fire behavior data. Cooperate with UAF to model effects of climate change on fire regimes. Initiate projects to develop habitat selection models for important species and to understand how species respond to changes in their habitat.



### Photos Tell Story of Change

In 2004, park staff obtained over 200 historical photos of Denali's glaciers. These are ground-based images made in the early 1900s by Cathcart, Capps, Washburn, and others on survey and research expeditions to the Denali area. That same year, R. D. Kapilo set up his camera in many of the same sites to repeat the images using a modern digital camera. The photo comparisons of the glaciers are often dramatic, showing significant changes over more than 80 years, including over 700 vertical feet of ice loss on a glacier in the Teklanika valley.



### Base Knowledge of Park Resources



## 15. Physical Effects of Climate Change ◀

Develop an understanding of how climate change may affect local and regional weather patterns, snowpack, glacial dynamics, permafrost, weathering, air quality, and other aspects of the park's physical environment.

## 16. Weather, Indices, and Fire Behavior

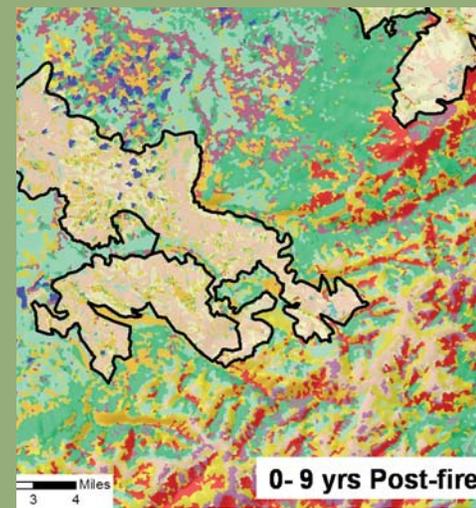
Gather historical weather data, verify its accuracy, and establish good weather predictors associated with fire development, fire behaviors, and the end date of the fire season. Examine historical weather data for commonness and rarity of significant weather events to determine the probability of such events. Compare fire behavior outputs using the Canadian fire behavior prediction software, inputting Canadian Forest Fire Danger Rating System (CFFDRS) indices versus actual fire behavior. Evaluate the Fire Weather Indices within CFFDRS to predict large fire growth. Determine the utility of moisture probes to model CFFDRS indices, and evaluate whether alternative drought indices would be useful in Alaska.

## 17. Ecological Impacts of Wildland Fires ▶

Gather and analyze existing data (e.g., 1980s paired plot and 2005-2007 videography and moose browse data) in order to investigate the effects of fires, including repeat fires and burn severity, and fire management practices of boreal forests, wildlife habitat, moose utilization, and subsistence resources. Investigate collaboration with Inventory & Monitoring program for long-term monitoring of fire impacts and hydrologic systems.

## 18. Wildland Fire Return Intervals

Analyze fuel characteristics (e.g., vegetation type, fuel load, moisture, and tree age) that allow previously burned areas to act as fuel breaks for new fires.



### Models Update Post-Fire Vegetation and Fuels Maps

In fire-prone areas, fire fuels and vegetation maps don't stay current very long because wildland fires burn vegetation and burned areas regrow. To update these maps (see an example of vegetation types following 2000 Chitsia and Otter Creek fires outlined on map), a model was developed for Denali that predicts how vegetation responds after a wildland fire. The model is based on data collected from fire-effects plots in burns of varying ages and severities that the fire crew set up in 2005 and 2007.



### Base Knowledge of Park Resources

# Strategies and Projects (cont'd)



## Mining the History

The adit (horizontal mine access opening) at Comstock Mine is being plugged using Centennial Challenge funds. The closure of this mine entry could be viewed as symbolic of the closure of an era of active mining, begun during the stampede of miners to the Kantishna area in 1905. The legacy of mining is rich in stories of characters and place, and how the mining activities affected what is now Denali National Park and Preserve.



## Base Knowledge of Park Resources

### Strategy C: Develop the historic contexts necessary to evaluate resources and generate nominations for National Register significance.

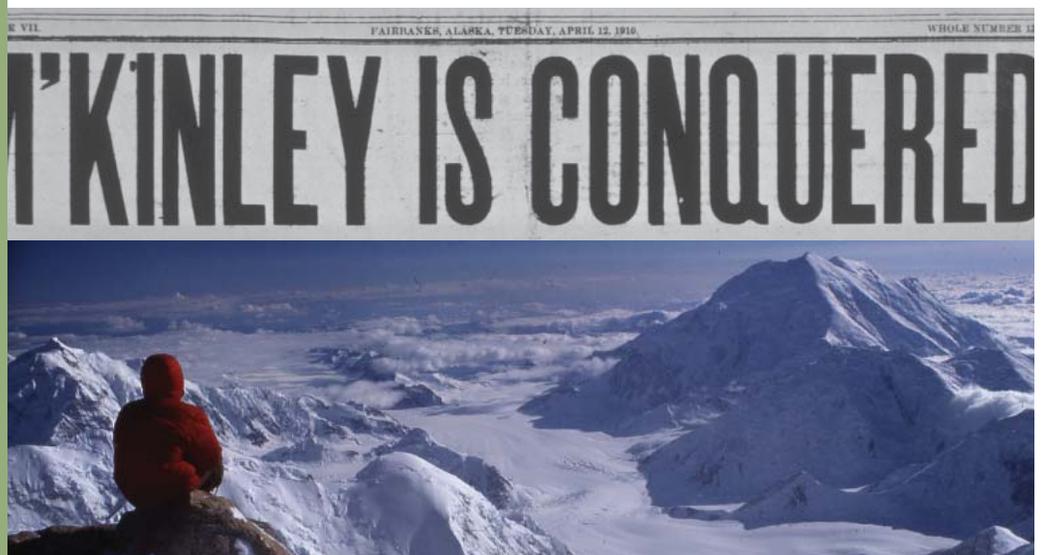
To appropriately protect historic and archeological sites and the resulting cultural landscapes, these resources need to be evaluated for National Register significance (project 24). However, to complete these determinations of eligibility, the sites need to be evaluated in their historic context. The record of historic context is a gap in knowledge, although pieces of this context are available from various sources. Several historical context themes need to be researched and compiled as in-depth histories—mining, mountaineering, science in the park, park road history, and the history of trapping and subsistence activities.

### 19. Mining History ◀

Develop a comprehensive history of mining from primary research and existing documents to help recognize the influences and impacts of mining on park resources.

### 20. Mountaineering History

Document the history of mountain climbing as well as the scientific studies conducted on the mountain.



## 21. Scientific Legacy ►

Synthesize information about the history of scientific studies conducted in the park, organize it in a historical context, and assess gaps in the documentary record.

## 22. History of the Park Road

Develop a history of the park road—based on historic site and road construction records—to provide a good source for interpretation and management.

## 23. Trapping History

Document the trapping history of Denali before and after the establishment of the park in 1917, and before and after the additions of 1980, to provide valuable information for the historical and subsistence record.

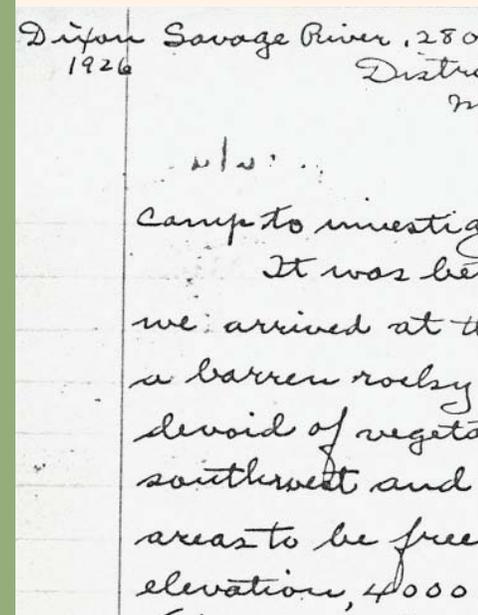
## 24. National Register Nominations

Review and determine what sites are eligible for nomination to the National Register of Historic Places (complete Determinations of Eligibility). Write nominations for sites determined to be eligible for appropriate protection. Follow requirements of the National Historic Preservation Act.



### Learning from Dixon's Legacy

Many of the enduring scientific values of Denali developed out of decades of pioneering natural history exploration and scientific journal-keeping by Olaus Murie, Joseph Dixon, George Wright, and Adolph Murie in the early 1900s. In 1926, Dixon penned notes about his discovery of the "first" Wandering Tattler nest in Denali. Current plant and wildlife observations in the park can be compared with Dixon's journals for insights into patterns of change over nearly a century.



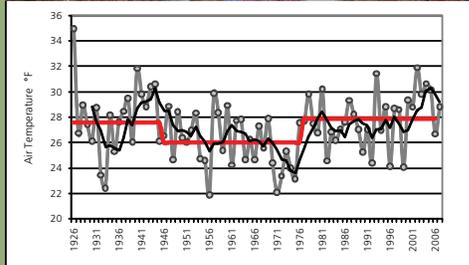
### Base Knowledge of Park Resources

# Strategies and Projects (cont'd)



## Denali's Climate and Sea Surface Temperatures in the Pacific Ocean

Recently researchers discovered that one of the most important influences on Denali weather is what is known as the Pacific Decadal Oscillation (PDO), an index of sea surface temperatures in the northern Pacific Ocean. The PDO has warm and cool phases that alternate, each lasting for several decades (red line). For the last 30 years, ocean temperatures have been warmer than normal, bringing warmer air temperatures to Denali (black line is a running five-year average of annual mean air temperature at Park Headquarters). The PDO is expected to revert to the cool phase in the next few years. Park staff will continue to monitor climate trends at representative locations in the park through remotely operated weather stations. Will the correlation of the decade-scale climate patterns with Denali's climate continue during the cool phase of PDO?



## Monitoring Resources

### Strategy D:

## Develop and/or implement vital signs monitoring protocols for physical and biological resources to monitor long-term ecological change.

Monitoring the condition of physical and biological resources will provide the baselines to maintain, preserve, and protect the ecological integrity of Denali. High-standards monitoring will help identify factors that influence the park's ability to maintain natural and healthy populations and natural processes. All the projects listed below (except for Trumpeter Swans (33)) develop or implement the peer-reviewed monitoring protocols for fauna and flora identified as vital signs by the Central Alaska Network (CAKN). Not all CAKN vital signs listed as having high relevance to Denali are listed here.

### 25. Air Quality Monitoring

Continue to implement air quality and visibility monitoring protocols in order to protect the park's air resources, which are designated Class I under the Clean Air Act. Continue to monitor lichen community structure (as a biological indicator of air quality) using the current vegetation monitoring protocols.

### 26. Monitoring of Climate and Snowpack ◀

Continue to implement the climate and snowpack monitoring protocols in order to evaluate the influence of local and global climate trends on resources within the ecosystem.

### 27. Glacier Monitoring

Quantify broad-scale changes to glacial environments by implementing the existing glacier monitoring protocol. Update the protocol format to meet the standards of the Inventory and Monitoring program.



## 28. Permafrost Monitoring

Develop a permafrost monitoring protocol that incorporates diverse monitoring methods at multiple scales in order to evaluate permafrost status parkwide, identify permafrost trends and how they affect the ecosystem, and contribute to statewide and global permafrost monitoring efforts.

## 29. Water Quality Monitoring ►

Develop and implement monitoring protocols to measure success toward the park water quality goal: “Water quality of park rivers, streams, lakes, and ponds is improved and/or maintained to support a diverse aquatic community and ecosystem function, and to meet or exceed federal and state water quality standards.” This effort includes Central Alaska Monitoring Network (CAKN) lake and stream studies.

## 30. Stream Morphology Monitoring

Develop and implement monitoring protocols to measure success toward the park goal: “Physical channel and floodplain integrity of park streams and rivers is maintained and/or improved to support natural geomorphic processes of fluvial systems and to support natural aquatic flora and fauna.”

## 31. Fish Monitoring

Develop and implement a protocol to monitor the distribution and abundance of freshwater fish and of salmon spawning areas. Examine the effects of climate change, contaminants, water quality, and subsistence use on fish populations.



### The Canary of Shallow Lakes

Denali contains thousands of lakes, many of which are shallow basins, rich in aquatic life. Some shallow lakes, which are located on more permeable soils, are vulnerable to drying as patterns of permafrost, rainfall, and hydrology change. The Central Alaska Network Inventory and Monitoring Program is using remote sensing, in conjunction with intensive field work, to track changes in the size, depth, water chemistry, and ecology of about 30 shallow lakes in Denali.



### Monitoring Resources

# Strategies and Projects (cont'd)



## Eagles are Golden

Going on its third decade is the long-term monitoring of golden eagles in Denali for nesting area occupancy and reproductive success. The study provides insights into the patterns and trends in golden eagle reproduction and production in the higher latitudes of western North America. From satellite tracking researchers have learned that juveniles have vast movements from Denali across western North America. Some roam from Denali to central Mexico during their first year of life. Results help Denali's managers understand the factors that impact the park's golden eagles, and thus maintain this species as an integral part of Denali's native fauna.



## Monitoring Resources

## Strategy D: (cont'd)

### 32. Monitoring of Passerine Birds

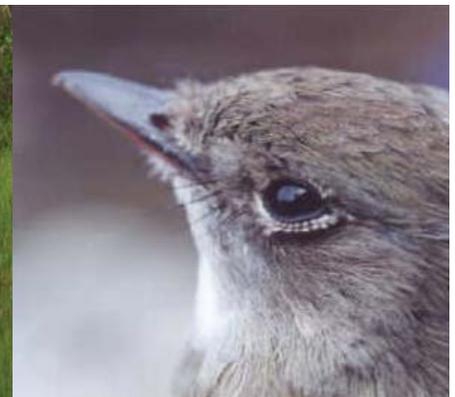
Continue to monitor passerine birds to determine how their abundance and distribution respond to changes in their habitats and to help document their population trends in the park and on a statewide level. Continue to conduct Breeding Bird Survey (BBS) routes in Denali to assess broad-scale changes in the abundance and distribution of land birds along the two BBS routes and to provide information to state and continental bird monitoring programs.

### 33. Trumpeter Swan Monitoring

Continue to provide financial support to the U. S. Fish and Wildlife Service for monitoring trumpeter swan breeding populations in the park.

### 34. Monitoring Golden Eagles and Peregrine Falcons ◀

Continue monitoring nesting area occupancy and breeding success of golden eagles to detect changes in occupancy and reproductive rates of the territorial populations. Continue to monitor peregrine falcon nest occupancy and breeding success.



### 35. Monitoring Important Herbivore Species

Develop monitoring protocols for important species of small- to medium-sized secondary producers. Species which have been identified as particularly important to Denali's ecosystem include arctic ground squirrels, red squirrels, snowshoe hares, willow ptarmigan, and beavers.

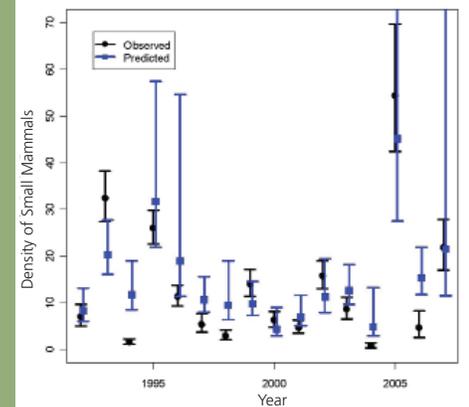
### 36. Small Mammal Monitoring ►

Continue to estimate annual population size and variation in small mammals in the Rock Creek drainage (using the Long-term Ecological Monitoring protocol).



#### When Are Voles Abundant?

Voles, by virtue of their small size and secretive habits, are not highly visible in Denali. Yet these species represent more park biomass than grizzly bears. Data collected during the 14th year of sampling (2005) confirmed that *observed* densities of voles (black bars in graph) can be *predicted* (blue bars) from a few key environmental variables. Based on these many years of monitoring, Rock Creek vole populations are high in years when spring comes early or when summer is moist; however, in the occasional year when both conditions occur, voles are not *even more* abundant. Fifty-seven percent of the variation in vole densities can be explained by these few variables.



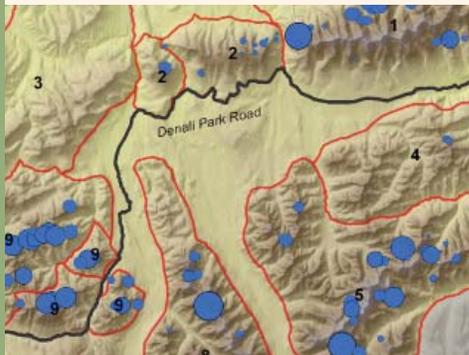
#### Monitoring Resources

# Strategies and Projects (cont'd)



## Dall's Sheep

Denali wildlife biologists are working with the Central Alaska Network to develop a methodology for estimating Dall's sheep abundance. In 2008, they conducted aerial surveys to obtain baseline counts to begin this process. Observers counted 1,526 sheep in the survey units that were surveyed completely (sightings as blue dots on map). While comparisons with past survey results should be made with caution, results of the 2008 survey suggest that sheep numbers in the traditional units east of the Muldrow Glacier have not changed significantly since the mid-1990s. Once a monitoring protocol is established, managers will have accurate estimates of abundance that can be compared across years and used to describe long-term park-wide trends and demographics in an unharmed sheep population.



## Monitoring Resources

## Strategy D: (cont'd)

### 37. Caribou Monitoring

Continue to provide financial support for the monitoring of the Denali Caribou Herd by the United States Geological Survey, Biological Research Division, in order to document the size, distribution, movements, and demographic makeup of the herd. Develop and implement a monitoring protocol for the Denali Caribou Herd.

### 38. Moose Monitoring

Finalize and implement the protocol for moose monitoring. Continue to conduct periodic moose surveys in a standardized 10,000-square-kilometer area north of the Alaska Range. Continue to conduct targeted moose surveys south of the Alaska Range to monitor locally-harvested moose populations.

### 39. Dall's Sheep Monitoring ◀

Develop and implement a protocol to monitor the distribution and abundance of Dall's sheep. Develop and implement a protocol to monitor migratory movements of Dall's sheep, and the impacts of human activity on migration.



## 40. Wolf Monitoring ►

Finalize and implement the protocol for wolf monitoring. Continue to monitor numbers and territories of wolf packs north of the Alaska Range.

## 41. Grizzly Bear Monitoring

Develop and implement a protocol to monitor the distribution and abundance of grizzly bears. Continue to monitor cub production and survival of grizzlies as a demographic component of the bear monitoring program.



### Wolf Watch

Denali's wolf population has been monitored since 1986. The park's wolves, like their prey, live at a low density on the landscape, and the territory occupied by one wolf pack in Denali may be 10 times as large as wolf territories in more temperate areas. The primary prey items of Denali's wolves are moose, caribou, Dall's sheep, beavers, salmon, and a variety of smaller prey. The largest wolf pack that has been observed in the park contained 29 wolves, but most packs are much smaller, averaging around eight wolves in most years.



### Monitoring Resources

# Strategies and Projects (cont'd)



## Plants and Place

Beginning in 2006, Denali botanists and the Central Alaska Network have been sampling plots distributed at 20-kilometer (12.5-mile) intervals across Denali's vegetation communities to detect changes in the fundamental properties of vegetation cover over time. It takes six years to complete a sampling cycle of the minigrid plots, plus one year to review data collected. The first cycle will be reviewed in 2012.



## Strategy D: (cont'd)

### 42. Monitoring Vegetation Structure and Composition ◀

Continue to implement the grid-based protocol to monitor vegetation communities across Denali.

### 43. Landcover Monitoring

Develop and implement protocols to monitor landcover and long-term landcover trends. Develop a protocol to detect short-term (0-17 years) differences in vegetation types particularly in burned areas. Develop a model for vegetation succession in burned areas.



**Monitoring Resources**

## 44. Soundscape Monitoring ►

Develop and implement soundscape monitoring protocols in order to detect changes in soundscapes across the landscape, and to meet the monitoring requirements that are included in the Denali Backcountry Management Plan and any that are developed for frontcountry areas.

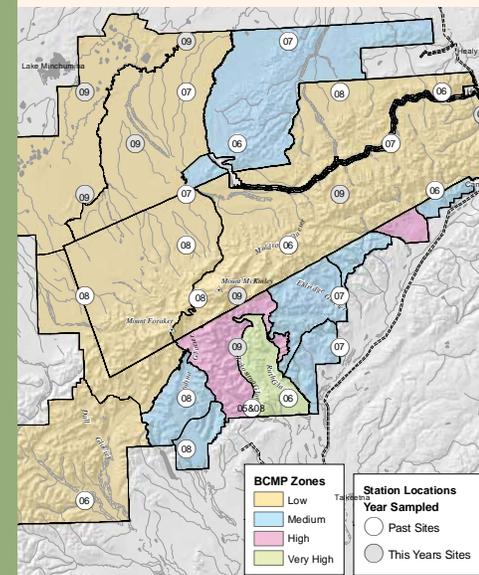
## 45. Monitoring of Plant and Landscape Phenology

Develop and implement a protocol to monitor the timing of seasonal snow cover, vegetation green-up, maximum greenness, and senescence on the landscape.



### Natural Surround Sound

Natural sound is both a resource in its own right, as well as an important aspect of the resource values of Denali's wilderness. The influence of motorized noise on visitor experience is a concern for park managers. Denali's Backcountry Management Plan, finalized in 2006, established indicators and standards for the natural sound environment, and implementation of the plan requires monitoring sound to evaluate if the standards are being met. Recording the baseline acoustic conditions systematically across the entire park (an inventory) is underway (see circles on map).



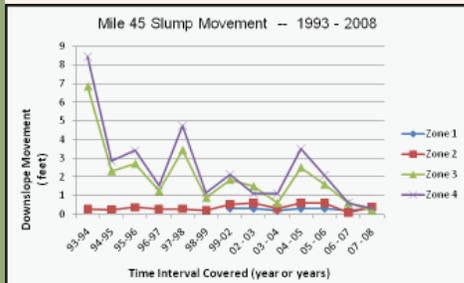
### Monitoring Resources

# Strategies and Projects (cont'd)



## Will the Landslide Slump Affect the Park Road?

Beginning in 1993, at Mile 45 of the park road, park staff established survey stations to monitor the rate of horizontal and vertical movements of a landslide. Based on an average of 35 stations, the down-slope movement on the slump surface—in the two zones below the road—has peaked during years when precipitation is high (1993-94, 1997-98, 1999-2002, and 2004-05). So far, the park road sits on relatively stable ground, but the apex of the scarp headwall (the nearest point to the park road) has eroded back to within 27 feet of the road.



## Monitoring Resources

### Strategy E:

### Monitor natural resources that may need management response.

Monitoring geohazards (e.g., the slump at Mile 45 of the Denali Park Road) and wildland fires ensures that park managers have information to make decisions about the management of developed areas in the park to afford the highest degree of staff and public safety possible.

### 46. Monitoring and Assessment of Geohazards ◀

Monitor and assess geohazards (e.g., earthquakes, landslides, avalanches, thermokarst) in the vicinity of developed areas in the park.

### 47. Documentation and Assessment of Wildland Fires

Continue to document wildland fires with GIS coverage of fire perimeters, on-site fire observations, and photography. Compare observed fire behavior with results from existing fire behavior models.



## Strategy F:

### Develop and implement plans to monitor and manage vulnerable park resources.

Certain park resources are particularly vulnerable to human activities or certain management actions (e.g., dinosaur fossil sites, cultural sites, darkness of night sky, and water quality). These projects develop and implement indicators and standards and effective management plans to avoid or minimize the impacts of these activities and actions on park resources. Factors that occur outside park boundaries that affect Denali's resources would be considered as well to achieve and maintain the desired conditions for park resources.

#### 48. Paleontological Resources

##### Management Plan ►

Develop and implement a management plan for paleontological resources to guide research and resource protection, to prioritize searches for new sites, and to develop site monitoring protocols.

#### 49. Cultural Sites Monitoring Plan

Develop and implement a cultural sites monitoring plan to standardize a rotating schedule for monitoring and assessing the condition of all cultural sites in the park to ensure appropriate protection.

#### 50. Natural Lightscapes Monitoring Plan

Develop a monitoring plan to preserve natural lightscapes in the absence of human-caused light, and to minimize the impacts to lightscapes in developed areas by incorporating lightscape-sensitive lighting designs into site plans.

#### 51. Waterway Navigability

Acquire all necessary data to assess navigability issues, support continued federal ownership where appropriate, and protect affected water resources within the park regardless of determination of title ownership.



#### Caring for Denali's Dinosaurs

After it became clear that Denali has a rich assortment of dinosaur track fossils, park managers prioritized completion of a Paleontological Management Plan to safeguard Denali's fossil resources. Questions the plan addresses include: When should fossils be removed for safekeeping? How should molds and casts made of fossils be documented? Should there be any limit to the number of researchers who are permitted to conduct paleontological research each summer?



#### Management and Mitigation

# Strategies and Projects (cont'd)



## Kantishna Stream Restoration

Placer mining activities in the Kantishna Mining District left plenty of unsightly barrels, debris, and toxic wastes—not to mention channelized streams and impaired watersheds. Waste removal, large-scale rehabilitation of stream flow, use of coconut log barriers, and revegetation are needed to restore these streams and riparian areas. After restoration, mining-legacy creeks, such as Caribou Creek, will resemble natural streams that provide functional habitat for aquatic creatures.



## Strategy G:

### Restore and monitor disturbed lands.

Most of Denali's physical and biological resources are in near-pristine natural condition and therefore the indicators seek to maintain rather than to achieve the desired condition. There are a few areas where the integrity of landscapes has been compromised by placer mining (past) or OHV activities (past and present). Remedial actions are needed to restore disturbed lands (projects 52, 54), and to monitor their recovery and future condition (project 55). It is important with management activities that disturb rivers (e.g., scraping the Toklat River for gravel) that the physical channel, floodplain integrity, and natural geomorphic processes of fluvial systems are maintained so these systems support natural aquatic flora and fauna.

### 52. Restoration of Mined Sites in Kantishna ◀

Revise and implement recovery plans for impaired watersheds (e.g., Slate Creek and Caribou Creek). Develop and implement restoration plans for disturbed mined lands in the Kantishna Mining District. Monitor disturbed and restored lands parkwide to ensure that restoration is effective and natural systems recover.



## Management and Mitigation

## 53. Monitoring and Mitigating the Impacts of Park Gravel Acquisition Operations

In areas of direct management impact from gravel acquisition, monitor and mitigate impacts to fluvial morphology and water quality.

## 54. OHV Trail Rehabilitation

Rehabilitate areas degraded by use of off-highway vehicles (OHVs) in the Cantwell Subsistence Traditional Use Area.

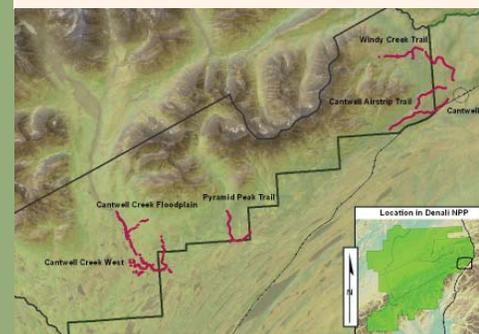
## 55. OHV Impacts Monitoring ►

Monitor the effects of OHVs on vegetation, wetlands, and other biological resources in areas where these vehicles are allowed for recreational and subsistence use on park and preserve lands.



### Happy Trails

Park staff will continue to use GPS to map nearly 25 linear kilometers (15.5 linear miles) of tracks made by OHVs in the park near Cantwell. Staff records information about 13 attributes for each section of trail (e.g., trail type, trail width, muddiness, the number of parallel paths, and degree of vegetation stripping on the trail). Repeat photography is another tool to look at trail changes over time. In areas now closed to OHV use (OHVs only allowed on red trails on map), park staff will monitor vegetation response.



### Management and Mitigation

# Strategies and Projects (cont'd)



## Traffic and Wildlife

Traffic patterns on the park road are affected by many things, including the number of buses and where they stop on the road for wildlife sightings. Researchers installed GPS units and touch screen panels on buses so bus drivers could record information about stops made on the park road to view wildlife. In 2007, the greatest number of large mammals were spotted near Sable Pass (see graph, Miles 38 to 43).

Researchers are creating a traffic model to simulate what the effect may be on visitor experience and wildlife behavior when vehicle schedules and numbers are manipulated. The model will be a tool that park managers can use to make decisions about the best way to transport visitors into Denali.



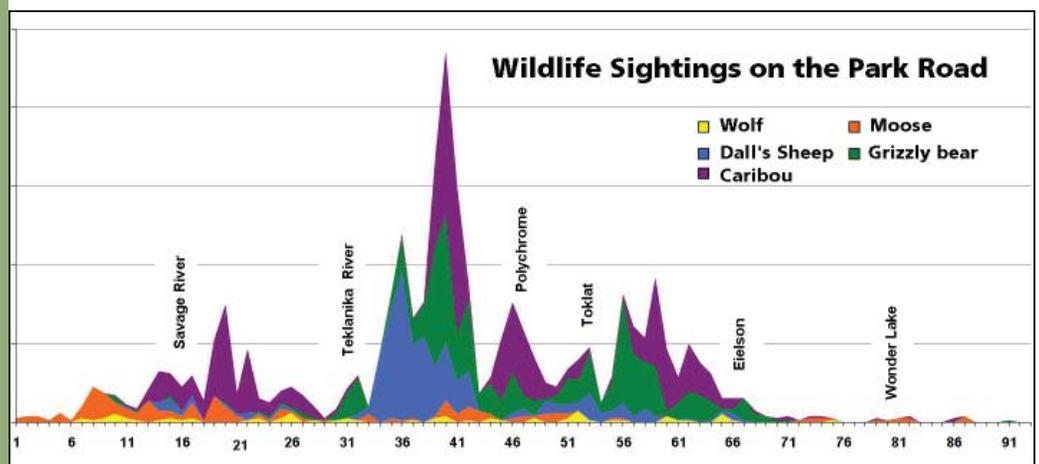
## Management and Mitigation

## Strategy H: Determine and monitor visitor carrying capacity by management area.

Protection of park resources and positive visitor experiences are achieved and maintained when the influence of park visitation is known and incorporated into park planning. By developing and implementing monitoring protocols (and indicators and standards) for various management areas of the park (e.g., park road, backcountry, developed areas (trails and campsites, entrance area, South Denali)), which will work for different segments of the visitor population, Denali can comply with the Backcountry Management Plan and maintain quality visitor experiences while protecting park resources.

## 56. Integrated Study of Park Road Capacity ◀

Complete the Park Road Capacity Study and develop indicators and standards for the park road experience beyond Mile 15. Develop monitoring protocols and studies for park road indicators and implement them at regular intervals. If indicated by the initial research, experimentally raise vehicle traffic and implement a Before-After-Control-Impact (BACI) study to determine whether standards are still achieved.



## 57. Backcountry Monitoring

Develop monitoring protocols using indicators of backcountry visitor experiences to address both day and overnight visits and to address year-round use. Develop protocols for monitoring impacts of visitor use on natural resources. Collect information on new indicators for visitors, such as scenic air tour passengers, whose experience is not adequately measured by existing backcountry indicators. Implement these protocols at regular intervals.

## 58. Trail and Campsite Impacts Monitoring ►

Quantify specific standards to evaluate the impacts of social trails and backcountry campsites, including the climbing corridor on Denali. Develop and implement a protocol to detect changes in the spatial extent and distribution of these impacts, as required by the Backcountry Management Plan.

## 59. Entrance Area Indicators and Standards

Develop and implement monitoring protocols to ensure that standards for frontcountry visitor experiences are maintained.

## 60. South Denali Indicators and Standards

Develop and implement monitoring protocols to ensure that standards for South Denali visitor experiences are maintained. Conduct studies before and after major facilities are constructed. Incorporate the mandates of partner land management agencies, including the state park system's emphasis on Alaska residents.



### Impacts and Indicators

Park staff, in consultation with a researcher expert in recreation social science, is completing a protocol for monitoring informal trail development in Denali's backcountry. The protocol will be used to document over time the distribution and density of "social trails" emanating from the park road, and how far they penetrate into wilderness. Denali is among the first national parks to initiate this type of trail monitoring.



### Management and Mitigation

# Strategies and Projects (cont'd)



## Bear Facts

By 1982, Denali had the highest rate of backcountry grizzly bear incidents of any U. S. National Park. Bears were obtaining food from hikers and garbage, causing property damage and injuring people. Between 1946 and 1983, 48 bears were relocated or destroyed. Denali's Bear Management Plan was developed to address these problems. Solutions included the use of bear-resistant food storage, proper garbage handling, and educational efforts. Since 1983, only seven bears have been relocated or destroyed.



## Management and Mitigation

### Strategy I:

### Minimize habituation of park wildlife.

To keep wildlife wild and humans safe, Denali has developed management plans for addressing bear-human and wolf-human interactions. These projects achieve the natural behavior of animals in Denali, part of the desired condition for the "Wildlife populations, habitat, ecosystems" fundamental resource and value.

## 61. Bear Habituation Management ◀

Revise and continue to implement the management plan for grizzly and black bears. Continue to implement strategies to safeguard food and garbage from bears and protect visitor safety. Develop methods to assess the effects of road traffic on bear movements and demography.



## 62. Wolf Habituation Management ►

Complete and implement a wolf management plan. Continue to protect vulnerable den and rendezvous sites from disturbance. Continue to implement strategies to prevent wolf habituation.

## 63. Wildlife Habituation Management – Other Species ►

Use aversive-conditioning techniques as appropriate to prevent wildlife behavior that might jeopardize the survival of wildlife or visitors. Manage human activities in such a way that wildlife does not become food-conditioned or otherwise habituated to human presence in harmful ways.



### Keep Wildlife Wild

Denali's Keep Wildlife Wild program has expanded the effort to discourage the feeding and habituation of all wildlife species, not just bears. Denali is one of the few parks to develop a wolf-human conflict management plan. To reduce habituation of wolves and disturbance during the critical denning period, commonly-used den areas are closed to human entry each spring until wolf activity can be determined. This approach allows wolves to choose den areas without human interference and allows for human use if the wolves den elsewhere.



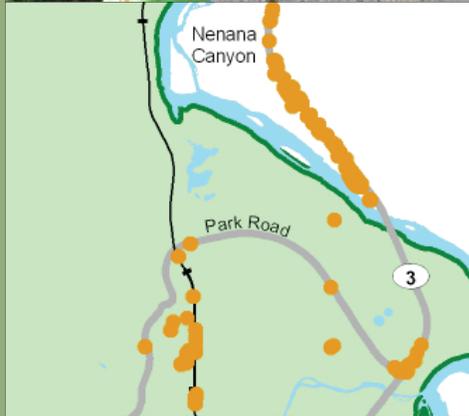
### Management and Mitigation

# Strategies and Projects (cont'd)



## White (Not-So) Sweet Clover

Of the 23 exotic (non-native) plant species documented in Denali, the ones that are capable of invading natural native plant communities are the greatest threat to the park. So far, these species only occur in the park within the footprint of human development (e.g., roadsides and near buildings). White sweet clover (*Melilotus alba*) has colonized river bars and roadsides near the park. By monitoring the locations (using GPS; see map) and severity of *Melilotus* infestations each year, the exotic plant team can respond with active measures to reduce these harmful exotics.



## Management and Mitigation

### Strategy J:

## Detect, monitor, and mitigate environmental influences external to the local natural ecosystem.

Park borders do not stop certain external influences (e.g., contaminants, exotics, diseases) from reaching Denali and impacting Denali's ecosystems. The goal is to identify, avoid, minimize, and mitigate those factors and management actions that increase contaminants, exotic species, disease, and other pests inside the park to help keep wildlife and plant populations natural and healthy.

### 64. Monitoring of Anthropogenic Contaminants

Monitor the levels of contaminants in aquatic and terrestrial habitats and biota. Implement appropriate recommendations of the Western Airborne Contaminants Assessment Program (WACAP).

### 65. Exotic Plant Species Monitoring ◀

Continue to monitor the distribution and spread of exotic plant species. Investigate the factors that allow exotic plants to enter and spread in the park, and manage exotic plant species where possible.

### 66. Exotic Animal Species Monitoring

Develop and implement a protocol to detect and monitor exotic animal species.

### 67. Wildlife Diseases Monitoring

Maintain awareness of the statewide distribution of significant wildlife diseases. Monitor the occurrence of diseases that pose a threat to park wildlife, with particular attention to human-introduced diseases.

### 68. Integrated Pest Management

Continue to implement an Integrated Pest Management (IPM) program to reduce risks to the public, park resources, and the environment from pests and pest-related management strategies.

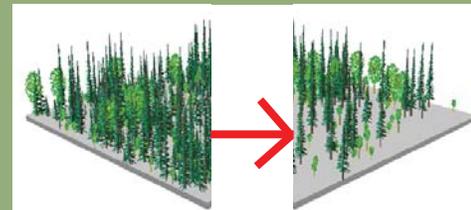
## Strategy K:

### Mitigate the risk of wildland fire to park infrastructure and cultural resource sites.

Knowing more about the response of vegetation after fuel treatments to reduce vegetation around structures in the frontcountry will help determine the most efficient ways to initially treat and maintain structures in full suppression zones. The goal is to protect cultural resources (and other infrastructure) from wildland fire.

#### 69. Fuel Treatments and Wildland Fire Risk ►

Document the pre-and post-treatment condition of the vegetation of the 2004 Denali frontcountry hazardous fuels treatment. Monitor the effects of the treatment on vegetation and evaluate the original prescription. Model fire risk associated with different types of fuel treatments, including the frontcountry treated and untreated areas. Determine maximum efficiency in hazardous fuels reduction techniques for application at Denali and elsewhere in Interior Alaska. Address fire hazard in areas within full suppression zones that are untreated in order to prioritize fuel treatments. Plan and implement fuels reduction projects as needed to protect natural and cultural resources.



#### Preparing for Fire

The islands of park buildings are surrounded by a sea of boreal forest that will someday burn—not if, but when. To create “defensible space,” in 2004, fire crews cut and thinned trees and removed brush around these structures. The goal was to reduce the risk of crown fire and therefore both reduce the risk of property damage and also improve safety for employees, visitors, and fire suppression crews. When pre- and post-treatment data for fuel levels and forest structure (see photos) are placed into fire models, the models indicate that after treatment, the crown fire potential has been reduced to zero.



#### Management and Mitigation

# Strategies and Projects (cont'd)

## Strategy L: Preserve the museum collection and rehabilitate and preserve park historic structures.

Protecting the resources and values associated with historic, archeological, and ethnographic resources requires bringing the museum collections to standards (projects 70, 72) and rehabilitating historic structures (project 74). In addition, Denali will be able to protect the museum collection while still providing access, by making electronic records (project 71) and by making finding aids (project 73).

### 70. Improving Collection Standards

Write the Scope of Collections Statement (SOCS), an Integrated Pest Management Plan, an Emergency Operations Plan, and a Structural Fire Plan for the Denali museum collection. Purchase equipment and storage materials (e.g., museum cabinets, shelving, archival supplies, and digital storage space. Re-house archival material and store natural history specimens properly. Meet 79 of 82 Collection Standards by completion of this project.

### 71. Digitizing the Museum Collection ◀

Photograph objects in the museum collection and digitize the archival collections in order to enhance object descriptions, document the condition of museum objects, provide visual cues to identify objects, and ensure the preservation and availability of the entire collection. Transfer motion picture film and oral history audiotapes to the medium that is preferred for long-term preservation.



#### Crampons, Butterflies, and Bison Skulls

These images represent examples of the more than 332,000 items held in the Denali museum collections. Collections include archives, cultural resource objects, and natural history specimens. Archives, which include photographs, documents, maps, and media, comprise 90% of collections. Once museum staff has digitized the collections, the general public, as well as park staff, will be able to search museum holdings or tour virtual exhibits on line.



#### Management and Mitigation

## 72. Addressing Catalog Backlog

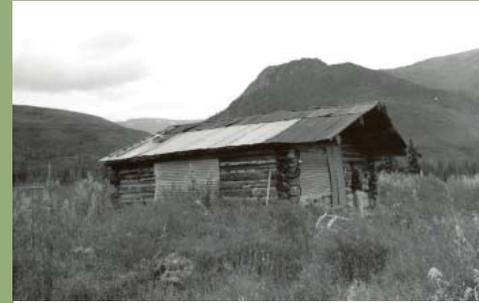
Catalog research and management documents to preserve the information and make them accessible for historical and scientific research, beginning with documents related to the ongoing predator-prey study and documents related to mining.

## 73. Creation of Finding Aids for Archival Collections

Create finding aids (documents that list what is available in the collection) to protect documents by decreasing the frequency with which they need to be handled.

## 74. Historic Structures Rehabilitation ►

Rehabilitate historic structures in the park (e.g., Doty House, Busia Cabin, Pearson Cache, and the Hotel Powerhouse). Improve the condition of these structures from poor or fair to good.

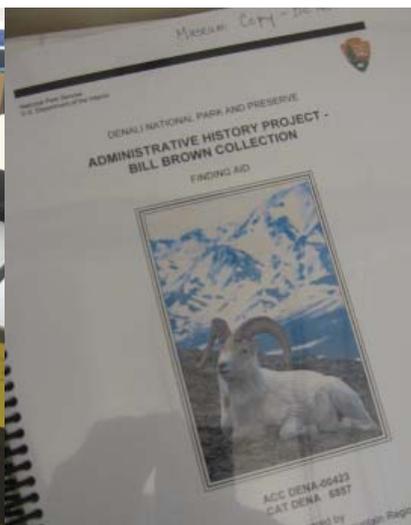


### The New Face of Busia Cabin

Johnny Busia arrived at Eureka camp (Kantishna) in 1918 to join his father and uncle in mining pursuits. Busia stayed nearly 40 years in Kantishna and lived in the cabin that still bears his name. The cabin is now on the National Register of Historic Places. In 2008, the park's special projects team rehabilitated and restored the Busia Cabin (compare with 1966 and 2006 photos above), following standards and guidelines for historic properties and consulting with cultural resource staff. Park staff replaced rotten logs, windows, doors, and the roof; leveled the cabin and replaced chinking; removed nearby vegetation and graded around the cabin. Efforts to prevent or lessen future damage will ensure that visitors will be able to picture Busia living at his cabin for many years.



### Management and Mitigation

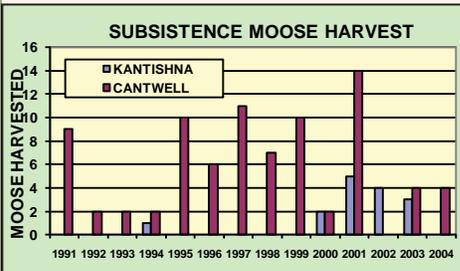


# Strategies and Projects (cont'd)



## Moose and Subsistence

Qualified rural residents around Denali can harvest moose on park lands under the terms of ANILCA. Small numbers of moose are taken near the communities of Cantwell, Kantishna, Minchumina, and Skwentna. Subsistence seasons and bag limits are set by the Federal Subsistence Board in consultation with local Subsistence Resource Commissions and Regional Advisory Councils. The total number of moose taken within Denali seldom exceeds 10 moose per year, so subsistence harvest has little effect on the park's population of more than 2,000 moose.



## Management and Mitigation

### Strategy M: Monitor and manage consumptive uses of park resources, including subsistence use.

Consumptive uses of fish and wildlife (subsistence use or sport) or timber products should not be allowed to disrupt or drive the natural processes of Denali's ecosystems. Management decisions, which protect park resources and thereby continue to provide for subsistence ways of life as well as sport opportunities, will be better informed by developing and implementing monitoring protocols for documenting forest resources (project 75), trapline activities (project 76), and past and contemporary wildlife harvests, harvest areas, and means of transportation (projects 77, 78, 79). Outcomes would include a comprehensive parkwide firewood/log management plan for qualified subsistence users and a furbearer harvest program.

### 75. Timber Resources Management

Establish a monitoring protocol to assess timber resources using plots and aerial photography. Formulate a plan for the subsistence use of firewood and cabin logs in the park.

### 76. Furbearer Trapping Management

Establish a furbearer harvest program, working with local trappers and Alaska Department of Fish and Game (ADF&G). Obtain furbearer harvest data from trapper surveys and ADF&G records. Assess the effects of various trapline management regimes on the population dynamics of marten and other furbearers.

### 77. Wildlife Population and Harvest Data ◀

Acquire data about wildlife populations and about subsistence and sport harvests. Evaluate existing data for consistency and identify gaps in knowledge of harvest numbers. Conduct wildlife population surveys as needed. Track ADF&G harvest data for game management units that include park lands.

## 78. Wildlife and State Game Regulations

Work with ADF&G and the Alaska Board of Game to identify regulations and management practices that would assist the National Park Service in achieving desired conditions for park wildlife.

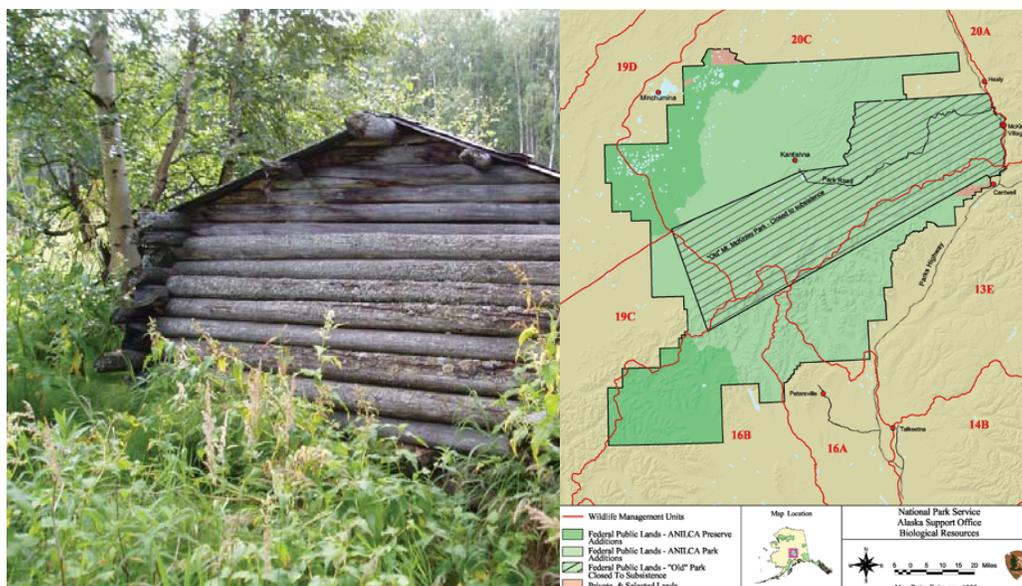
## 79. Documentation of Subsistence Customs and Traditions ►

Document the history of contemporary and traditional subsistence practices, the adoption and use of new technologies for subsistence activities, and the impacts of federal management regulations and policies on the subsistence way of life.



### Passing on Traditions

In March 2008, elders from Nikolai travelled to Cantwell to supervise and instruct BJ Gore, an Alaska Native high school student, in the building skills used to construct a moosehide boat. Moosehide boats have been traditionally used to move moosemeat on waterways after the hunt. The boat building process was documented on video and is posted on Denali's website.



## Management and Mitigation

# Strategies and Projects (cont'd)



## Protecting Park Resources

Rangers and resources staff recently developed a coordinated series of funding requests to support increased staffing, aircraft flight hours, equipment, and specialized training for ranger field staff. New technology such as GPS and GIS are being used effectively to gather and manage resource protection information. Two recent high-profile poaching cases were successfully prosecuted as a result of the increased attention brought to boundary issues by the Harry Karstens Wildlife Protection Initiative. These two cases made it clear that the NPS is serious about protecting park resources. The Karstens Initiative has also made it possible to develop new partnerships that strengthen efforts to protect park resources.



## Management and Mitigation

### Strategy N: Enhance and increase the effectiveness of wildlife protection by deterring illegal activities.

Curtailing illegal motorized access to park lands and the poaching of wildlife helps keep wildlife populations natural and healthy.

#### 80. Harry Karstens Wildlife Protection Initiative ◀

Deter illegal off-highway vehicle (OHV) activity and illegal hunting through an integrated program. Provide consistent ground and aerial patrol presence, including hiring additional backcountry and winter kennels staff, and by increasing helicopter access during hunting season. Map OHV trails parkwide. Increase the effectiveness of patrols by regular upgrades for training and equipment. Provide training in GIS, GPS, and database management to ranger staff. Organize data and information-gathering tools to improve targeting of patrol activity. Enlist the cooperation of other agency enforcement personnel, volunteer boundary watchers, and local community members. Educate the public about park regulations and the park mission through printed material, maps, and displays.

#### 81. Boundary Marking

Mark critical sections of the park boundary and develop a GIS inventory of boundary sign locations so that signs can be effectively monitored and maintained over time.



## Management and Mitigation

# Strategies and Projects (cont'd)

## Strategy O:

### Improve estimation of park visitation.

Estimates of the number of park visitors by different visitor segments will help park managers to gauge visitor impacts on park resources, provide for quality park experiences to various segments, and to custom-fit park protection messages to each segment. Tools and models are needed to estimate total number of visitors and track numbers in distinct visitor segments, including dispersed entry visitors, and frontcountry and backcountry hikers. Visitor carrying capacity need to be defined in some management zones. Some significant types of park visitation are not accounted for, and the park's model for estimating visitation needs to be improved.

### 82. Dispersed Entry Visitation

Develop a tool to estimate the numbers and describe the basic visit characteristics for dispersed entry visitors (those who enter the park from locations other than the park road, including those who fly over, but do not land).

### 83. Day-Hiker Inventory

Develop a system for estimating day-hiker use both in the frontcountry and backcountry, to answer questions about how many visitors are day-hiking, what their demographic characteristics are, and where and how far they go when day-hiking in Denali.

### 84. Visitation Model

Develop a comprehensive model for estimating visitation to Denali within different visitor segments (e.g., independent travelers and packaged-tour visitors with one overnight) during all seasons. Replace the formula presently used in the Monthly Public Use Report with the model that incorporates not only visitor counts, but also indirect data from state and other sources.



## Strategy P: Monitor trends in adjacent community populations, land use, and local economy.

The relationship of surrounding human communities and land uses to park visitors and resources is not well understood. Measuring community understanding and support of Denali in gateway communities from Anchorage to Fairbanks and nearby Bush communities (e.g., Minchumina, Nikolai, Skwentna) will help managers learn if efforts are needed to inform the public about the national park's role in the community's economy. This strategy also coordinates with the CAKN human use vital sign monitoring (project 85).

### 85. Human Populations Monitoring

Develop and implement a CAKN-prescribed monitoring protocol to use state and federal census data to monitor trends in the number of people residing in communities in and near the park.

### 86. Community Survey

Develop a survey to be employed periodically in a random sample of citizens from communities between Anchorage and Fairbanks to measure such things as the public perception of the national park as a beneficial/detrimental influence in the region; public understanding of the purposes of the park; the reasons for local public use or avoidance of the park; and the response of local community members to current and potential management strategies (including fire management).

### 87. Economic Impact Model

Develop an economic model—potentially in cooperation with other parks or the entire Alaska Region—that demonstrates the impact of Denali on local and regional jobs and on income.



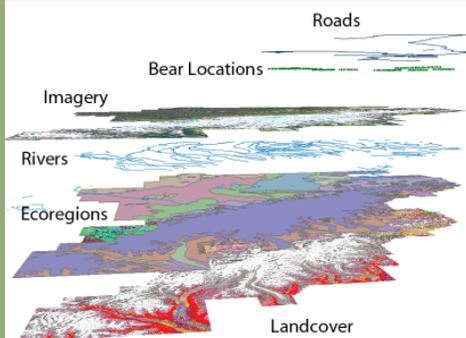
Parks and People

# Strategies and Projects (cont'd)



## Where are the Bears?

GIS technology organizes data as layers of similarly categorized features. Denali's GIS dataset presently comprises over one terabyte of data in 4,200 different layers. The layers can be overlain to produce visual products such as maps as well to discover relationships between coinciding features. A recent project combined layers showing bear locations, hydrology, landcover, roads, and topography to determine patterns of habitat use by bears on the south side of the Alaska Range.



## Data Management

## Strategy Q: Develop and implement effective data management strategies for use by managers, specialists, and the public.

For information about park resources and research to be most useful in support of park management and decision-making, it needs to be stored, organized, and available for distribution or further analysis. Data management must comply with formats that are standardized.

### 88. GIS Database ◀

Assure that the GIS database accurately manages park resource information for efficient use by park and associated researchers and managers—including natural resource data layers, cultural resource base map, access routes (e.g., OHV, boat, trail), hunting camps, and available base maps in coordination with the Alaska Regional Office data service standards. Develop new layers as required for park management through other projects. Develop tools and training to effectively use geospatial data throughout the park. Where appropriate, make GIS data available to the public through NPS internet sites.

### 89. Cultural Resources Data Management

Standardize and update all records in the Automated National Catalog System (ANCS+) for museum records, the Archeological Site Management Information System (ASMIS) for archeological records, and the List of Classified Structures (LCS) for historic building records.



## 90. Natural Resources Data Management

Develop standardized data management, archiving, and distribution for natural resource data sets, technical reports, and research-related records. Coordinate with the CAKN data management structure and efforts.

## 91. Data Dissemination and Availability

Develop an appropriate Internet data distribution system for commonly requested natural resource data sets (e.g., climate, wildlife, air quality, museum collections, and technical library). Coordinate with CAKN data dissemination efforts.



**Data Management**



## 94. Researchers-in-Residence ►

Offer park-based sabbaticals for researchers to create opportunities for researchers to collaborate with educators and communicate the relevance of their projects to various audiences.

## 95. Science-based Education Seminars

Host seminars for specific audiences (e.g., the current MSLC Field Seminars or the *Fire in Alaska* workshop).

## 96. Research and Community Connections

Engage resource staff and researchers in local communities through their involvement in science-based curricula, citizen science programs, teacher trainings, youth camps, and high school or college level internships.

## 97. Education Staff

Support Denali's educational staffing by converting two education specialist positions from temporary subject-to-furlough to permanent subject-to-furlough.



### Researchers-in-Residence

The Murie Science and Learning Center plans to host a "Researcher-in-Residence" each year. This program is designed to increase the opportunities for visitors to learn about current science occurring in the park. The researcher will conduct research, confer with park staff across multiple divisions, and produce educational outreach media. The researcher receives office space and a stipend to offset living costs associated with this experience.



### Education and Communication



# Strategies and Projects (cont'd)



## Building on Success

As part of the original vision for the MSLC Complex, a residential facility capable of housing small groups of researchers and education groups, will be built to provide year-round science and science-education opportunities. It is anticipated that this facility, to be located near the MSLC and Murie Dining Hall, would incorporate sustainable practices, as well as support current unmet needs for researchers and students who wish to deepen their experiences with Denali National Park and Preserve.



## Education and Communication

### Strategy S:

**Develop staffing and infrastructure to enhance bridges between research and interpretation and to facilitate higher levels of understanding and preservation of park resources.**

Staff and facilities development will bring the Murie Science and Learning Center (MSLC) to the intended level of “fully operational” in support of its goals for Denali and other MSLC parks.

### 98. MSLC Staffing

Hire an MSLC Research Coordinator and a MSLC Webmaster, and continue to fund an MSLC Education Coordinator, who would work in partnership between the Center for Resources, Science, and Learning and the MSLC.

### 99. MSLC Facilities Development ◀

Fund and build the year-round MSLC Residential Facility to support staff, visiting researchers, and education groups. Funds would either be obtained through project funding or a donation capital campaign.





# Strategies Integral to the Success of Other Strategies and Projects

In addition to the 19 comprehensive strategies, the National Park Service will pursue several other strategies that underlie the success of all the other strategies and projects. These are not discreet projects, but rather they are general ways of doing business that should continuously be addressed and budgeted for. These support strategies include:

**Conduct periodic strategic program reviews.** Periodically review the park's staffing situation, in order to identify potential or impending deficiencies or strengths. Identify projects, make appropriate budget plans, and form strategic partnerships to solve staffing needs. Fill identified staffing needs to accomplish the strategies and projects that have been identified.

**Provide adequate staff training, development, and learning opportunities.** Maintain a high level of expertise and professionalism among resources, enforcement, education, and interpretation staff. Provide multiple opportunities for staff to learn, develop new skills, acquire new knowledge, become familiar with new equipment or techniques, and distribute research results.

**Collaborate with other agencies and institutions.** Work with other land management agencies, federal, state or private biologists and researchers, and universities to maintain high standards of inventory, management, and research activities. Collaborate with other enforcement agencies to cultivate an interest in wildlife protection.

**Engage external research partners.** Develop and circulate information on resource knowledge gaps to researchers. Facilitate research and provide basic logistics to attract quality research that will inform park management and protection activities. Examples of ongoing partnerships include those with the University of Alaska (UA) Geophysical Institute, the UA Geology Field Camp, Cooperative Ecosystem Study Units, and the U.S. Geological Survey.

**Maintain accountability for mitigation prescribed through environmental analysis.** Monitor compliance with and effectiveness of mitigation measures prescribed through NEPA environmental analysis (Environmental Impact Statements, Environmental Assessments) of new development projects, including no net loss of wetlands.





# Projects Listed by Priority

Each of the 99 projects was scored for five criteria: legal or program obligation, closeness of linkage to resource condition, urgency to conduct the project or peril to resource, degree of political or public interest, and cost-effectiveness of the project. Scores (1-3) were assigned as follows: 1=higher priority, box is shaded with dark green;

## Highest Priority

Legal/Program Obligation  
Link to Resource Condition  
Urgency/Peril to Resource  
Political/Public Interest  
Cost-Effectiveness



Project	Project Title	Score	Legal/Program Obligation	Link to Resource Condition	Urgency/Peril to Resource	Political/Public Interest	Cost-Effectiveness
I-61	Bear Habituation Management	5	1	1	1	1	1
B-16	Weather, Indices, and Wildland Fire Behavior	6	1	1	1	1	2
B-18	Wildland Fire Return Intervals	6	1	1	1	1	2
D-25	Air Quality Monitoring	6	2	1	1	1	1
I-62	Wolf Habituation Management	6	1	1	2	1	1
J-67	Wildlife Diseases Monitoring	6	1	1	2	1	1
K-69	Fuel Treatments and Wildland Fire Risk	6	1	1	1	1	2
M-78	Wildlife and State Game Regulations	6	2	1	1	1	1
N-80	Harry Karstens Wildlife Protection Initiative	6	1	1	1	1	2
A-2	Paleontological Resources Inventory	7	2	1	2	1	1
A-7	Wildland Fire History Prior to 1950	7	3	1	1	1	1
B-14	Biological Effects of Climate Change	7	2	1	1	1	2
C-24	National Register Nominations	7	1	1	2	2	1
D-26	Monitoring of Climate and Snowpack	7	2	2	1	1	1
D-27	Glacier Monitoring	7	2	1	1	1	2
D-32	Monitoring of Passerine Birds	7	2	1	2	1	1
D-34	Monitoring Golden Eagles and Peregrine Falcons	7	2	1	2	1	1
D-39	Dall's Sheep Monitoring	7	2	1	2	1	1
D-44	Soundscape Monitoring	7	2	1	1	1	2
E-47	Documentation and Assessment of Wildland Fires	7	2	2	1	1	1
G-54	OHV Trail Rehabilitation	7	1	1	1	1	3
G-55	OHV Impacts Monitoring	7	2	1	1	1	2
H-56	Integrated Study of Park Road Capacity	7	2	1	1	1	2
I-63	Wildlife Habituation Management	7	1	1	2	2	1
M-75	Timber Resources Management	7	2	1	1	2	1
M-77	Wildlife Population and Harvest Data	7	2	1	1	1	2

2= medium priority, medium green; or 3=lower priority, light green.  
 The sum of the 5 scores became the project score. Lower project scores indicate higher project priority. Projects are listed here (pages 56-59) by three tiers of priority scores: Highest, Medium, or Lowest. Within each tier, projects are arranged by total score, then by project number.

Link to Resource Condition  
 Urgency/Peril to Resource  
 Political/Public Interest  
 Cost-Effectiveness  
 Legal/Program Obligation

Project	Project Title	Score	Link to Resource Condition	Urgency/Peril to Resource	Political/Public Interest	Cost-Effectiveness	Legal/Program Obligation
A-4	Inventory of Rare and Endemic Flora	8	1	1	1	2	3
A-8	Inventory of Smoke Conditions	8	1	1	3	1	2
A-13	Inventory of Cultural Landscapes	8	1	1	2	2	2
D-29	Water Quality Monitoring	8	1	1	2	2	2
D-30	Stream Morphology Monitoring	8	2	1	2	2	1
D-33	Trumpeter Swan Monitoring	8	2	1	2	2	1
D-34	Caribou Monitoring	8	2	1	2	1	2
D-39	Moose Monitoring	8	2	1	3	1	1
D-41	Grizzly Bear Monitoring	8	2	1	2	1	2
F-48	Paleontological Resources Management Plan	8	2	1	3	1	1
F-51	Waterway Navigability	8	1	3	1	2	1
G-53	Monitoring and Mitigating the Impacts of Park Gravel Acquisition Operations	8	1	2	2	2	1
H-57	Backcountry Monitoring	8	2	1	2	2	1
J-65	Exotic Plant Species Monitoring	8	2	1	1	2	2
L-71	Digitizing the Museum Collection	8	1	1	1	3	2
M-79	Documentation of Subsistence Customs and Traditions	8	3	1	1	1	2



# Projects Listed by Priority

## Medium Priority

Link to Resource  
Urgency/Peril to Resource  
Political/Public Interest  
Legal/Program Obligation  
Cost-Effectiveness



Project	Project Title	Score	Link to Resource	Urgency/Peril to Resource	Political/Public Interest	Legal/Program Obligation	Cost-Effectiveness
A-10	Archeological Survey	9	1	1	3	2	2
A-11	Native Place Names Archeological Survey	9	1	1	3	2	2
B-17	Ecological Impacts of Wildland Fires	9	2	1	2	2	2
C-23	Trapping History	9	3	1	1	3	1
D-40	Wolf Monitoring	9	2	1	3	1	2
D-42	Vegetation Structure and Composition	9	2	1	2	2	2
D-43	Landcover Monitoring	9	2	1	2	2	2
D-45	Monitoring Plant and Landscape Phenology	9	2	1	2	3	1
G-52	Restoration of Mined Sites in Kantishna	9	1	1	3	2	2
H-59	Entrance Area Indicators and Standards	9	2	1	2	2	2
M-76	Furbearer Trapping Management	9	2	1	2	3	1
O-84	Visitation Model	9	2	2	1	2	2
Q-89	Cultural Resources Data Management	9	2	2	1	3	1
A-5	Inventory of Bird Status and Distribution	10	3	1	2	1	3
A-9	Burn Severity	10	2	1	3	3	1
B-15	Physical Effects of Climate Change	10	3	2	2	1	2
C-20	Mountaineering History	10	3	1	3	2	1
D-28	Permafrost Monitoring	10	2	2	1	3	2
D-31	Fish Monitoring	10	2	1	2	2	3
F-49	Cultural Sites Monitoring Plan	10	2	1	2	2	3
H-58	Trail and Campsite Impacts Monitoring	10	2	1	3	2	2
J-66	Exotic Animal Species Monitoring	10	3	1	3	2	1
J-68	Integrated Pest Management	10	2	2	3	2	1
L-70	Improving Collections Standards	10	2	1	3	3	1
L-72	Addressing Catalog Backlog	10	1	1	3	3	2
N-81	Boundary Marking	10	3	2	2	2	1
O-83	Day-Hiker Inventory	10	3	2	2	2	1
Q-88	GIS Database	10	2	3	1	3	1
Q-90	Natural Resources Data Management	10	3	2	1	3	1
Q-91	Data Dissemination and Availability	10	3	2	3	1	1
R-92	Science-Rich Media	10	3	1	3	2	1
R-96	Research and Community Connections	10	3	1	3	2	1

# Lowest Priority

Link to Resource  
 Urgency/Peril to Resource  
 Political/Public Interest  
 Cost-Effectiveness  
 Legal/Program Obligation

Project	Project Title	Score	Link to Resource	Urgency/Peril to Resource	Political/Public Interest	Cost-Effectiveness	Legal/Program Obligation
A-3	Nonvascular Plant Inventory	11	3	1	3	3	1
A-12	Native Place Names Map	11	3	1	3	2	2
C-19	Mining History	11	3	1	3	2	2
C-22	History of the Park Road	11	3	1	3	3	1
D-35	Monitoring Important Herbivore Species	11	2	1	3	3	2
D-36	Small Mammal Monitoring	11	2	1	3	3	2
E-46	Monitoring and Assessment of Geohazards	11	3	2	3	2	1
J-64	Monitoring of Anthropogenic Contaminants	11	3	2	2	1	3
R-95	Science-Based Education Seminars	11	3	1	3	2	2
98	MSLC Staffing	11	3	1	3	3	1
A-1	Special Geologic Features Inventory	12	3	1	3	2	3
C-21	Scientific Legacy	12	3	1	3	3	2
L-73	Creation of Finding Aids for Archival Collections	12	3	2	3	2	2
P-85	Human Populations Monitoring	12	2	3	3	3	1
P-86	Community Survey	12	3	3	3	2	1
R-93	Trans-Disciplinary Communication and Training	12	3	2	3	3	1
R-94	Researchers-in-Residence	12	3	2	3	3	1
F-50	Natural Lightscapes Monitoring Plan	13	3	3	3	3	1
H-60	South Denali Indicators and Standards	13	3	3	2	3	2
P-87	Economic Impact Model	13	3	3	3	2	2
O-82	Dispersed Entry Visitation	14	3	2	3	3	3
O-99	MSLC Facilities Development	14	3	2	3	3	3
A-6	All Taxa Biodiversity Inventory	15	3	3	3	3	3



# Funding Denali's RSS



One purpose of the RSS is to guide the park's investment (human and fiscal) in the stewardship of cultural and natural resources. The RSS assigns funding needs for implementing RSS strategies via projects to several National Park Service funding sources, and also provides a means of accountability for funds used to attain and maintain desired conditions of park resources.



Currently the total expenditure of funds for resource stewardship at Denali (i.e., resource management, historical restoration, resource education, resource planning, and resource protection) is less than one quarter of the park's total expenditures (approximately 5 of 21 million).



The RSS budget indicates that funding will be adequate to address the key stewardship issues affecting the park only if the current resource stewardship funding is sustained (and increased to account for inflation) *and* is supplemented by increases in funding. These funding needs will have to compete for priority within the park, Alaska Region, and NPS Servicewide. Supplemental increases of approximately \$500,000 are needed from both the park's annual operational base budget (Operation of the National Park Service or ONPS) *and* from NPS project funds (Servicewide Comprehensive Call (SCC), Concession Franchise Fee (CFF), or Federal Lands Recreation Enhancement Act (FLREA) funds). The funding analysis also assumes that two large needs for attaining desired conditions (restoration of disturbed lands and fixing deficiencies in the museum collection) continue to receive funding support via special base fund allocations through FY2010.



The implementation of comprehensive strategies is aided greatly by the current high-quality monitoring and research efforts at Denali; the high degree of integration of the park's resource stewardship with the Central Network Inventory and Monitoring Program; the efficiencies developed during the Core Operations Analysis; and the significant investment of park CFF and FLREA funds to resource stewardship.



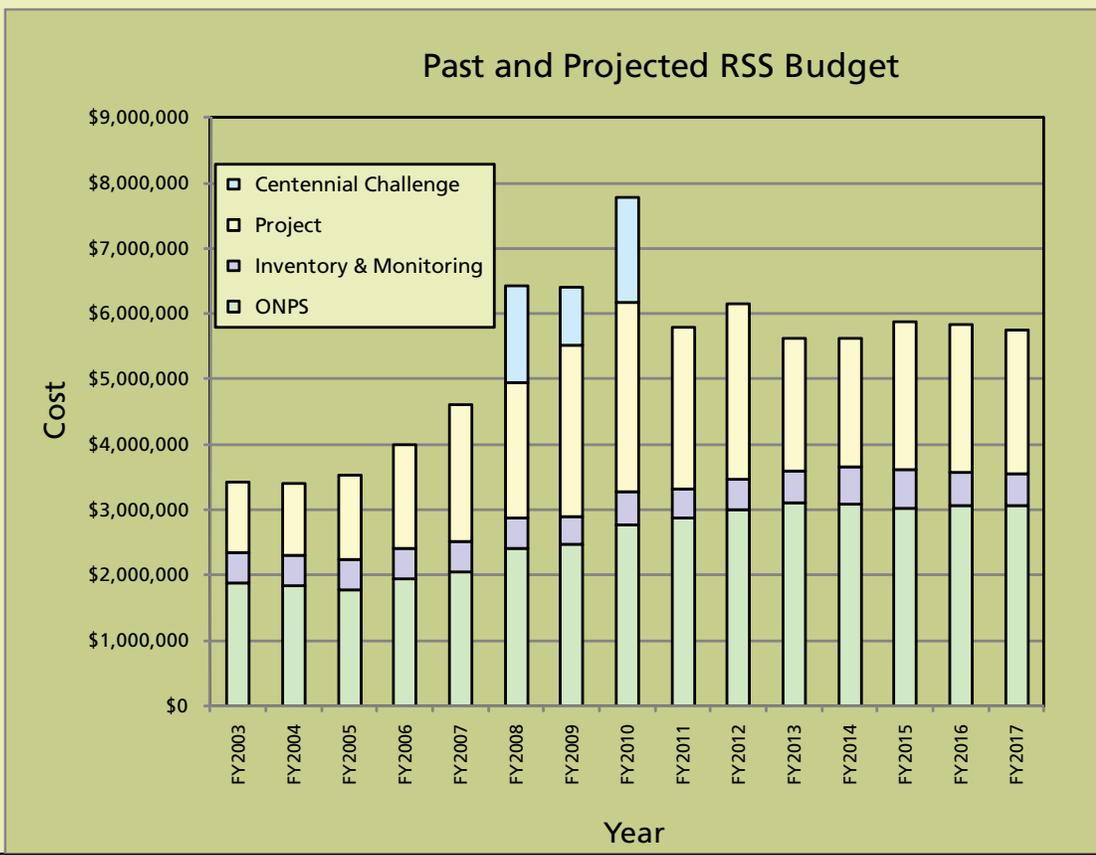
*Pen used by Woodrow Wilson on February 26, 1917 to sign the legislation establishing McKinley National Park.*

More than two-thirds of funding for RSS projects at Denali is non-base. The nature of this funding is highly variable. In 2003, the park did not yet have significant CFF funding; in 2007, this funding was reduced by over 75 percent. In 2005, Federal Lands Recreation Enhancement Act (FLREA) legislation disqualified many resource stewardship projects that had been previously funded under Fee Demonstration (Fee Demo) legislation.

*It will be difficult to maintain the current level of non-ONPS funding without both the continued flexibility in use of other fund sources and the continued commitment by park management to resource stewardship while facing other high-priority park needs.*

The long-term stability of resource stewardship efforts will remain vulnerable until an increased proportion of the program is base-funded—as the Central Alaska Network Inventory and Monitoring Program was base-funded as a result of the Natural Resource Challenge.

It is also important to reiterate that the RSS does not address *all* the resource stewardship projects that could enhance management of the park, but instead focuses on those needs that are critical to maintaining the desired condition of park resources and values, as well as on the park’s legal mandates.



# Team Who Constructed Denali's RSS

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Guy Adema	Project Management; Physical Resources
Tom Meier	Biological Resources
Ann Kain	Cultural Resources
Amy Craver	Cultural and Subsistence Resources
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