National Park Service
U.S. Department of the Interior

State of the Park Report 2012

Denali National Park and Preserve

Alaska

2016

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On the cover: Denali National Park and Preserve contains an intact sub-arctic ecosystem, some of the oldest archeological sites in Alaska, and thousands of dinosaur tracks along with the highest peak in North America.

Disclaimer. This State of the Park report summarizes the current condition of park resources, visitor experience, and park infrastructure as assessed by a combination of available factual information and the expert opinion and professional judgment of park staff and subject matter experts. The internet version of this report provides the associated workshop summary report and additional details and sources of information about the findings summarized in the report, including references, accounts on the origin and quality of the data, and the methods and analytic approaches used in data collection and assessments of condition. This report provides evaluations of status and trends based on interpretation by NPS scientists and managers of both quantitative and non-quantitative assessments and observations. Future condition ratings may differ from findings in this report as new data and knowledge become available. The park superintendent approved the publication of this report.

Executive Summary

The mission of the National Park Service is to preserve unimpaired the natural and cultural resources and values of national parks for the enjoyment, education, and inspiration of this and future generations. NPS Management Policies (2006) state that "The Service will also strive to ensure that park resources and values are passed on to future generations in a condition that is as good as, or better than, the conditions that exist today." As part of the stewardship of national parks for the American people, the NPS has begun to develop State of the Park reports to assess the overall status and trends of each park's resources. The NPS will use this information to improve park priority setting and to synthesize and communicate complex park condition information to the public in a clear and simple way.

State of the Park report

The purposes of this State of the Park report are to:

- Provide to visitors and the American public a snapshot of the status and trend in the condition of a park's priority resources and values;
- Summarize and communicate complex scientific, scholarly, and park operations factual information and expert opinion using non-technical language and a visual format;
- Highlight park stewardship activities and accomplishments to maintain or improve the State of the Park;
- Identify key issues and challenges facing the park to help inform park management planning.

Park purpose, fundamental and other important resource values

The park purpose is a clear statement of why Congress and the president established the park as a unit of the National Park System as derived from the law(s) establishing the park. The purpose of Denali National Park and Preserve has evolved from the time Congress established the original Mount McKinley National Park to the present and has increased in complexity because of the different mandates that apply to the Old Park (the original Mount McKinley National Park), the national park additions (added by the Alaska National Interest Lands Conservation Act (ANILCA), the national preserve (also added by ANILCA), and the designated wilderness (covering 99 percent of the Old Park).

Mount McKinley National Park (Old Park): In 1917 Congress established Mount McKinley National Park as (1) "a public park for the benefit and enjoyment of the people," and (2) a "game refuge." Consistent with these purposes, the statute directed the Secretary of Interior to publish rules and regulations "aimed at the freest use of the said park for recreation purposes by the public and for the preservation of animals, birds, and fish and for the preservation of the natural curiosities and scenic beauties thereof." (39 Stat. 938)

Denali National Park and Preserve: In 1980 Congress passed ANILCA (16 USC §§ 3101-3233, Pub. L. 96-487) that enlarged and renamed the unit Denali National Park and Preserve. Section 101 of ANILCA describes the broad purposes of the new conservation system units throughout Alaska, including enlarged national parks and preserves such as Denali. These are the following:

- Preserve lands and waters for the benefit, use, education, and inspiration of present and future generations
- Preserve unrivaled scenic and geological values associated with natural landscapes
- Protect populations of wildlife and fish and their habitats
- Preserve extensive, unaltered ecosystems in their natural state
- Protect resources related to subsistence needs
- Protect historic and archeological sites
- Preserve wilderness resource values and related recreational opportunities such as hiking, canoeing, fishing, and sport hunting
- Maintain opportunities for scientific research in undisturbed ecosystems
- Provide the opportunity for rural residents engaged in a subsistence way of life to continue to do so

Section 202 stated that the Denali National Park and Preserve additions are to be managed for the following specific purposes:

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

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

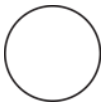
Denali National Park and Preserve has other important resources and values that are not primary to the park's purpose and significance, but are important for both park management and visitors. These are resources and values that Denali possesses and has a legal mandate to protect, but which do not account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

Condition of resources and values at Denali

The summary tables below (Resource Stewardship Strategy table and State of the Park table), and the supporting information that follows, provide an overall assessment of the condition of priority resources and values at Denali National Park and Preserve based on scientific and scholarly studies and expert opinion. The internet version of this report, available at http://www.nps.gov/stateoftheparks/dena/, provides additional detail and sources of information about the resources summarized in this report, including references, accounts on the origin and quality of the data, and the methods and analytical approaches used in the assessments. Reference conditions that represent "healthy" ecosystem parameters, and regulatory standards (such as those related to air or water quality) provide the rationale to describe current resource status. In coming years, rapidly evolving information regarding climate change and associated effects will inform our goals for managing park resources, and may alter how we measure the trend in condition of park resources. Thus, reference conditions, regulatory standards, and/or our judgment about resource status or trend may evolve as the rate of climate change accelerates and we respond to novel conditions. In this context, the status and trends documented here provide a useful point-in-time baseline to inform our understanding of emerging change, as well as a synthesis to share as we build broader climate change response strategies with partners.

The Status and Trend symbols used in the summary tables below and throughout this report are summarized in the following key. The background color represents the current condition status, the direction of the arrow summarizes the trend in condition, and the thickness of the outside line represents the degree of confidence in the assessment. In some cases, the arrow is omitted because data are not sufficient for calculating a trend (e.g., data from a one-time inventory or insufficient sample size).

Condition Status		Trend in Condition		Confidence in Assessment	
	**Warrants Significant Concern**		**Condition is Improving**		**High**
	**Warrants Moderate Concern**		**Condition is Unchanging**		**Medium**
	**Resource is in Good Condition**		**Condition is Deteriorating**		**Low**

Summary Table for the Resources Stewardship Strategy

The following table summarizes the condition of park resources in a way that corresponds to the list of the Fundamental Resources and Values and Other Important Resources and Values in Denali's Resource Stewardship Strategy (RSS)—see mention of these resources and values on page iii. The Resource Stewardship Strategy table can be considered as a "report card" for implementation of the RSS. The information in the Rationale column points to one or more places in the State of the Park summary tables and the tables in Chapter 2.

Resource Stewardship Strategy Summary Table 2012

Fundamental Resources and Values and Other Important Resources and Values

Priority Resource or Value	Condition Status/Trend	Rationale
Wildlife populations, wildlife habitat, and the processes and components of the park's natural ecosystem		Refer to the following resources or values: Natural Resources: Wildlife Habitat and Ecosystem Function: Aquatic Natural Resources: Wildlife Habitat and Ecosystem Function: Terrestrial Natural Resources: Wildlife Populations
Wilderness character, wilderness resource values, and wilderness recreational opportunities		Refer to the following resources or values: Wilderness: Wilderness Character
Scenic and geologic values of Mount McKinley and the surrounding mountain landscape		Refer to the following resources or values: Natural Resources: Scenic and Geologic Features Natural Resources: Climate
Visitor enjoyment and inspiration from observing wildlife in its natural habitat and other natural features		Refer to the following resources or values: Visitor Experience: Recreational Opportunities (Wildlife Viewing)
Historic, archeological, and ethnographic resources		Refer to the following resources or values: Cultural Resources: Archeological Resources, Cultural Anthropology, Cultural Landscapes, Historic Structures, History, Museum Collections
Paleontological resources		Refer to the following resources or values: Natural Resources: Paleontological Resources
Air quality		Refer to the following resources or values: Natural Resources: Air Quality
Subsistence resources and opportunities		Refer to the following resources or values: Subsistence
Scientific research, education, and interpretation about natural ecosystems and geologic features and processes		Refer to the following resources or values: Natural Resources: Scientific Research Visitor Experience: Science-based Education

State of the Park Summary Table

Priority Resource or Value	Condition Status/Trend	Rationale
Natural Resources		web ▸
Air Quality		Air quality in Denali is generally very good, although small amounts of airborne contaminants are transported into the park each year from local, regional, and international sources. Some park ecosystems are considered to be highly sensitive to atmospheric deposition of sulfur and nitrogen. Visibility is typically exceptional, although changing fire regimes due to climate change may increase the number of hazy days.
Scenic and Geologic Features		Landscape changes often take place at imperceptible rates, although some events such as landslides, earthquakes, and surging glaciers are notable reminders that the landscape is constantly changing. Monitoring has demonstrated an accelerated rate of change in many geophysical features due to climate change, including observations of thinning and retreating glaciers and thawing permafrost.
Paleontological Resources		Since the discovery of the first dinosaur fossil in 2005, 200+ sites with 1,000+ trace fossils have been inventoried. Less than 10 percent of the Cantwell Formation has had reconnaissance for paleontological resources. Known sites that are at-risk are monitored every other year. Other fossiliferous formations exist.
Wildlife Habitat and Ecosystem Function: Aquatic		Data on the condition of aquatic ecosystems are spatially limited. Based on the available data, water quality in rivers and streams is expected to be good and to meet standards. Fish, invertebrate, and diatom communities appear to be in a natural condition. Denali is working to restore natural channels, flow, and riparian vegetation on placer-mined streams near Kantishna. Caribou and Slate creeks have been removed from the impaired stream list because of improved turbidity, but Stampede and Slate creeks have been added to the list due to high levels of arsenic and antimony. Average mercury concentrations in lake trout are above published thresholds for the health of some fish-dependent wildlife species. Lakes in some areas show decreases in surface area.
Wildlife Habitat and Ecosystem Function: Terrestrial		Climate change likely is affecting the diversity and distribution of forest, shrub, and tundra plant communities. Changes in the diversity and distribution of plants have been documented in repeat photography and repeat vegetation sampling. Anecdotal evidence suggests that aspen green-up occurs earlier now than in the past. While the High Fire Potential days (yearly values and five-year moving average for 2008–2012) are within the range of natural variation (0 to 26 days, 4 to 12 days, respectively), the average season length of potential fire activity was 145.2 days, which was higher than the range (99 to 142 days) of five-year averages during 1994–2010.

Priority Resource or Value	Condition Status/Trend	Rationale
Wildlife Populations		Denali's fauna remain relatively unchanged compared to their population status prior to the Euro-American occupation of Alaska. Predator-prey interactions continue with minimal human influence. However, recent changes in regulations on adjacent lands, which allow more harvest (i.e., trapping, hunting), may influence the local population dynamics of those resident species that cross outside park boundaries. Many other human activities beyond park boundaries have the potential to negatively affect migratory species, which may lead to a loss of native species or population declines over time. Park efforts to document changes in species populations vary significantly across species. Ten common songbird species, several small mammal species, moose, Dall's sheep, and grizzly bear have stable populations over the last five years. Caribou herd size has increased to an estimate of 2,300 in 2012. Density of wolves in fall 2012 was at a 25-year low. All measures of Golden Eagle reproductive success have declined since 1988; from 2008 to 2012, the rate of egg-laying continued to decline and included some of the lowest rates since the start of the study. Trumpeter Swans have increased in abundance and distribution since 1975, but the increase has slowed since 2005. The total number of reported bear-human incidents was stable between 2008 and 2012.
Scientific Research		The number of researchers each year is stable (about 50–70). Research information is provided to the Denali Leadership Team for its use in evaluating management options. Fellowships have been awarded to graduate students and others through the Murie Science and Learning Center. Park scientists continue to publish results in peer-reviewed journals and as natural resource technical reports.
Cultural Resources		web ▸
Archeological Resources		Less than one percent of the park has been surveyed for prehistoric or historic resources. Of the 133 known prehistoric sites, only 3 percent have associated dates and 90 percent do not have any National Register documentation. Of the 80 percent of sites that have had a condition assessment in the last decade, 51 percent are in good condition. Of the 156 known historic sites, 12 percent have associated dates and are associated with a research theme, and 60 percent are without any National Register documentation (ASMIS 2012, National Register database 2012). Of the 54 percent of sites that have had a condition assessment in the last decade, 55 percent are in good condition. Forty-six percent of the known historic sites have not had a condition assessment in the last 10 years and 32 percent of the known historical sites have not been evaluated for threats and/or disturbances (ASMIS 2012).
Cultural Anthropology		Multiple studies have been conducted in the northwest area of the park, but little work has been conducted elsewhere. There are no Traditional Cultural Places recorded in the park. As elders pass away, knowledge of such places will diminish.
Cultural Landscapes		The number of cultural landscapes identified is 16: five have completed Cultural Landscapes Inventories (CLIs), eight have incomplete CLIs, and three are not yet in the database. The five landscapes with completed CLIs have been determined eligible for nomination to the National Register.
Historic Structures		Denali has 136 known historic structures for which reports have been published for 11 percent. Twenty-five percent of the structures have no National Register documentation. Of the known historic structures, 42 percent are in good condition.

Priority Resource or Value	Condition Status/Trend	Rationale
History		Many historic themes for the park have not been researched, such as the history of mountaineering. A two-volume administrative history of the park has been published, but the park has not initiated or completed an historic resource study.
Museum Collections		As of 2012, the museum collections included 372,353 objects that are accessioned, but only 52 percent of these have been catalogued to current NPS standards. There is a large backlog in museum management tasks, and paperwork is expired or non-existent for many loans. The park has a five-year Scope of Collections Statement and several other recently-developed plans to direct and improve the operations of the museum collections. The Resource Stewardship Strategy includes several projects to manage and improve the collections. Compactor units were added to maximize storage. Scanning objects has begun to make the collections more accessible.
Visitor Experience		web ▸
Number of Visitors		The 5-year average number of visitors (2008–2012) was 397,542. The 10-year average number of visitors (2003–2012) was 403,474.
Visitor Satisfaction		The percentage of visitors satisfied with their visit in 2012 was 97 percent, which is lower than the five-year average, but higher than the 10-year average.
Interpretive and Education Programs – Talks, Tours, and Special Events		Programs provided by rangers, education specialists, and Murie Science and Learning Center (MSLC) partners have expanded to include such offerings as distance learning via Skype and the Denali Music Festival (first offered in 2012). The quality of training and mentoring of seasonal rangers has improved. Seasonals often move on to other jobs, and the ability to hire seasonal rangers and offer programs is subject to fluctuations in budget.
Science-based Education		Connecting park visitors with science was improved in the last five years by new fact sheets, web upgrades, new one-day field offerings, continued citizen science and field seminar offerings, as well as continued collaboration between research and education.
Interpretive Media – Brochures, Exhibits, Signs, and Website		The new Eielson Visitor Center opened in 2008. The number of people who follow posts on Denali's social media, e.g., Facebook and Twitter, continues to grow. The park brochure was redesigned and updated in 2012.
Park Community: Volunteers and Partnerships		The number of volunteers in Denali has almost doubled over the last five years. Outreach to and interaction with local stakeholders continues through engagement in the Vehicle Management Plan, the Subsistence Resource Commission, and partnerships. The MSLC was unable to achieve fully its goal of serving the seven other northern parks because of lack of funding.
Recreational Opportunities		Opportunities for recreating in the park are well received by visitors. Some vehicle crowding in viewsheds and at wildlife stops occurs, but not regularly. A review of the current capacity set for backcountry units is needed. Improvements to the quality of the mountaineering experience have been made by policies that address such things as the noise of overflights, human waste disposal, and the ratio of independent to guided climbers.
Accessibility		Many structures are not accessible. The park has hired multi-lingual staff and offers print materials available in multiple languages. Park films and displays offer audio and/or captions. Few displays are suitable for being touched by the sight-impaired or offer an alternative touchable version.

Priority Resource or Value	Condition Status/Trend	Rationale
Safety		Overall safety for park visitors is good and on an even trend. Accidents and injuries involving park visitors are rare, the response to those incidents is quick and professional, and crime is rare. Since 2008, Denali has seen an overall decline in the number and severity of recordable and lost-time injuries for park employees.
Park Infrastructure		web ▸
Overall Facility Condition Index		The 626 assets at Denali have an overall Facility Condition Index (FCI) of 0.090, which is "Good" based on industry and NPS standards, and has improved compared to the 2008 overall value of 0.136. FCI is the cost of repairing an asset, such as a building, road, trail, or water system, divided by the cost of replacing it.
Energy Consumption		Energy usage (BTUs per gross square footage of buildings) at the park in 2012 was 14 percent higher than the average for the previous four years.
Water Consumption		Water consumption at the park in 2012 was 14 percent lower than the four-year average for 2008–2011 based primarily on a water leak being identified and fixed.
Wilderness Character and Stewardship		web ▸
Overall Wilderness Character		Ongoing monitoring of a full range of wilderness resources indicates the status of the qualities of wilderness character: **Natural**: most ecosystems components are healthy. **Undeveloped**: aircraft use for administration is stable, yet the net number of installations has increased in the last five years. **Untrammeled**: hindrances or interference are minimal, e.g., radio collaring, fire suppression of human-caused fires. **Opportunities for solitude or primitive and unconfined recreation**: opportunities are abundant except in popular areas near the park road and at air landing portals. **Other features**: paleontological and cultural resources are being identified and documented. There is positive momentum for protecting wilderness character for the future.
Wilderness Stewardship		Informational support for wilderness stewardship as of 2012 consisted of clear knowledge of legislative direction and history, science-based information, and policy support from management. The implementation of the Backcountry Management Plan (BMP), the robust wilderness monitoring program (e.g., soundscapes, social trails), current organizational structure (including multi-division support) and the offerings of park-wide training about wilderness provide a strong and clear mandate for wilderness stewardship.

Priority Resource or Value	Condition Status/Trend	Rationale
Subsistence		web
Subsistence		There are concerns about the decline in abundance of fish and marten. The population sizes, sex ratios, and age distribution of moose and caribou, which are harvested in Game Management Unit 13E (Cantwell vicinity) in preserve areas, continue to be documented as stable by the U.S. Fish and Wildlife Office of Subsistence Management's Federal Subsistence Permit System. There is some concern about increased harvesting of timber for firewood in the Windy Creek area. No timber surveys have been conducted in the area of trapline cabins near Lake Minchumina. Opportunities for subsistence activities continue to be available. There is some concern about the continuity of subsistence, because there are fewer youth in subsistence communities near the park.

Summary of Stewardship Activities and Key Accomplishments to Maintain or Improve Priority Resource Condition

The list below provides examples of stewardship activities and accomplishments by park staff and partners to maintain or improve the condition of priority park resources and values for this and future generations (for a more detailed list, see Chapter 3 below):

Natural Resources

- Finalized Denali's new strategic document, the Resource Stewardship Strategy (RSS), which provides guidance for research, resource management, and resource education over the next 20 years, 2008–2027 (2009)
- Documented first known occurrence of Tundra Swans nesting within the park (2011)

Cultural Resources

- Published *Snapshots from the Road: a Roadside History of Denali National Park and Preserve* (2011)
- Completed a Determination of Eligibility for the Denali Park Road (2009)—it officially has been determined eligible for listing on the National Register of Historic Places

Visitor Experience

- Responded to the first bear-caused human fatality in the 95-year history of the park (2012)
- Completed the Vehicle Management Plan (2012)
- Opened the new Eielson Visitor Center (2008)

Park Infrastructure

- Completed construction of a new emergency services building and annex (2011), a new wastewater treatment facility (2011), Mountain Vista Rest Area (2010), and the new Eielson Visitor Center (2008) which was rated as a Leadership in Energy and Environmental Design (LEED) building at the Platinum level
- Opened the reconstructed Triple Lakes Trail (2011)
- Installed water bottle fillers in support of a reduction in single-use water bottles in the park (2012)

Wilderness

- Progressed significantly in developing a robust wilderness character monitoring program, an outcome, in part, of the implementation of the Backcountry Management Plan
- Collaborated with the Aldo Leopold Wilderness Institute to develop a Denali Wilderness Character Map, an important tool for monitoring wilderness character as part of the larger monitoring program
- Filled a new position called Backcountry District Ranger and Wilderness Coordinator (2012)

Subsistence

- Supported and acknowledged passage of Proposal WP10-95 to protect subsistence activity (2011)—see page 55
- Convened Denali's Subsistence Resource Commission (SRC) for the first time at Lake Minchumina (spring 2010)

Key Issues and Challenges for Consideration in Management Planning

These are some of the major current issues and challenges at Denali National Park and Preserve:

1. Management of vehicles along the Denali Park Road to maintain wildlife protection and visitor satisfaction
2. Impacts of trapping and hunting of wolves near the park on the population status and viewability of wolves in the park
3. Analysis of natural and human-induced floodplain changes on the Toklat River system
4. Implementation of the Backcountry Management Plan so that backcountry hikers and campers experience the wilderness within the standards developed for such things as natural soundscapes and numbers of visitor encounters
5. Restart of a coal-fired power plant adjacent to the park
6. Documentation and evaluation of Denali's cultural resources
7. Setting and meeting Environmental Management Systems goals for green parks, and water and energy usage
8. Climate change considerations in park management

Chapter 1. Introduction

The purpose of this State of the Park report for Denali National Park and Preserve is to assess the overall condition of the park's priority resources and values, to communicate complex park condition information to visitors and the American public in a clear and simple way, and to inform visitors and other stakeholders about stewardship actions being taken by park staff to maintain or improve the condition of priority park resources for future generations. The State of the Park report uses a standardized approach to focus attention on the priority resources and values of the park based on the park's purpose and significance, as described in the park's Foundation Document or General Management Plan. The report:

- Provides to visitors and the American public a snapshot of the status and trend in the condition of a park's priority resources and values.
- Summarizes and communicates complex scientific, scholarly, and park operations factual information and expert opinion using non-technical language and a visual format.
- Highlights park stewardship activities and accomplishments to maintain or improve the state of the park.
- Identifies key issues and challenges facing the park to inform park management planning.

The process of identifying priority park resources by park staff and partners, tracking their condition, organizing and synthesizing data and information, and communicating the results will be closely coordinated with the park planning process, including natural and cultural resource condition assessments and Resource Stewardship Strategy development. The term "priority resources" is used to identify the fundamental and other important resources and values for the park, based on a park's purpose and significance within the National Park System, as documented in the park's foundation document and other planning documents. This report summarizes and communicates the overall condition of priority park resources and values based on the available scientific and scholarly information and expert opinion, irrespective of the ability of the park superintendent or the National Park Service to influence it.

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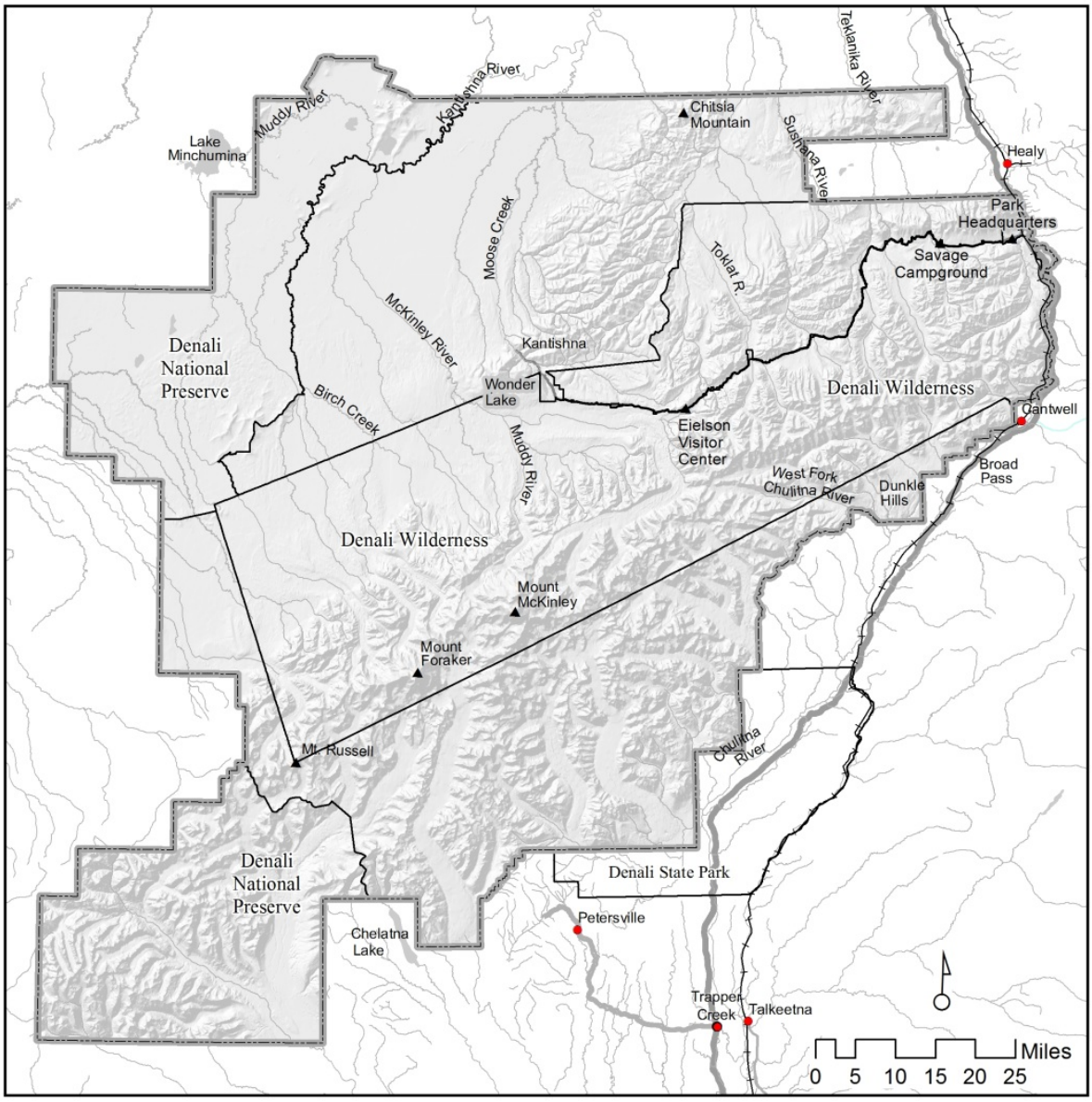
Climate impacts many aspects of park management, from ecological systems to park infrastructure. The climate is changing and human influence is now detectable in nearly all major components of the climate system, including the atmosphere and oceans, snow and ice, and various aspects of the water cycle (IPCC 2013). Global patterns of change demonstrate that the human effects on climate are even more pronounced in high latitudes and Polar Regions (Larsen et al. 2014). As a region, Alaska has warmed more than twice as rapidly as the rest of the United States over the past 60 years, with average annual air temperature increasing by 3°F (1.7°C) and average winter temperature by 6°F (3.3°C) (Chapin et al. 2014). The observed impacts of a warming climate in Alaska include declining sea ice, shrinking glaciers, thawing permafrost, changing ocean temperatures and chemistry, increased coastal erosion, and more extensive insect outbreaks and wildfire (e.g. Larsen et al. 2014, Chapin et al. 2014, Markon et al. 2012).

Even with multiple lines of evidence that Alaska is warming, interpreting trends and other climatic indicators locally is complicated because there are few long term measurements over a vast geographic region. Alaska's climate is also dynamic with strong linkages to atmospheric and oceanic processes, such as the position of the polar jet stream, the occurrence of equatorial El Nino events and the extent of Arctic sea ice (Papineau 2003, Boisvert and Stroeve 2015).

A climate index of sea surface temperature anomalies, evident in many Alaska long-term climate stations, is the Pacific Decadal Oscillation (PDO). The PDO indicates that much of the warming that has occurred since the middle of the 20th century occurred in the late 1970s as a stepwise shift, and is reflected in the PDO climatic transition from a cool to a warm phase (Chapin et al. 2014, Bieniek et al. 2014). In the early 2000s the PDO shifted back to a cooler phase resulting in statewide temperatures that were cooler than previous decades while still reflecting a long term warming trend (Bieniek et al. 2014). It is important to note that most of the climate monitoring in Alaskan parks began during this cooler phase and because of the short record doesn't reflect the long term trend. The most recent years have been highly variable and encompass two of the warmest years on record for Alaska, 2014 and 2015 (NOAA 2016). The north slope of Alaska has continued to warm despite changes in the PDO.

The effects of our warming climate on Alaska park resources can be dramatic in the form of melting glaciers and permafrost, more frequent fires, and changes in vegetation. The need for a better understanding of these changes and how they will impact our natural resources is recognized as a national priority (NCA 2014). The data and information gathered from Alaskan national parks provide an important piece of the puzzle for understanding the drivers and effects of climate change locally and regionally and underscore the importance of science in our national parks.



Map of the Park

Location of the Park in Alaska
Other national park units are outlined in green.

Chapter 2. State of the Park

The State of the Park is summarized below for six categories—Natural Resources, Cultural Resources, Visitor Experience, Park Infrastructure, Wilderness Character and Stewardship, and Subsistence—based on a synthesis of the park's monitoring, evaluation, management, and information programs, and expert opinion. Brief resource summaries are provided below for a selection of the priority resources and values of the park. Clicking on the web ▸ symbol found in the tables and resource briefs below will take you to the internet site that contains content associated with specific topics in the report.

The scientific and scholarly reports, publications, datasets, methodologies, and other information that were used as the basis for the assessments of resource condition are referenced and linked throughout the report and through the internet version of this report that is linked to the NPS IRMA data system (Integrated Resource Management Applications). The internet version of each report, and the associated workshop summary report available from the internet site, provide additional detail and sources of information about the findings summarized in the report, including references, accounts on the origin and quality of the data, and the methods and analytical approaches used in data collection and the assessments of condition. Resource condition assessments reported in this State of the Park report involve expert opinion and the professional judgment of park staff and subject matter experts involved in developing the report. This expert opinion and professional judgment derive from the in-depth knowledge and expertise of park and regional staff gained from their being involved in the day-to-day practice of all aspects of park stewardship and from the professional experience of the participating subject matter experts. This expert opinion and professional judgment utilized available factual information for the analyses and conclusions presented in this report. This State of the Park report was developed in a park-convened workshop.

The status and trends documented in Chapter 2 provide a useful point-in-time baseline measured against reference conditions that represent "healthy" ecosystem parameters, or regulatory standards (such as those related to air or water quality). We also note that climate change adaptation requires us to continue to learn from the past, but attempting to manage for conditions based on our understanding of the historical "natural" range of variation will be increasingly futile in many locations. Thus, these reference conditions, and/or our judgment about resource condition or trend may evolve as the rate of climate change accelerates and we respond to novel conditions. Our management must be even more "forward looking," to anticipate plausible but unprecedented conditions, also recognizing there will be surprises. In this context, we will incorporate climate considerations in our decision processes and management planning as we consider adaptation options that may deviate from traditional practices.

2.1. Natural Resources

Air Quality

web ▸

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Ozone	Concentration of ground-level ozone		Ozone concentrations and seasonal exposures are generally low and unlikely to cause injury or reduced growth in plants. The trend from 2000–2009 was relatively stable (NPS-ARD 2015).
Atmospheric Deposition of Sulfur in Precipitation	Sulfur Wet Deposition		From 2005–2009, estimated sulfur wet deposition was 0.2 kilograms per hectare per year (kg/ha/yr). This level falls within the caution category because Sullivan et al. (2011) rated the sensitivity of Denali's ecosystems to sulfur and nitrogen deposition as "Very High." The 10-year trend in sulfur concentrations occurring in precipitation was relatively stable (NPS-ARD 2015).
Atmospheric Deposition of Nitrogen in Precipitation	Nitrogen wet deposition		From 2005–2009, estimated nitrogen wet deposition was 0.3 kg/ha/yr. This level falls within the caution category because some Denali ecosystems are considered to be highly sensitive to atmospheric deposition of nitrogen (Sullivan et al. 2011, Pardo et al. 2011). The 10-year trend in nitrogen concentrations occurring in precipitation was relatively stable (NPS-ARD 2015).

Air Quality (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Visibility	Annual average Haze Index		Estimated average visibility from 2005–2009 was 1.9 deciviews (dv) above natural conditions. From 2000–2009, visibility remained relatively stable (NPS-ARD 2015).

Resource Brief: Historical and Projected Changes in Climate at Denali

Climate change impacts all aspects of park management. Future climate conditions may shift beyond the historical range of variability. Climate change will manifest itself not only as shifts in such indicators as mean annual temperature and total annual precipitation, but also as changes in climate variability (e.g., more intense heat waves, storms, and flooding). These changes are likely to alter visitor use patterns and demands on facilities and operations, cause shifts in the composition and structure of natural communities, and accelerate weathering, deterioration, and loss of cultural and paleontological resources. Land managers will deal with both rapid change and multiple uncertainties. Understanding climate change projections, and associated levels of uncertainty, will facilitate planning actions that are robust, regardless of the precise magnitude of change in the coming decades.

Average seasonal and annual temperatures and total annual precipitation and snowfall from the 89-year historical climate record (1926–2015) at park headquarters are shown in the tables and graphs below. This site is one of the few long-term weather stations in the state of Alaska; analysis of long-term records across the interior region revealed that temperature departures (from the long-term average) tend to be fairly consistent across the region, making a single station with a long-term record a valuable resource for looking at trends (Keen 2008). Future climate projections for Alaska are based on multi-model averaged data for a range of potential emissions scenarios (Stewart et al. 2013). Temperature and precipitation projections over the next century have been calculated on a monthly time scale for the Denali headquarters area. The projections are based on the PRISM model historical baseline projected at a 2km resolution using the mid-range emissions scenario (representative concentration pathway RCP 6.0). These graphs are useful in looking at overall trends in temperature increases versus specific values due to the uncertainty in models and natural climate variability (SNAP 2016).

Temperature 1926–2015					
Season	Average °F	Record High °F	Date/Year	Record Low °F	Date/Year
Winter	4.3	17.0	2000	-8.0	1932
Summer	52.6	58.6	2004	48.9	1970
Spring	27.2	36.7	1926	19.4	1971, 1972
Autumn	24.7	35.1	2002	16.1	1932
Annual	27.2	91.0	6/22/1991	-54.0	2/5/1999

Precipitation 1928–2015					
Season	Average Total In.	Record High Total In.	Date/Year	Record Low Total In.	Date/Year
Winter	2.13	6.34	1937	0.42	1942
Summer	7.92	14.9	1967	3.75	1940
Spring	1.64	7.32	1948	0.18	1993
Autumn	3.33	9.34	1935	1.26	1969
Annual	15.02	27.57	1967	9.18	1960

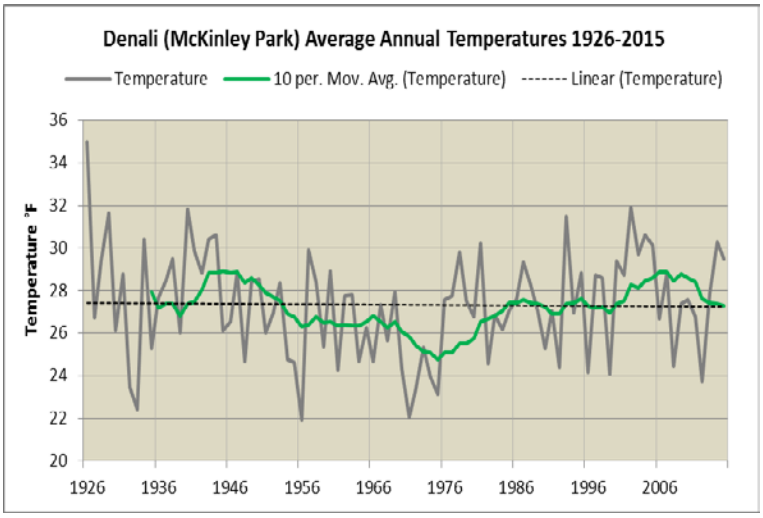
Historical and Projected Changes in Climate at Denali (Continued)

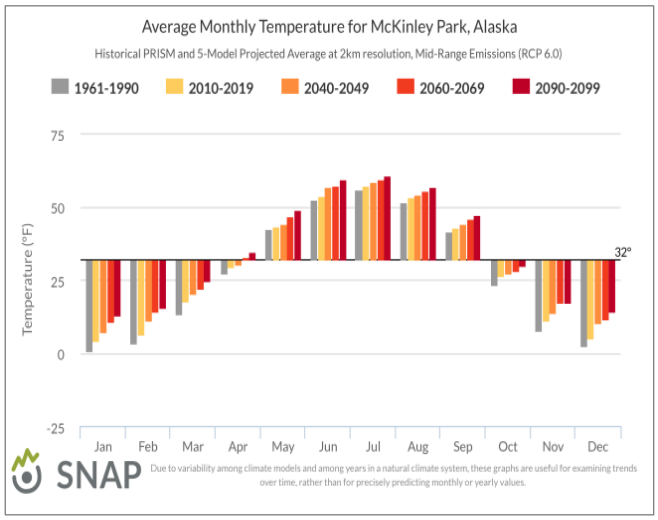
Snowfall 1926–2015					
Season	Average Total In.	Record High Total In.	Date/Year	Record Low Total In.	Date/Year
Autumn	29	106	1970	6	1954
Winter	34	113	1936–37	8	1941–42
Spring	17	93	1948	1.4	1993
Annual	79	174	1970–71	31	2002

Historical trends and future projection for temperature

The observed temperature trend is non-linear, with multi-decadal variations (graph below left). Annual temperature departures (from the long-term average) were mostly negative (cooler than normal) in the mid-20th century, shifting to mostly positive (warmer than normal) around 1976 when the Pacific Decadal Oscillation (PDO) underwent a phase shift from negative to positive (warmer than normal temperatures). At the start of the twenty-first century, the PDO became negative and the temperatures decreased again, which could be seen for most of Alaska with the exception of Arctic Alaska. Over the past several years the PDO has been positive, coinciding with a strong El Nino pattern, resulting in two of the warmest years on record in 2014 and 2015 for the state of Alaska. Seasonally, temperatures in Denali showed increasing trends in winter, spring, and summer.

Seasonal trends highlight the extreme variability in temperatures, especially in the winter, spring, and fall. For every season, except for the fall, the average temperatures for the latest climate normal reference period (1981–2010) are warmer than the long-term seasonal average between 1926 and 2015.

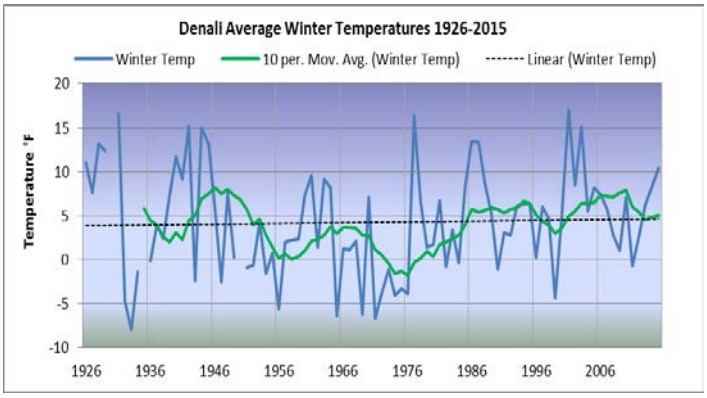


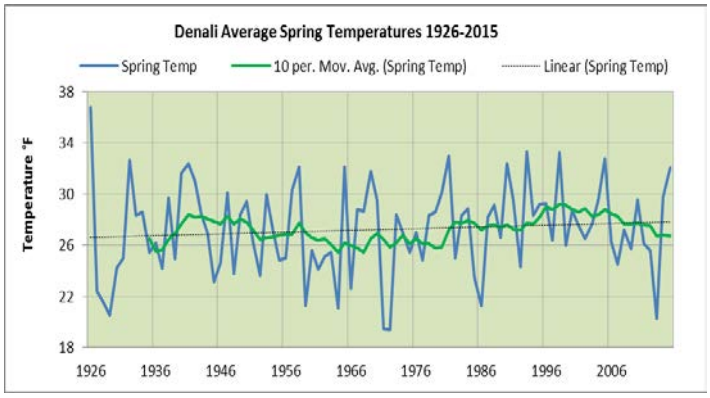


Average annual temperatures at Denali from 1926–2015. The green line shows the 10-year moving average. The dotted line shows a simple linear regression trend (graph above left). The Scenarios Network for Alaska and Arctic Planning (SNAP) monthly temperature projections for the next century at Denali Park headquarters are shown in the right graph (SNAP 2016).

Winter: Average winter temperatures (December, January, and February) in Denali range between -8.0°F (1932) to 17.0°F (2000). The long-term average (1926–2015) is 4.3°F. The winter season average temperature for the 1981–2010 climate normal period is 5.8°F. The overall trend is positive but not significant; the temperature increase is non-linear, with multi-decadal variations. Persistent warm periods and temperatures that reach above freezing in winter can pose problems to an ecosystem that is dominated by snowcover for a good portion of the year: snow turns to rain, which leads to icing, which makes foraging difficult; plants are subject to desiccation because of low or no snow cover; and subnivean fauna are left unprotected.

Historical and Projected Changes in Climate at Denali (Continued)



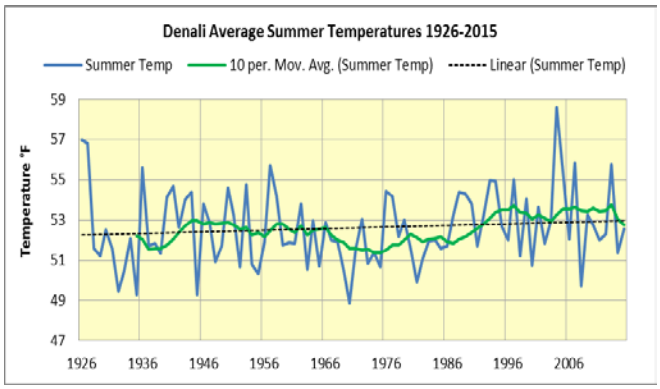


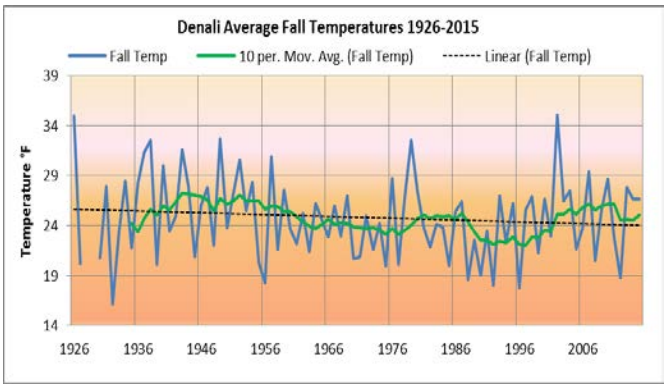
Average winter temperatures (December, January, February) (above left) and average spring temperatures (March, April, May) (above right) at Denali Park headquarters over the past 89 years. The green line shows the10-year moving average on both graphs. The dotted lines show a simple linear regression trend for each season.

Spring: The average spring temperatures at Denali range between 19.4°F (1971, 1972) and 36.7°F (1926). The long-term average spring temperature is 27.2°F and the most recent climate normal period average is 28.0°F. The overall trend in spring season temperatures is positive, but not significant. The warmest spring period occurred between the mid-1990s and mid-2000s and one of the coldest spring periods on record occurred in 2013. Extremes in spring temperatures, especially in late spring can have repercussions related to the timing of many phenological events that are triggered by the return of warmer temperatures in May.

Summer: Average summer temperatures have also increased over the long period of record, but again the increase is not statistically significant. The range in summer temperatures is only ≈10°F, compared to the winter season temperature range of ≈25°F. The warmest summer on record was in 2004 and the coolest summer on record was 1970. Three of the warmest summers on record have occurred in the past 10 years (2007, 2013, and 2005). The long term average summer temperature is 52.6°F and the 1981–2010 average is 53.0°F. An increase in summer temperatures can lead to many scenarios that fall out of the "normal" range of expectations including impacts to the fire season, insect outbreaks, wildlife migrations, aquatic ecosystems, active layer thawing, etc.

Fall: Fall is the only season that shows an overall decreasing trend in temperatures over the 1926–2015 period (the trend is not significant). The long term seasonal average for the fall season in Denali is 24.7°F and the average over the latest climate normal period (1981–2010) is 24.0°F. Average fall temperatures range from 16.1°F in 1932 to 35.1°F in 2002. Changes in early fall season temperatures can once again impact the timing of many phenological events that are triggered by cooler temperatures and decreasing daylight.





Average summer temperatures (June, July, August) (above left) and average fall temperatures (September, October, November) (above right) at Denali Park headquarters over the past 89 years. The green line shows the 10-year moving average on both graphs. The dotted lines show a simple linear regression trend for each season.

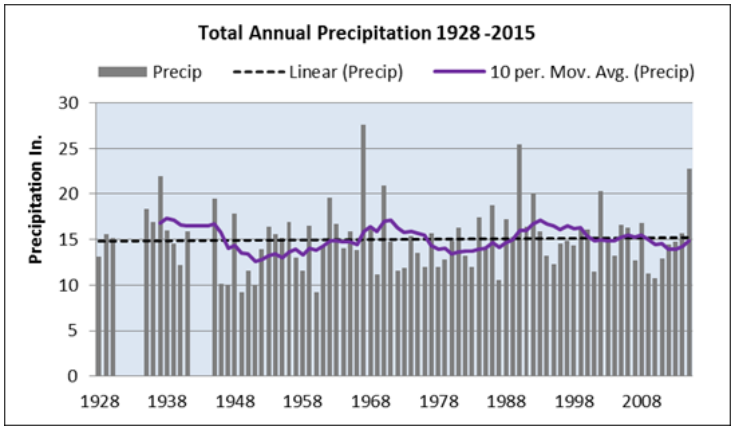
Historical and Projected Changes in Climate at Denali (Continued)

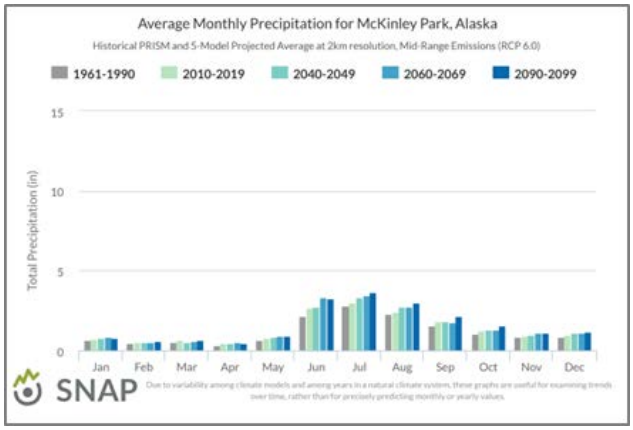
Temperatures are projected to increase for all seasons by mid-century, with the greatest increases likely in winter (graph below right). There is general agreement among individual climate models in the direction and magnitude of warming over the coming decades. Warming temperatures pose serious threats to park resources, in a region where average temperatures are so near freezing.

Historical trends and future projection for precipitation

Observed annual precipitation showed strong inter-annual variability and no significant linear trend (graph below left). The average annual precipitation total over the entire period of record is 15.02 inches and for the latest climate normal period (1981–2010) is 15.06 inches. The range in total annual precipitation over the past 89-years is between 9.18 inches (1960) and 27.57 inches in 1967. Total annual precipitation is projected to increase throughout the next century, particularly in the summer season (graph below right) (SNAP 2016). Precipitation variability is likely to remain large over the coming decades (larger uncertainty in precipitation than in temperature projections) (Stewart et al. 2013).

Seasonal trends show the extreme variability in precipitation between seasons and among seasons, and can also be used to highlight extreme events that have large ecological implications for humans (i.e. floods, droughts) and wildlife (i.e. high or low snowfall).



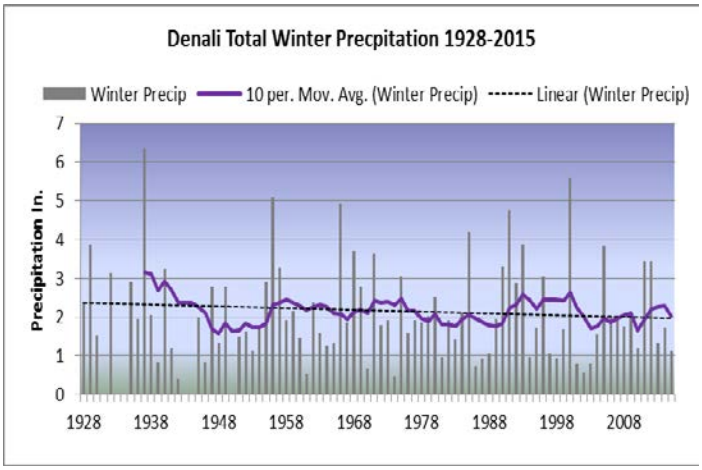


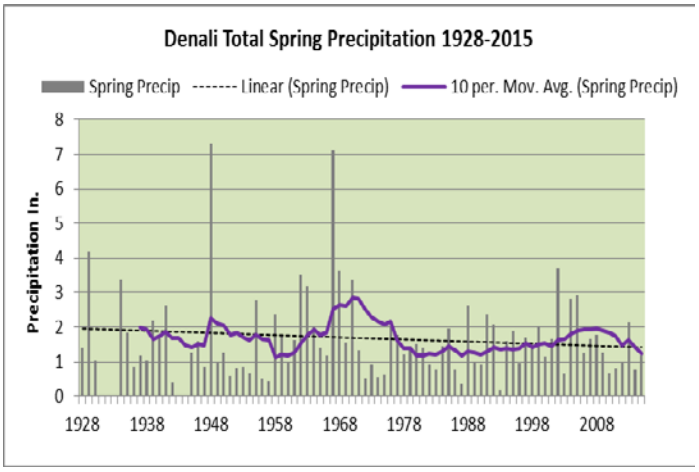
Total annual precipitation at Denali from 1928–2015. The purple line shows the 10-year moving average. The dotted lines show a simple linear regression trend (graph above left). The Scenarios Network for Alaska and Arctic Planning (SNAP) monthly precipitation projections for the next century at Denali Park headquarters are shown in the graph above right (SNAP 2016).

Winter: The total amount of winter precipitation (snow water equivalent, sleet, rain, etc.) is on average 2.13 inches (≈1928–2015); the 1981–2010 normal is 2.09 inches. The average snowfall total during the winter is ≈34 inches (this refers to the total cumulative snowfall and not the snow depth on the ground). The snowiest winter on record is 1936–1937, which had a total of 113 inches of snow that amounted to 6.34 inches of precipitation (snow water equivalent). Winter precipitation and snowfall trends have decreased over the observed record, but the trends are not significant. Increasing winter temperatures can lead to an increase in the number or intensity of rain-on-snow events that could potentially disrupt the path to the food supply for wildlife.

Spring: Spring is the driest season of the year at Denali Park headquarters. On average ≈1.64 inches (snow water equivalent and rainfall) falls between March 1 and May 31. Snowfall totals average ≈17 inches during the spring. The wettest spring on record was 1948 with 7.32 inches of precipitation recorded. Both the total precipitation and the total snowfall trends have shown decreases over the period of record. The precipitation projections indicate that late spring may see an increase in precipitation amounts. Late spring snowfall events can interfere with the timing of bird migrations, wildlife health, green-up, and other ecological processes that begin once the snow has melted.

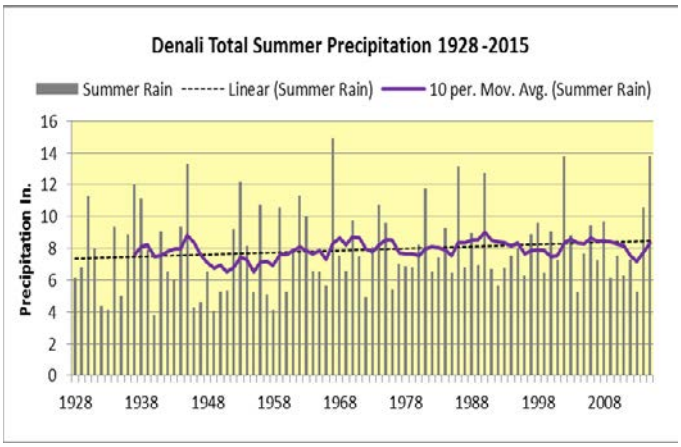
Summer: More than half of the annual precipitation falls as rain during the summer months between June 1 and August 31. The average summer rainfall is 7.92 inches (8.08 for the 1981–2010 normal period). The wettest summer on record was 1967; a total of 14.9 inches fell causing catastrophic flooding in interior Alaska. The overall trend in total summer rainfall is positive, but not significant, with an increase of ≈0.13 inches/decade. The precipitation projections show that precipitation will increase the most during the summer months; more rain and more intense rain events can lead to flooding, landslides, and soil instability.

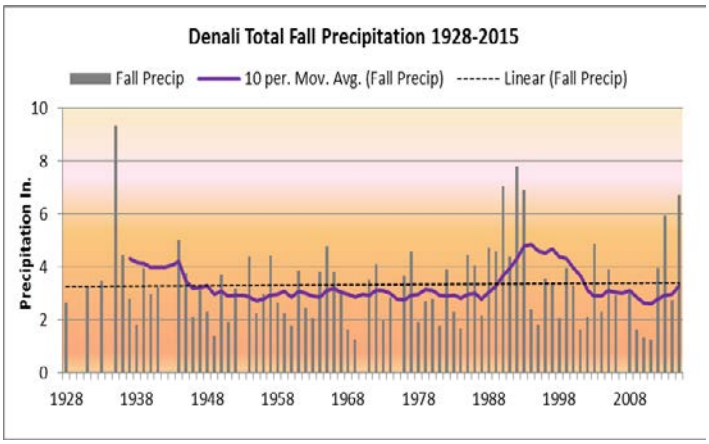




Total winter precipitation (December, January, February) (above left) and total spring precipitation (March, April, May) (above right) at Denali Park headquarters over the past 87 years. The purple line shows the 10-year moving average on both graphs. The dotted lines show a simple linear regression trend for each season.

Fall: During the fall months an average of 3.33 inches of rain/melted snow falls at park headquarters; fall is the second wettest season after summer. The wettest fall on record was in 1935 with a total of 9.34 inches falling between September 1 and November 30. Fall snowfall totals are on average ≈29 inches. The snowiest fall on record was in 1970 when 106 inches of snow was recorded. There is no apparent trend in the fall precipitation totals. The projections indicate there may be more precipitation during the early fall period in the future.





Total summer precipitation (June, July, August) (above left) and total fall precipitation (September, October, November) (above right) at Denali Park headquarters over the past 87 years. The purple line shows the 10-year moving average on both graphs. The dotted lines show a simple linear regression trend for each season.

Other projections

In addition to warmer mean temperatures and changes in annual precipitation, climate change will exhibit itself in many other ways. Permafrost is projected to thaw across large portions of Interior Alaska by 2100 under both low and high emissions scenarios, altering local hydrology and potentially impacting roads, buildings, and other infrastructure (Stewart et al. 2013, Panda 2014). The growing season is projected to increase 15–25 days by mid-century, and warmer spring temperatures already are linked to increased wildfire activity in Alaska (Stewart et al. 2013). Global climate change will interact with regional phenomena, such as the Pacific Decadal Oscillation (PDO). The phase of the PDO (negative or positive) may modify observed climate trends, with the negative phase dampening and the positive phase exacerbating overall climate change trends. Significantly warmer temperatures and a more variable precipitation regime may lead to both more frequent droughts and more severe flooding and erosion.

Scenic and Geologic Features

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Glaciers	Rate of change for glacier volume and extent		A 2012 inventory shows almost all of Denali's glaciers have shrunk in extent and volume from the 1950s to 2010 (Arendt et al. 2012; Capps and Sarwas, *in prep.*). In addition, mass balance and volume change data from a small sampling of glaciers indicate steady-to-increasing rates of volume loss since the 1950s, so increasing rates of ice loss park-wide are suspected (Burrows and Adema 2011, Burrows 2014, Arendt et al. 2013). The glacier shrinkage measured in Denali is consistent with global trends attributed to anthropogenic climate change (Solomon et al. 2007).
Permafrost	Area of thermokarst		Total area of thermokarst has not been measured or monitored. However, two specific thermokarst features in the Toklat Basin have been monitored qualitatively since 2003. Thermokarst features in the Toklat Basin expanded in area by 30 percent from 2003 to 2008 (Yocum et al. 2007, unpublished photographs 2003, 2008).
	Carbon flux		Carbon flux in relation to permafrost thaw has been investigated since 2003 near the park at the Eight Mile Lake site, which is one of a global network of permafrost observatories. Tundra soils at sites with extensive permafrost thaw released more carbon than was taken up during the growing season. Most of this released carbon was identified as "ancient" based on isotopic analysis. At sites with moderate permafrost thaw, shrub growth increased and soils took up more carbon than at sites with minimal thaw (Schuur et al. 2009).
	Permafrost temperature (thermal state of permafrost, soil temperature profile)		Permafrost borehole temperature profiles have been collected at Eight Mile Lake since 1985. From 1989 to 1997, a warming trend at all depths was documented (Osterkamp 2003). From 1997 to 2001, a cooling trend at shallow depths occurred due to winters with no snow pack (Zhang et al. 2001). From 2002–2011, the warming trend has leveled out, with permafrost temperatures at all depths within 1°C of melting. The latent heat of fusion slows the warming of frozen ground while thawing continues. This pattern of permafrost warming is consistent with other borehole measurements across sub-arctic latitudes worldwide (Romanovsky et al. 2012).

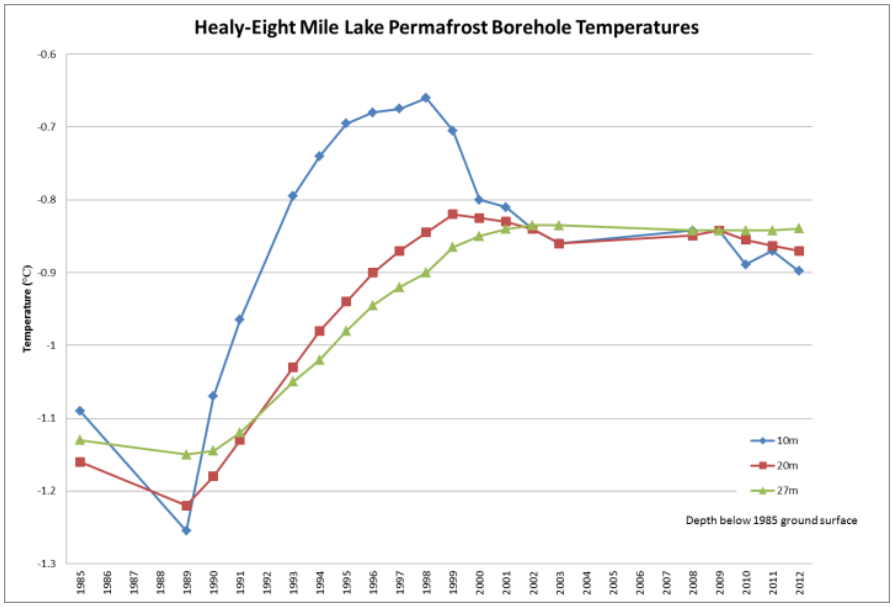
Scenic and Geologic Features (continued)

web

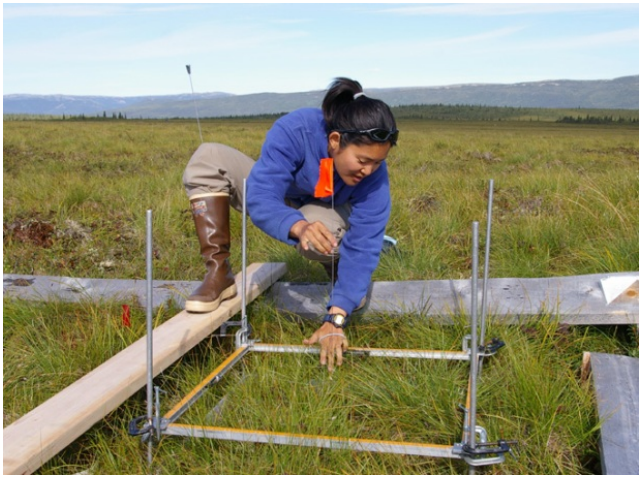
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Night Sky	Night sky brightness adjacent to development		While night skies are relatively pristine throughout much of the park, a 2010 survey conducted by the NPS Natural Sounds & Night Skies Division documented anthropogenic light at even the most remote sites (Duriscoe and Moore, *in prep.*). Anthropogenic light continues to increase near developed areas as new structures are built in and adjacent to the park.
	Parkwide Anthropogenic Light Ratio (ALR)		Anthropogenic Light Ratio (ALR) is a measure of light pollution calculated as the ratio of average anthropogenic light to average natural light under moonless night sky conditions (Moore et al. 2013). Based on the 2010 night sky survey, ALR for Denali is **<0.05**, which means that on average, night skies in the park are less than 5% brighter than natural conditions (NPS-NSNSD 2015). It is unlikely that average light pollution across the park has changed significantly in the past five years, given the slow population growth rate (3%) in the Anchorage and Fairbanks statistical areas (U.S. Census Bureau 2014).

Resource Brief: Permafrost Warming

Permafrost is soil or rock that is frozen for at least two years. In Alaska, Denali is located at the broad geographic boundary between areas that are mostly permafrost and those that have little permafrost (either none, or discontinuous permafrost). In and near Denali, permafrost is at a temperature below, but very near, freezing. With a warming climate, changes in air temperature can radically affect landscapes by bringing soil temperatures within tenths of a degree of thawing.



In 1985, a forward-thinking researcher established a borehole into the permafrost at a site near Eight Mile Lake in the Stampede Corridor just outside the park, in order to investigate soil temperatures at several depths (Osterkamp 2003). Permafrost at all depths of the borehole began warming in about 1989 (see graph). By 1995, the permafrost at all depths had warmed to within 1 ^{o}C of freezing. Beginning about 2000, the temperature at all depths stabilized at about -0.85 ^{o}C (Osterkamp et al. 2009). At near-freezing temperatures, warming energy absorbed by permafrost is not expressed as a temperature change near the surface; instead, the latent heat of fusion (i.e., water changing from a solid to a liquid) slows the warming of nearly-thawed frozen ground while the top of the permafrost layer retreats downward.



Measuring permafrost temperature

As frozen ground retreats down and the active layer of summer thaw becomes deeper, soil organisms decompose the organic matter releasing carbon (C) or nitrogen (N), which have been sequestered in frozen soils. The decomposition results in the additional release of CO_2 and methane (greenhouse gases), accelerating the climate warming already occurring (Schurr et al. 2009).

As ice-rich permafrost thaws, the local ground surface often subsides, creating depressions called thermokarst. Thermokarst terrain provides researchers the opportunity to investigate the interactions among permafrost thaw and the ecosystem's hydrology, plant communities, carbon exchange, and nutrient cycling. The Eight Mile Lake site is now part of an international network of permafrost observatories and has several concurrent long-term research projects.

Paleontological Resources

web ▸

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Inventory of Paleontological Resources	Percentage of park-wide inventory completed		Since the discovery of the first dinosaur fossil in 2005 (Denali National Park and Preserve 2013), less than 10 percent of the Cantwell Formation has had reconnaissance for paleontological resources to document fossil type, location, baseline condition, risk factors and disturbance, and protection measures, if needed (NPS-CAKN 2011; NPS, *in review*). Paleontologists have documented many thousands of tracks from several different types of dinosaurs over a wide area of the park (Fiorillo and Adams 2012). One trackway contains several thousand tracks. New discoveries and studies have allowed paleoenvironmental reconstructions and age interpretations (Tomsich et al. 2010, Denali National Park and Preserve 2008a, 2008b, 2012).
Monitoring of Paleontological Resources	Percentage of known sites in good condition		Known sites, which are highly significant or at-risk, are being monitored every two years (NPS, *in review*).

Wildlife Habitat and Ecosystem Function: Aquatic

web ▸

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Rivers and Streams	Water chemistry parameters are within the range of natural variability and meet Alaska water quality standards		With the exception of placer-mined streams in the Kantishna Hills, it is reasonable to expect that the water chemistry in rivers and streams parkwide is within the natural range of variability, meets Alaska water quality standards, and has not changed substantially since the 1990s (Edwards and Tranel 1998, Simmons 2009, 2010, 2011, 2013, Brabets and Ourso 2013).
	Macroinvertebrates: Percentage of taxa that are native		To date no potentially non-native (i.e. unexpected) taxa have been captured in the ongoing inventory of aquatic macroinvertebrate diversity (Conn 1998, Milner et al. 2003, Simmons 2009, 2010, 2011, 2013).
	Macroinvertebrate community composition		With the exception of placer-mined streams in the Kantishna Hills, it is reasonable to expect that the macroinvertebrate community composition in rivers and streams parkwide is within the natural range of variability and has not changed since the 1990s (Conn 1998, Milner et al. 2003, Simmons 2009, 2010, 2011, 2013).
	Diatoms: Percentage of species that are native		To date no unexpected species have been detected in the ongoing inventory of diatom diversity, although two unidentified species have been collected. Occasional nuisance blooms of *Didymosphenia geminata* have been observed, although anecdotal evidence suggests that these blooms may have occurred historically (Simmons 2009, 2010, 2011, 2013).
	Diatom community composition		With the exception of placer-mined streams in the Kantishna Hills, it is reasonable to assume that diatom community composition in rivers and streams parkwide is within the natural range of variability (Simmons 2009, 2010, 2011, 2013).

Wildlife Habitat and Ecosystem Function: Aquatic (Continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Shallow Lakes	Water levels		Lake surface area (as measured using remote sensing) in the Minchumina Basin Lowlands was stable between 1980 and 2007, whereas lake surface area in the Eolian Lowlands decreased considerably (Larsen 2011, Larsen and Kristenson 2012). Twenty-six percent of these Eolian Lowlands lakes shrunk substantially during this time period, and 19 percent of the lakes dried completely (Larsen 2011, Larsen and Kristenson 2010). Detecting change in lakes in the Minchumina Basin Lowlands is difficult because researchers are unsure if water level in these lakes is stable or if they are unable to detect change due to the shape of the lake basins and their steep sides. It is not well understood why lakes in the Eolian Lowlands are drying, but possible explanations include reduced annual precipitation, changes in the timing and duration of snow melt, permafrost degradation, and paludification.
	Water chemistry		Based on field research conducted since 2006, total nitrogen and total phosphorus concentrations in the majority (≈90%) of the shallow lakes are within the natural range of variability (Larsen and Kristenson 2010). The remaining 10 percent of lakes sampled have elevated nitrogen and phosphorus concentrations—likely due to permafrost degradation along the lake margin (Larsen and Kristenson 2010). Two unknowns are the extent of permafrost degradation and the role that permafrost historically has played in the ecology of shallow lakes. Thus, it is difficult to discern whether the current rate of permafrost degradation is negatively impacting the park's lake ecosystems.
	Phytoplankton		In general, algal biomass in the park is extremely low in comparison with other regions of Alaska (Larsen 2010). Elevated algal biomass is observed periodically in lakes with extensive permafrost degradation or eutrophied lakes in the Minchumina Basin Lowlands; concentrations remain within the natural range of variability.

Wildlife Habitat and Ecosystem Function: Aquatic (Continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Ecosystem Contaminants	Mercury in fish and sediments		Atmospheric mercury from regional and international sources has slowly accumulated in park ecosystems through deposition and bioaccumulation. Average mercury concentrations in Denali lake trout are above published thresholds for the health of some fish-dependent wildlife species (kingfisher, mink, and river otter). Since the early 1900s, percent enrichment of mercury in lake sediments has increased steadily in Wonder Lake (Landers et al. 2008).
	Semi-volatile organic compounds (SOCs) in fish and sediments		Semi-volatile organic compounds (SOCs) from international sources have been detected in Denali's remote ecosystems. Some SOCs measured at relatively low concentrations in lake sediments have increased in recent decades. The highest concentrations of SOCs in Denali were found in fish, due to bioaccumulation of lipophilic contaminants. Concentrations of PCBs and dieldrin (an insecticide banned in the U.S. in 1987) were higher than expected in some individual fish, although none were at concentrations that exceeded human health standards established by the Alaska Department of Health and Social Services (Landers et al. 2008).
Ecosystem Function of Mined and Disturbed Watersheds	Water quality: Trace metals and/or turbidity meet Alaska water quality standards		Under section 303(d) of the Clean Water Act (1972), the state is required to develop lists of impaired waters that are too polluted or otherwise degraded to meet water quality standards. The park is working in conjunction with other federal agencies, state agencies, universities, and private industry to improve water quality impaired by past mining (Ritchie et al. 2013). Both Caribou and Slate creeks, formerly listed as impaired due to turbidity, have now been removed from the impaired list because of reclamation efforts by the NPS (ADEC 2012, EPA 2011). However, Stampede Creek has been added and Slate Creek has been added back due to elevated levels of antimony and arsenic (ADEC 2012, Denali National Park and Preserve 2009, 2010).
	Mined/disturbed streams/floodplains returned to natural conditions		Denali is reclaiming mined/disturbed stream channels and floodplains to support natural geomorphic processes and riparian flora and fauna. Reclamation includes rebuilding natural channel meanders and leveling tailings piles to reduce flooding and turbidity, which also establishes the foundation of a functioning riparian ecosystem (Denali National Park and Preserve 2009, 2010, EPA 2011).
	Percentage of mined/disturbed area successfully revegetated		Revegetation in mined/disturbed areas is critical to: (1) minimize runoff of sediments that cause physical and chemical pollution of streams and (2) plant riparian vegetation from which additional vegetation can re-establish (Densmore and Holmes 1987, Densmore 1994).

Wildlife Habitat and Ecosystem Function: Terrestrial

web ▸

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Plant Phenology	Annual timing of aspen flowering, green-up, and leaf senescence		The warming climate likely has affected the plant phenology in Denali, a phenomenon observed elsewhere over longer periods. In seven years of observations in aspen phenology plots, park staff has detected strong inter-annual variation in the timing of important growth events and has related this variation to temperature (Roland and Nicklen 2010). However, the period of observation is too short for detecting trends in these indicators with such high variability. Anecdotal evidence suggests that green-up occurs earlier now than in the past.
Exotic Plant Species Abundance and Distribution	Number of exotic plant species		Exotic plants have invaded Denali within the last 100 years. There are now 28 exotic plant species documented in the park (Densmore et al. 2001, NPS-EPMT 2011). There is no indication that this number of species changed during 2008–2012. Increasing park visitation, continuing in-park development and related habitat disturbance, and a warming climate suggest an on-going or increased threat of invasion by additional exotic species.
	Distribution and abundance of exotic species		Exotic plants are currently restricted to the footprint of human disturbance along the park road. There is no indication that the distribution or abundance of exotic species changed substantially during 2008–2012. With increasing park visitation, on-going in-park development and related habitat disturbance, and a warming climate, park staff expects continuing or increased threats from new exotic species or those exotics that already have a presence in the park. Each year park staff inventories exotic plant populations and uses eradication measures (Walter and Mahovlic 2011, Ring and Mahovlic 2013).
Forest Communities	Diversity, distribution, and abundance of tree species in plot network		Park staff has sampled the vegetation plots only once. However, evidence from repeat photography suggests that there have been major increases in tree colonization in the subalpine zone. In addition, fieldwork in 2012 has shown major localized spreading of poplar in subalpine areas over a 54-year period (unpublished data, Viereck 1966). Recent studies (see review in Roland et al. 2013) predict large changes in Alaska boreal forests in response to a changing climate, including changes driven by increased fire frequency and severity.
	Diversity, distribution, and abundance of understory species* in plot network		Recent work predicts large changes in boreal forests, including the forest understory, in response to a changing climate, including increased fire frequency and severity. See review in Roland et al. (2013). * Vascular plants, mosses, and terricolous (living on or near the soil/ground) macro-lichens are included when considering the species of the forest, shrub, tundra, and wetland plant community types. Only crustose and epiphytic lichens and hepatics (liverworts) are excluded, although some information on these groups is also available. The landscape is a mosaic with sometimes diffuse boundaries among "types" of vegetation.

Wildlife Habitat and Ecosystem Function: Terrestrial (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Shrub Communities	Diversity, distribution, and abundance of shrub species in plot network		Warming likely will affect the distribution of shrub species at a landscape scale, which likely will be documented in the network of plots established for long-term monitoring of vegetation. Anecdotal evidence from repeat photography suggests shrub encroachment has occurred in some areas. Recent measurements suggest changing successional pathways leading to the establishment of stands of trees in areas that formerly were occupied by shrub communities (unpublished data, Viereck 1966).
	Diversity, distribution, and abundance of shrub understory species* in plot network		The warming that likely will affect the distribution of shrub species at a landscape scale, will likely affect plants in the understory as well. Park staff will be able to monitor vegetation change in shrub communities within the plots established for long-term vegetation monitoring. * Vascular plants, mosses, and terricolous (living on or near the soil/ground) macro-lichens are included when considering the species of the forest, shrub, tundra, and wetland plant community types. Only crustose and epiphytic lichens and hepatics (liverworts) are excluded, although some information on these groups is also available. The landscape is a mosaic with sometimes diffuse boundaries among "types" of vegetation.
Tundra Communities	Diversity, distribution, and abundance of tundra species* in plot network		Plant species in the tundra may be the most vulnerable to ecosystem changes brought about by a warming climate, because they may be displaced by trees and shrubs invading the tundra from lower elevations. Evidence from repeat photography and studies elsewhere strongly suggests that the encroachment of larger-statured woody taxa would negatively impact tundra communities by outcompeting these plants in a warmer climate. * Vascular plants, mosses, and terricolous (living on or near the soil/ground) macro-lichens are included when considering the species of the forest, shrub, tundra, and wetland plant community types. Only crustose and epiphytic lichens and hepatics (liverworts) are excluded, although some information on these groups is also available. The landscape is a mosaic with sometimes diffuse boundaries among "types" of vegetation.
Wetland Communities	Diversity, distribution of open wetlands		Repeat photos in Denali show shrub encroachment into wetlands and ponds, which are shrinking at a landscape level. Several studies elsewhere have shown drying of the boreal landscape and shrub encroachment of open wetlands (e.g., Klein et al. 2005, Berg et al. 2009).
	Plant species composition of wetlands		Repeat photos in Denali show shrub encroachment into wetlands and ponds, which are shrinking at a landscape level. Several studies elsewhere have shown drying of boreal landscape and shrub encroachment of open wetlands (e.g., Klein et al. 2005, Berg et al. 2009).

Wildlife Habitat and Ecosystem Function: Terrestrial (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Fire Regime	Fire frequency – the recorded number of natural fire starts per year for all fires affecting the park		During 1952–2010, the number of natural fire starts (i.e., wildfires) per year ranged from 0 to 18. In 2012, 2 wildfires were detected, well within the range of natural variability. During 1952–2010, the number of wildfires per year, based on a five-year moving average, ranged from 0.2 to 6.4. During 2008–2012, the average number of wildfires per year was 2.6, well within the range of five-year averages (DOI 2012, Weddle unpublished data 2012b).
	Fire extent – the recorded number of acres burned per year on NPS lands*		During 1982–2010, the fire extent (acres burned per year) ranged from 0 to 117,508 acres. During this same time period, the five-year average of fire extent ranged from 2,385 to 36,235 acres. In 2012, a total of 216.8 acres burned; during 2008–2012, the average fire extent was 9,353 acres. Both values are well within the range of natural variability. Modeled fire patterns in Denali identify the potential for annual fire extent in the near future to exceed 1,500,000 acres (Loya et al. 2011). Of the five years with the largest fire extent, three of them have occurred in the last 11 years (DOI 2012, Weddle unpublished data 2012b). * Prior to 1982, natural wildfires were regularly suppressed and the fire extent for the years prior to 1982 may not reflect accurately the natural growth of wildfires. To remove this bias, these years have been excluded from these analyses.
	Daily Cumulative Fire Duration – the number of days in the year when fire was active on the landscape*		During 1982–2010, the Daily Cumulative Fire Duration ranged from 0 to 126 days, and the five-year moving average ranged from 12.2 to 65.2 days each year. Fire Duration in 2012 was 16 days, and the five-year average for 2008–2012 was 48.6 days. These values are within the range of variability. However, there is an increasing trend in the five-year average for Fire Duration; the two highest five-year averages were 2005–2009 and 2007–2011 (DOI 2012, Weddle unpublished data 2012b). * Prior to 1982, natural wildfires were regularly suppressed and the fire extent for the years prior to 1982 may not reflect accurately the natural growth of wildfires. To remove this bias, these years have been excluded from these analyses.
	High Fire Potential - number of days the duff moisture code (DMC) is above 80 (very dry)		During 1994–2010, at Lake Minchumina weather station, High Fire Potential averaged 8 days (the range was 0 to 26). During 2008–2012, the High Fire Potential average was 7.8 days (the range was 4 to 12) (AICC 2012, Weddle unpublished data 2012a).

Wildlife Habitat and Ecosystem Function: Terrestrial (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Fire Regime (continued)	Fire Potential Seasonality (dates and number of days from when the DMC stays above 20 to when the DMC drops and remains below 20 (within the recorded records) (the range of natural variability is defined as that during 1994–2010)		Since 1998, with few exceptions, the number of days of the fire season has increased. During 1994–2010, the earliest date recorded for the DMC to reach or exceed 20 was April 25, while the latest recorded date above 20 was October 31. During 1994–2010, the fire potential season length varied from 61 to 156 days. In 2012, the season ran from May 9 to August 25, for a total of 108 days, within the normal range. During 2008–2012, the average season length was 145.2 days, which was higher than the range (99 to 142) of five-year averages during 1994–2010 (AICC 2012, Weddle unpublished data 2012a).

Wildlife Populations

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Caribou	Population size, demography, and distribution		The Denali Caribou Herd numbers about 2,300 caribou (spring 2012 estimate) and slowly has been increasing by about 2 percent per year over the last decade. The herd is the largest it has been since suffering a major decline during 1989–1993 as a result of repeated severe winters (Adams 2012). Adams has been studying the herd since 1984, focusing on a cohort of females (to determine long-term trends in cow caribou survival and productivity) and a cohort of males (to determine survival and growth of bulls).
Dall's Sheep	Population size, demography, and distribution		Dall's sheep abundance was 2,232 in 2011, as estimated from distance sampling surveys conducted in July (Schmidt and Rattenbury 2013). Historical aerial survey data have been lacking, but the 2011 estimates were similar to those based on counts in the 1980s (Singer et al. 1981, Van Horn and Dalle-Molle 1984, Taylor et al. 1988). Based on ground composition surveys, the number of lambs per 100 ewe-like sheep was lower in 2012 (10.9) than in any year since 1993, when the productivity estimate was 6 lambs per 100 ewes. Five-year productivity estimates for 2008–2011 range from 29 to 40, with an average of 34 lambs per 100 ewe-like sheep.
Moose	Population size, demography, and distribution		In the survey area (north of the Alaska Range), the number of moose was estimated to be 1,477 in 2011, slightly higher than estimates in 2008 (1,279) and in 2004 (1,104) (Owen and Meier 2012). Density was slightly higher in 2011 (0.15 moose / km^2) compared to 2008 (0.14 moose/km^2). The calf:cow ratio was 29:100 in 2011 and 24:100 in 2008. The percentage of cows with one calf or two calves was 21% and 4% in 2011, and 22% and 1% in 2008.
Wolves	Population size, demography, and distribution		Wolf densities have decreased from a local high of 8.3 wolves/1000 km^2 in the fall of 2007 to a 25-year low of 3.6 wolves/1000 km^2 in the fall of 2012 (Borg and Burch 2014). Wolf abundance, distribution, and demographics have been monitored since 1986 (Mech et al. 1998).
Grizzly Bears	Population size, demography, and distribution		Based on annual data about bear mortality and cub production from 1991–2005, the population size was estimated to be relatively stable at approximately 300 (Owen and Mace 2007). There are no known indications that the demographics have changed.

Wildlife Populations (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Small Mammals	Number, distribution, density, and relative abundance		Surveys to estimate population sizes and distribution of small mammals (mostly voles) have been conducted annually in the Rock Creek watershed since 1992. These surveys provide a long-term data set for this watershed. Because small mammals do not move great distances, these estimates represent local numbers and do not necessarily provide measures of park-wide small-mammal populations. The numbers of small mammals detected on the plots were highest in 2005 and 2008, and few were detected during the dry years of 2010 and 2012. In 2012, the two most-common vole species captured in Rock Creek were Northern Red-backed Vole (on all four plots) and Tundra Vole (only on riparian plots); there were no Singing Voles captured. The trend for voles seems to be relatively stable in the long term (Flamme and MacCluskie 2012).
Passerines	Abundance, distribution, and trends of the 12 most common passerine (songbird) species		From the mid-1990s to 2009, there was no change in the abundance of 10 species of common songbirds, but an annual decline (-4.3 percent per year) for Wilson's Warbler and an annual increase (+6.4 percent per year) for Fox Sparrow (Schmidt et al. 2013).
Golden Eagles	Occupancy of nesting territories and reproductive success (egg laying, nest success, and fledgling production)		Park biologists have monitored Golden Eagle territory occupancy and reproductive success since 1987. During 1988–2010, there was a slight increase in the probability of territory occupancy, and negative trends in all measures of reproductive success, including a 25 percent decline in rates of egg-laying and fledgling production. During 2008–2012, the rate of egg-laying continued to decline and included some of the lowest rates since the start of the study (McIntyre and Schmidt 2012).
Trumpeter Swans	Abundance and distribution		The abundance and distribution of Trumpeter Swans have been monitored cooperatively with the U.S. Fish and Wildlife Service every five years since 1975. The abundance of Trumpeter Swans has increased and their distribution has expanded in Denali and Alaska since 1975, including expansion into higher elevation ponds and lakes. The rate of growth of numbers of Trumpeter Swans in Denali has slowed since 2005 (Groves 2012).

Wildlife Populations (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Fish	Salmon escapement		Few data are available, but it is reasonable to expect that the number of fish returning to spawn is within the natural range of variability and has not decreased since 2007.
	Species richness and distribution of resident fish		Few data are available (Simmons 2009, 2010, 2011, 2013, but it is reasonable to expect that the species richness and distribution of resident fish are within the natural range of variability and have not changed since data were last collected: 1981 for the road corridor (Miller 1981) and 2004 for the western/northwestern area (Markis et al. 2004).
	Fish movements		Culvert replacements along the park road presumably are removing any obstacles to fish movement; however, data on fish response are very sparse.
Wood Frogs	Chytrid infection		Chytrid infection of amphibian populations was not detected in Interior Alaska in Denali (likewise no infection in Tetlin or Innoko National Wildlife Refuges) during an assessment conducted in 2006–2008 (Chestnut et al. 2008). However, recent assessments have detected chytrid in amphibians north and south of the park (Chestnut et al., *in prep.*). Low counts of chytrid spores were detected in water samples collected in Denali in 2009 (Chestnut pers. comm.). Climate warming may increase the occurrence of chytridiomycosis (Bosch et al. 2007).
Bear-Human Interactions	Number of interactions reported annually in the Bear-Human Information Management System (BHIMS)		In the last five years, the total number of bear-human interactions has ranged from 47 to 98, with an average of 78 (King and Colligan 2012). This five-year average is lower—about 50 percent lower—than the 10-year average. It is difficult to determine if there have been fewer interactions, or a drop in reporting of interactions. A bear-mauling fatality in 2012 was the first in the history for the park. Bear-human incidents have been variable but stable.
Interactions of Humans with Wolves and Other Wildlife	Number of interactions reported on the Wolf Encounter Form (WEF); reports about other wildlife including Golden Eagles		In the past five years, wolf-human interactions ranged from 4 (2012) to 15 (2008), for a 5-year average of 14, with fewer interactions in more recent years (King and Colligan 2012). The number of interactions between humans and other species of wildlife (including wildlife damage to property and wildlife obtaining human food) has been collected only anecdotally. For Golden Eagles, there is apparently no negative effect of recreational hiking on the occupancy of nesting territories or reproductive success (Martin et al. 2011).

Wildlife Populations (continued)

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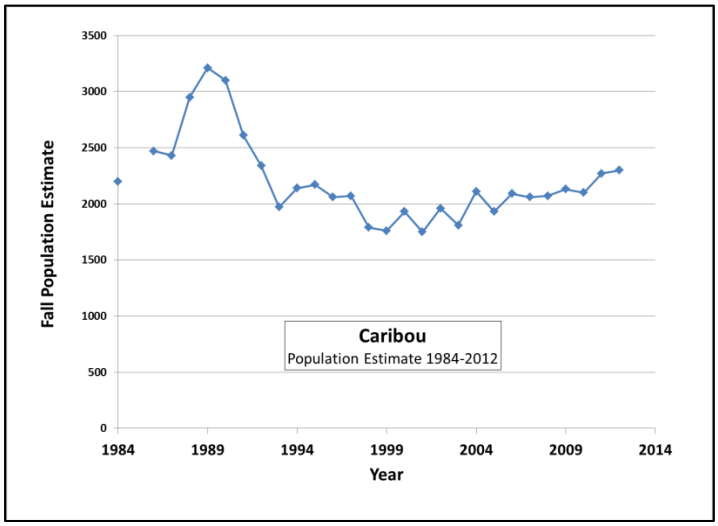
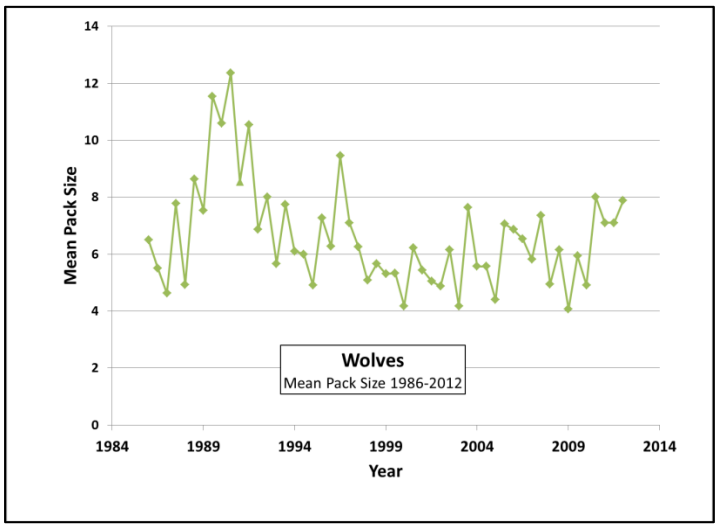
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Sheep Gap Spacing	The Vehicle Management Plan requires a 10-minute break (pause) in vehicular traffic every hour at sheep crossings.* Averaged over five years, this goal must be met at least 95 percent of the time, and in any one year, this goal must be met at least 90 percent of the time.		During the 2011 and 2012 seasons, for observations at known sheep crossings, a 10-minute gap in traffic was achieved 87 percent of the time (McKenny et al. 2013). Maintaining sheep gaps was a greater problem during peak season, although there were some issues with maintaining sheep gaps during early and late seasons as well. Mile 68.5 was the only location where the standard was achieved consistently. *Dall's sheep cross the road at these Mileposts: 21.6, 37.6, 52.8, and 68.5.

Resource Brief: Monitoring Predator and Prey

Biologists have monitored wolf and caribou populations in Denali since the mid-1980s. Denali's intact ecosystems and relatively unmanipulated predator-prey systems serve as a reference for managed systems elsewhere. The graphs at right show the fall population estimates for the Denali Caribou Herd (1984–2012) and the mean pack size for wolves in spring and fall (1986–2012).

A wolf with caribou prey





***Top*: Caribou fall population estimate; *Bottom*: Mean pack size of wolves**

Scientific Research

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Enhancing Denali as a Living Laboratory for Research	Number of researchers with permits		In 2012, 23 new projects were issued Research and Collecting Permits (compared to 22 in 2011 and 11 in 2010). Including these 23 projects, the total number of research projects with active Research and Collecting Permits in 2012 was 66. From 2008–2012, 40 graduate students received research fellowships totaling $162,859.
	Satisfaction of researchers with research experience		Researchers working in Denali during 2004–2008 completed a survey to gauge their satisfaction with their research experience (Tyrrell 2010). Researchers were especially pleased with customer service and park housing. One of the researcher suggestions resulted in a new handout to make researchers aware of logistical options. A future survey is needed for confirmation of trend.
Using Research to Make Management Decisions	Satisfaction of park management team with research for decision-making and adaptive management		The Denali Leadership Team has used research information about wolves, Toklat River geomorphology, and the slump at Milepost 45 for evaluating management options. Other projects that gather data useful to park managers include: (1) monitoring the effects of the dust palliative calcium chloride, applied to the park road, in water runoff near and away from the park road and (2) documenting the recovery of vegetation in areas damaged by Off-Road Vehicle (ORV) routes after specific ORV trails were established.

2.2. Cultural Resources

Archeological Resources

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Prehistoric Resources	Knowledge: Percentage of known prehistoric sites with known date ranges associated with a research theme		In 2008, 4 out of the 109 known prehistoric sites (4 percent) had known date ranges associated with research themes. By 2012, 24 more sites had been identified, but none of these has known date ranges associated with research themes, reducing the percentage of sites with known date ranges to 3 percent (ASMIS 2012).
	Inventory: Percentage of park adequately surveyed for prehistoric resources		Based on GIS calculations of acres surveyed in the park from 1960 to the present, less than one percent (0.8%) of the park has been surveyed for archeological resources. In 2008 there was a cultural resource inventory program, which is no longer active. In recent years, most sites are discovered and recorded through Section 106 compliance (National Historic Preservation Act) for park projects. These surveys are a biased sample of the archeology site distribution in the park, as park projects are mainly located in modern use areas (e.g., the Entrance Area, along the Denali Park Road), which does not necessarily represent the distribution of historic or prehistoric use areas.
	Documentation: Percentage of known prehistoric sites with adequate National Register documentation		Of the known prehistoric and protohistoric sites, 90 percent do not have any National Register documentation (9 percent have been determined eligible, and 1 percent has been determined ineligible). One prehistoric site has been nominated to the National Register, and data recovery has been conducted at this site (ASMIS 2012, National Register database 2012).
	Condition: Percentage of known prehistoric archeological resources in good condition		Of the known prehistoric and protohistoric sites, 80 percent have had a condition assessment in the last 10 years. About 51 percent are in good condition (18 percent are in fair condition, 1 percent is in poor condition, 1 percent was destroyed, 11 percent have unknown conditions, and 5 percent were not able to be relocated during the assessments). The remaining 20 percent of the known prehistoric or protohistoric sites have not had a condition assessment in the last 20 years. The park does not have a condition assessment plan for archeological resources, and the assessed condition of many sites is believed to be inaccurate. Natural forces likely have impacted sites adversely. Fifteen percent of recorded sites have been disturbed and 28 percent are threatened or disturbed. One quarter of sites have no recorded threats or disturbances and 32 percent of all known sites have not been evaluated for threats or disturbances (ASMIS 2012).

Archeological Resources (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Historic Resources	Knowledge: Percentage of known historic sites with known date ranges associated with a research theme		Twelve percent (18 of 156 historic sites) are associated with a research theme (ASMIS 2012).
	Inventory: Percentage of park adequately surveyed for historic resources		Evaluation of impacts on cultural resources from a variety of projects (Section 106 compliance) has provided additional inventories of historic resources in recent years. The caution exists because only 0.8 percent of the park has been surveyed for archeological resources (includes historic) based on GIS calculations of acres surveyed (1960–present).
	Documentation: Percentage of known sites with adequate National Register documentations		Of the 156 known historic sites, 19 percent have been determined eligible, 10 percent have been nominated, and 11 percent have been determined not eligible, leaving 60 percent without any National Register documentation (ASMIS 2012, National Register database 2012).
	Condition: Percentage of known historic archeological resources in good condition		Of the156 known historic archeological resources, 55 percent are in good condition (29 percent fair, 11 percent poor, 1 percent destroyed, 1 percent inundated-uncertain, and 4 percent unknown). Forty-six percent of these known historic sites have not had a condition assessment in the last 10 years (ASMIS 2012). Thirty-two percent of the known sites have not been evaluated for threats and/or disturbances (ASMIS 2012).

Resource Brief: Bison, Caribou, and Sheep Associated with Occupations of Teklanika West

One important prehistoric archeological site in Denali is the Teklanika West site (HEA-0001). In 1965, Frederick West used this site and three others in Interior Alaska to define the Denali Complex (West 1967, West 1975). Because the artifacts found at these four sites were similar to those of the Dyuktai tradition of northeast Asia, West hypothesized that the Denali Complex sites were the same age as the Dyuktai sites, or 12,000–10,000 years old.

Archeologists from the University of Alaska Fairbanks conducted a field school at the Teklanika West site in 2009 to reexamine the site and better determine its periods of occupation. Field participants recovered more than 1,500 artifacts and an assemblage of large and small mammal bones associated with them. Field evidence confirms that there have been multiple occupations at the site, with the oldest dating to 12,600 years ago, indicating that the upper Teklanika River valley was deglaciated by that time. Archeologists found a changing set of bones associated with the different occupations—bison bones associated with the earliest occupations, caribou bones with the middle occupation, and sheep bones with the components from about 1,350 years ago.

Archeologists working in the field

Cultural Anthropology

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research and studies exist to understand the relationship among the park's ethnographic resources and their use		Multiple studies have been carried out for the northwest section of the park (Johnson 1999, Gudgel-Holmes 1991, Gudgel-Holmes 1989, Gudgel-Holmes 1988, Gudgel-Holmes 1984a, Gudgel-Holmes 1984b, Gudgel-Holmes 1979, Gudgel-Holmes and Holmes 1989, Haynes et al. 2001, Schneider et al. 1984, Williams et al. 2005). Little work has been conducted in the rest of the park.
Documentation	Sufficient documentation exists on areas of importance for Tribes and on Traditional Cultural Places (TCP)		The only document (Andrews 1977) that exists regarding the importance of known cultural resources in the park identifies three park sites as important to tribes. There are no Traditional Cultural Places (TCPs) recorded in the park. As elders pass away, the knowledge of traditional important places in the park will diminish.

Cultural Landscapes

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research exists to understand the relationship of the park cultural landscapes to the park's historic contexts		There are five Cultural Landscape Inventories (CLIs) that have been completed. Eight CLIs are incomplete and three additional CLIs have been identified, but not initiated. Denali's landscapes (aside from the mining ones) have not been well defined (NPS 2008, NPS CLI 2013, Curran 2004, Ferreira 2009, Ferreira and Mikesh 2007, Ferreira and Mikesh 2008a and 2008b).
Inventory	The scope of cultural landscapes in the park is understood		Denali has five completed CLIs (NPS CLI 2013). The potential for additional cultural landscapes is great in a park of this size.
	Percentage of landscapes in the Cultural Landscape Inventory that have been evaluated for eligibility for the National Register		Of the 13 known landscapes in the CLI database, only five (38 percent) have been evaluated—and determined eligible—for nomination to the National Register.
Documentation	Percentage of cultural landscapes with adequate National Register documentation		The Headquarters Historic District cultural landscape has adequate National Register documentation (Brown et al. 2008). Many of the sites in the Kantishna/Wonder Lake Area cultural landscape have not had their National Register status evaluated (Layton 2012).

Historic Structures

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Percentage of historic structures evaluated using appropriate historical contexts		One hundred percent of the 136 historic structures have been evaluated (LCS 2012).
Documentation	Percentage of historic structures with adequate National Register documentation Adequate documentation includes the following designations: nominated, determined eligible, determined ineligible, recommended eligible, or recommended ineligible		Documentation in the form of Historic Structure Reports has been published for 15 of Denali's 136 historic structures (11 percent). Twenty-five percent of Denali's historic structures have no National Register documentation (ASMIS 2012).
Condition	Percentage of historic structures in good condition		Of Denali's 136 historic structures in the database, from 2008–2012, the number of historic structures in good condition increased from 54 (40 percent) to 57 (42 percent) (LCS 2012).
	Overall condition of historic structures is stable or improving		While the percentage of Denali's 136 historic structures in good condition increased during 2008–2012, the percentage of structures in poor condition increased from 53 (39 percent) in 2008 to 59 (43 percent) in 2012 (LCS 2012). The park does not have a historic structures management plan, and the condition of historic structures will continue to degrade due to benign neglect.

History

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research is conducted to understand significance of sites		Researchers have investigated the pre-World War II era of the park, but little work has been done in the later historic period. No research has been conducted on the history of mountaineering in the park, and many other historic themes for the park have not been researched. At the end of 2012, the position of park historian was vacant, so until this position is filled, there is no person to conduct or facilitate historical research.
	Sufficient research is conducted to establish the reasons for park creation and site history		A two-volume Administrative History of the Park has been published (Norris 2006a, Norris 2006b). The park has a Historic Resource Study (Brown 1991), but it is not current and needs to be updated.
	Research at the appropriate level precedes planning decisions involving cultural resources		Typically, research has not been carried out for planning decisions involving cultural resources; however, cultural resource staff is becoming more involved in the planning process.
Inventory	Percentage of cultural resources listed in appropriate Service-wide inventories, including the National Register		Only 24 percent of sites have been evaluated for the National Register.
Documentation	Percentage of historic properties with adequate National Register documentation or with Determinations of Eligibility (DOEs)		Only 26 percent of the park's 297 sites have been evaluated for the National Register or have had DOEs completed on them (ASMIS 2012). These evaluations are not being actively accomplished. DOEs are only good for 10 years.

Museum Collections

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Inventory	The Scope of Collection Statement for the park is clear and understood, and the museum collection and use of the collection reflect this guidance		According to the five-year Scope of Collection Statement (2009), the museum collection should be relevant to the park in what is accessioned and in access to the collections. The 2005 Museum Management Plan (MMP) suggested that a team review the appropriateness of certain collections in the museum. Such a team has not yet been formed and the collections have not been reviewed. Based on a 2002 survey of park staff, the MMP suggested improved access to museum collections. Park staff began digitizing the museum collections (e.g., in 2012, staff scanned about 1,000 Adolph Murie slides and photographed covers of rare books and dozens of historic objects and stone tools).
	Percentage of objects accessioned and catalogued		From 2008–2012, the total number of items that were accessioned was 132,654 (compared to 17,050 in 2004–2007). During 2008–2012, 42,549 items were catalogued (compared to 40,149 in 2004–2007). Of the total 372,353 items that are accessioned, only 52 percent are catalogued to current NPS standards. There are objects and archives to be processed in the museum collections vault, as part of a museum management backlog. There is a need to ensure that research-related documents (researchers' field notes, reports, and publications) are included in the museum archives, and that their collected specimens are accessioned promptly in the museum.
Documentation	Paperwork is current for short-term and long-term loans of museum objects and archives		Paperwork is expired or non-existent for many loans.
Needs Assessment	Needs for the museum collections are assessed in a timely way and included in budgets for projects and personnel		Strategy L in the Resource Stewardship Strategy, "Preserve the museum collection and rehabilitate and preserve park historic structures," includes the following broad projects: Improving Collection Standards, Digitizing the Museum Collection, Addressing Catalog Backlog, and Creating of Finding Aids for Archival Collections. A museum curator position was created and filled, and seasonal, SCA, and STEP employees were hired. Several projects to improve the museum collections were funded.

Museum Collections (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Needs Assessment (continued)	Plans for museum management (museum management plan, scope of collections, archival processing plan, collections storage plan, and integrated pest management plan, housekeeping plan, and emergency operations plan) are regularly reviewed, updated, approved, and implemented		In the last five years, the following plans were created through contracts: • Scope of Collection Statement (2009)—revised to reflect the purpose of collecting, the uses of the collection, restrictions, management actions, and what constitutes the cultural resources and natural history parts of the collection • Collection Storage Plan (2008) • Museum Collections Emergency Operations Plan (2010) [emergency contacts and phone numbers need to be updated regularly] • Integrated Pest Management Plan (2008)
Condition	Overall condition of the museum collections is good, and storage facility standards are met		Humidifiers were fitted with the correct filters. In annual reporting about NPS museum standards, Denali's collection facility met the standards by these percentages by year: 85.5 in 2008, 81.6 in 2009, 90.8 in 2010, 2011, and 2012. Some deficiencies cannot be remedied easily (e.g., the storage vault could flood due to the presence of a water pipe that services the steam humidifier and there is no drain in the collections vault), while others could be (e.g., replacement of the type of floor paint that is flaking and causing dust). There is a lack of sufficient space to effectively manage the collection (only space for three to five years of collections growth), there are problems associated with south-facing windows (need UV shades to reduce heat gain), and there is exposure of the rare book cabinet to window heat.

Resource Brief: Museum Collections – Special Stories from the Park

As of August 2012, the museum collection includes 372,353 items. The museum collection includes four collections of special significance because they relate to the life and scientific studies of Adolph Murie. The first is the Adolph Murie Collection comprising his camera, lens, camera case, film samples, and 1,020 slides. His photography in Mount McKinley National Park (the park name at the time) includes shots of wildflowers, other flora, fauna (see fox slide below, DENA 32289.277), and scenery. The second collection is five binders of his personal herbarium specimens. The third collection is illustrations of eight herbarium sheets by the Muries' daughter, Gayle, such as *Potentilla uniflora* (see illustration at right, DENA 32280). The final collection is Louise "Weezy" Murie-McLeod's *Wildflowers of Denali* manuscript that she completed in partnership with Adolph and his photos. Publication of this work is pending.

By 2012, all these collections were accessioned and catalogued. The slides were scanned and used to create three *finding aids*. Finding aids are like a table of contents to an archival collection—they are tools for NPS staff and outside researchers to use to locate the files and documents they need.

Photo of fox by Adolph Murie

One finding aid for the slides includes the 191 images that correspond with the flower manuscript. Two additional finding aids cover flora and fauna and general scenery of Denali and other locations.

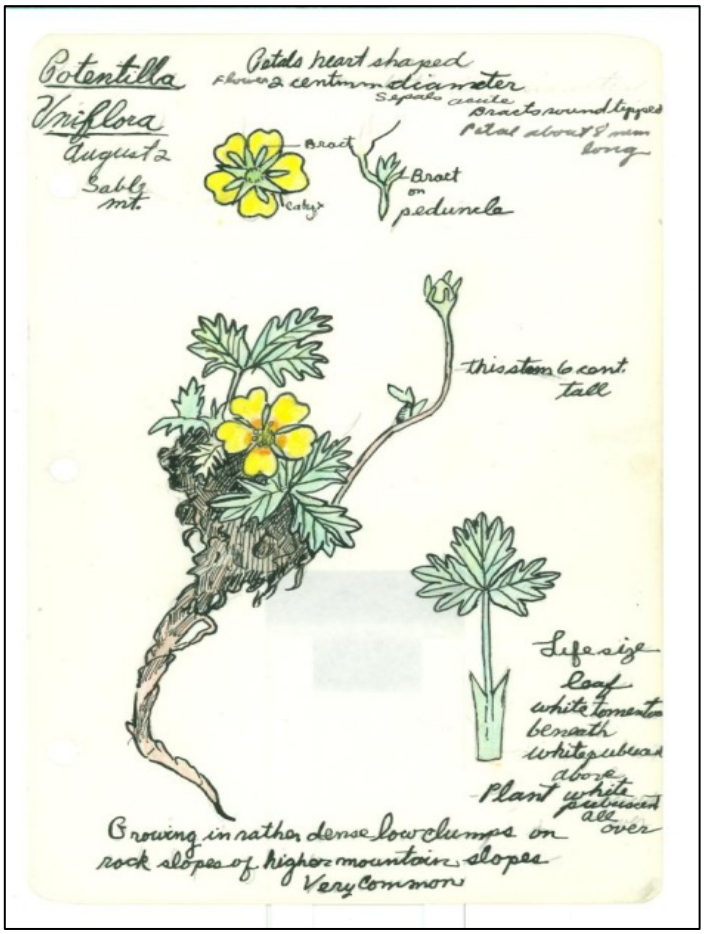


Illustration of *Potentilla uniflora* by Gayle Murie, daughter of scientist Adolph Murie

2.3. Visitor Experience

Visitor Numbers and Visitor Satisfaction

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Number of Visitors	Number of visitors per year		Over the last five years, visitors to the park numbered 413,097 (2012), 406,580 (2011), 377,686 (2010), 358,040 (2009), and 432,309 (2008). During 2008–2012, the 5-year average number of visitors was 397,542. During 2003–2012, the 10-year average number of visitors was 403,474. Source: NPS Stats
Visitor Satisfaction	Percent of visitors who were satisfied with their visit		Based on the standard visitor satisfaction survey conducted each year, the percentage of visitors satisfied in FY12 was 97.0 percent, which is slightly lower than the average for the previous five years (97.8 percent), but higher than the average for the previous ten years (95.9 percent) and higher than in FY11 (96.0 percent). Source: 2012 Visitor Survey Card Data Report

Interpretive and Education Programs – Talks, Tours, and Special Events

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Ranger Programs	Number and quality of programs and attendance		Ranger programs are dependent on seasonal rangers, and the number of seasonal rangers hired is subject to fluctuations in budget. Thus, the number of programs offered each year fluctuates. Also, several seasonal rangers are funded with soft money. The quality of training and mentoring for these seasonals has improved, but it is an investment in a resource that is always slipping away as seasonal workers move on to other jobs. Since 2006 the number of seasonal rangers and programs has increased. For most programs, attendance per program has risen somewhat since 2008. (Fluctuations in program attendance are at least partially influenced by fluctuations in park visitation). Source: Servicewide Interpretive Report
NPS Education Programs	Number and quality of programs run by NPS, and number of participants		Education programs provided by NPS staff include science lessons offered via Skype and in-school and in-park programs for local and visiting youth. The education team greatly expanded its distance learning offerings in 2012, reaching almost 1,000 students in 13 states. The park's two education specialists hold term positions funded with soft money, rather than permanent positions.

Interpretive and Education Programs – Talks, Tours, and Special Events (continued)

web ▸

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Partnership Education Programs	Number and quality of programs run collaboratively with park partners		The Murie Science and Learning Center partners with numerous organizations to expand education offerings. The MSLC partners to co-run youth camps, co-create interpretive displays, and share training opportunities with non-profits and universities. The quality and strength of these partnerships have remained strong over the last five years.
Junior Ranger Programs	Number of programs and attendance		The park provides Junior Ranger booklets and badges, as well as Discovery Packs (backpacks full of educational materials for loan to families) at numerous visitor centers and contact stations in the park. These programs remain popular. Source: Servicewide Interpretive Report
Special Events	Variety and longevity of events, community involvement		The park hosts Winterfest and Earth Day annually, and usually hosts another major event each year (e.g., commemoration, anniversary, symposium). In 2012, the park hosted the first Denali Music Festival and celebrated the coin launch of the Denali quarter.

Resource Brief: Distance Learning

Because it is difficult, if not impossible, for many teachers and students to come to the park, Denali has created new free, interactive, distance learning programs to help classes learn about this special place and to enhance existing curricula.

In December 2012, Denali education rangers teleported themselves via Skype into third through sixth grade classrooms across the United States to present fun, standards-based science lessons on Sled Dog Adaptations and The Geology of Mount McKinley. Over four weeks, two rangers Skyped with 1,139 students in 13 states. Feedback from teachers and students has been overwhelmingly positive. Based on these successes, Denali plans to offer distance learning programs from November through January on an annual basis. Over time the distance learning program will benefit from technological upgrades and the creation of a dedicated space where the large backlit projector screen and other AV equipment can remain assembled for weeks at a time.

Ranger Rachel from Denali Skypes to third grade students in Aurora, Nebraska, sharing with them the mission of the NPS before beginning a program about sled dog adaptations. Photo credit: Barrett Stinson at theindependent.com

Science-based Education

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Connecting Visitors to Park Science	Opportunities for citizen science		The Murie Science and Learning Center engages local youth in park science through ongoing winter monitoring of lake ice and snow on Horseshoe Lake. The MSLC also offers several field classes that allow "citizens" to assist with collection of field data about where a glacier terminus is (glacier monitoring), and with documenting changes in the landscape (repeat photography).
	Opportunities for connecting to park science at Murie Science and Learning Center (talks, programs, displays)		For more than five years, the MSLC has provided visitors with in-depth science experiences during lecture series, field seminars, teacher trainings, partner-run education programs for tour groups, and visitor displays. Two new digital science exhibits and numerous new one-day field seminars were added to the science offerings in 2012.
	Connecting to park science through print and web media		In the last five years, 50 new fact sheets were created for Denali; 15 fact sheets were created for several other MSLC parks; and web upgrades were initiated for several Nature and Science pages including the page about Natural Features. A "Science Friday" posting on Facebook was initiated at the end of 2012.
Bridging Research and Education	Number of projects benefitting from resources and education staff collaboration		Collaborative projects in 2012 included the Researcher-in-Residence program, Discovery Camp, the GeoCorps volunteer program, research fellowship programs, judging science fairs at Tri-Valley School in Healy, and development of MSLC programs.

Interpretive Media – Brochures, Exhibits, Signs, and Website

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Wayside Signs	Condition and currency of signs		Many of the park's waysides were created and installed, or replaced, since 2004. Information (including maps) is valid. However, changes in park infrastructure and bus services will render some information obsolete. Extreme cold temperatures, sun, and vandalism shorten the life expectancy of signs. All waysides are entered into the FMSS database.
Park Directional Signs	Usefulness, quantity, and placement		Park directional signs are current and in good physical condition. Based on the 2011 Visitor Services Project, 93 percent of visitors are satisfied with park signage (Manni et al. 2012). Some survey respondents requested improved signage on trails and the loading location for tour buses.
Exhibits	Condition and currency of exhibits at Denali Visitor Center (DVC) and Eielson Visitor Center (EVC)		Most displays at the Denali Visitor Center (2005) and the Eielson Visitor Center (2008) are relatively new and up-to-date. They regularly are serviced and maintained. Exhibits at Eielson are vulnerable to water damage with roof leakage. The earthquake exhibit at Eielson is in need of updating.
	Condition and currency of exhibits at the (non-NPS) Talkeetna Museum		Though the physical condition of the Talkeetna Museum exhibits recently has been upgraded, the exhibits are in need of an overhaul to provide a clearer focus and coherent thematic messages for the displays.
	Condition and currency of Murie Science and Learning Center science exhibits		The MSLC features displays with information on current park science. There were challenges in maintaining five digital displays in "museum mode," and steps were taken to improve their functionality in 2012. The physical displays need to be updated for enhanced experiential learning.
Print Media	Accuracy and availability of primary park publications		The park map/brochure was redesigned and updated in 2012. Small changes are made with each annual printing. The Alpenglow visitor guide (summer and winter) is revised each season.
Audio-visual Media	Condition and currency of orientation films		Films shown at the park are: a general park film (DVC and MSLC in winter), a mountaineering film (Talkeetna Ranger Station and EVC), and a film about the history of the park road (Wilderness Access Center). These films were developed in the past decade and are in good condition. All facilities offer viewing with assisted listening devices. All films feature open captions and audio description.
	Condition and currency of other AV material		Short videos and audio pieces (available at the DVC and EVC) are in good condition. Three popular webcams ("Puppy Cam" and Mount McKinley—both summer only, and Alaska Railroad Depot at Denali) are in good working condition.

Interpretive Media – Brochures, Exhibits, Signs, and Website (continued)

web ▸

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Websites	Currency and scope of website; number of website visitors		A motivated web team continues to develop the breadth and depth of the Denali website. Challenges to the website include having no dedicated web coordinator, keeping information current, and keeping abreast of technical changes and new areas in the Content Management System, such as the introduction of the Education Portal.
	Social media: Facebook updates and "likes," overall activity		The number of Denali Facebook followers continues to grow steadily. Members of the social media team post regularly, actively monitor posts to respond to questions and comments, and continue to explore innovative new ways to engage followers, such as using quizzes. The team also posts regularly to Twitter, YouTube, and Flickr.

Resource Brief: Media Offerings – Web, Social Media, and Digital Products

Denali uses a robust online presence, social media, and emerging digital products to help visitors connect with a place they may never have an opportunity to experience otherwise. Beginning in 2007, a video podcast series in iTunes has provided short documentaries about park features and issues (now at 17 offerings). In 2009, the park was a "beta-tester" with Twitter, and its audience has since grown to more than 8,000 followers. Several blogs emerged on the park website on topics ranging from the historic park kennels and the Artist-in-Residence program to what it is like to walk the entire length of the 92-mile Denali Park Road in summer. The kennels blog has since evolved to include a popular video series, "Puppy Paws." In late 2010, Denali launched sites on Flickr, YouTube, and Facebook. To keep its collective voice fresh and diverse, the park actively recruits and encourages social media contributors from all park divisions. With more than 18,000 Facebook followers by the end of 2012, the audience at facebook.com/DenaliNPS seems to be growing at about 1,000 new followers every month.

An online multimedia presentation

Several innovative Flash-interactive products became available on the park website, starting in 2011, on topics ranging from soundscape recordings and changing vegetation patterns to resources about Discovery Hikes and transportation choices for tour and shuttle buses. Trail guides and interactive maps were a concentrated effort for more than three years. Most recently, the park has enjoyed remarkable success with several non-narrative, experience-based products: three webcams, including a popular "Puppy Cam;" a time-lapse video of Northern Lights set to music that went viral on YouTube; and an array of 29 interactive stitched-image panoramas—of remote park locations—that users can pan and zoom through.

Science and research information available on Denali's website

Plans are underway to produce several new 30-second videos with park scientists and launch a resurgence of short documentary offerings on iTunes and YouTube. In addition media specialists plan two opportunities for visitors to share their own park stories (1) through audio recordings on "Your Denali Story," and (2) a new video series, "You Tell Us," that asks visitors to answer questions crafted from the park's interpretive theme matrix.

Park Community: Volunteers and Partnerships

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Volunteers	Number and hours contributed		The number of volunteers in Denali has almost doubled in the last five years, from 263 in 2008 to 504 in 2012. During the same timeframe, the number of hours worked by volunteers also has increased from 40,000 to 58,000. There is significant interest in the volunteer opportunities available in Denali including trail crew, mountaineering safety ranger, campground host, invasive plant removal, and kennels assistant.
Partnerships	Number of official and unofficial partnerships		Through the MSLC, Denali officially partners with numerous organizations including Alaska Geographic, Doyon-Aramark, Denali Education Center, University of Alaska, and Upper Susitna Soil and Water Conservation District. The MSLC also seeks to serve Alaska's seven other northern parks, but has little capacity to do so due to lack of funding. Other park partners include Alaska Department of Fish & Game, Alaska Department of Environmental Conservation, Denali State Park, U. S. Geological Survey, U. S. Fish & Wildlife, Federal Highway Commission, Denali Borough School District, Denali Borough, Denali Arts & Humanities Alliance, Denali Subsistence Resource Commission, Student Conservation Association, Geological Society of America, and researchers from many universities.
Civic Engagement	Number of and engagement by local stakeholders		The park continues outreach with stakeholders for park planning (e.g., Vehicle Management Plan) and the Subsistence Resource Commission.
Inholders	Park engagement with land owners with inholdings inside the park		Examples of engagement with land owners with inholdings inside the park include using the Regional Inholders Access guide to achieve a consistent approach to providing access to inholdings, supporting legislation which will permit the use of microhydro to provide "green" energy for use at Kantishna Roadhouse and Camp Denali, permitting access to water (Skyline Lodge), and working with new management (Denali Backcountry Lodge). There is considerable concern regarding inholder vehicle traffic on the park road, especially the number and behavior of day tours/trips, and the inability of the park to set management controls on this traffic in order to meet the standards set in the new Vehicle Management Plan.

Recreational Opportunities

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Visitor Transportation System (VTS)	Visitor satisfaction with shuttle buses		In a 2011 Visitor Services Project (VSP) (Manni et al. 2012), 88 percent of 275 respondents rated the Visitor Transportation System into the park as very good (59 percent) or good (29 percent). The Vehicle Management Plan (VMP) prioritizes visitor access to, and satisfaction with, the shuttle bus system.
	Visitor satisfaction with tour buses		In 2011, 90 percent of visitor groups rated the Tundra Wilderness Tour as very good (71 percent) or good (19 percent), and 79 percent rated the Denali Natural History Tour as very good (55 percent) or good (24 percent) (Manni et al. 2012). Currently, visitor comments reflect a need to adjust the length and destination of the tour product. The VMP provides the flexibility to adjust tour products to meet visitor interests and needs.
	Vehicle spacing for wildlife stops, rest stops, and scenic vistas		During 2012, the number of vehicles at a wildlife stop was within the standards established by the VMP for Subzones 1 and 2, but not for Subzone 3 (Eielson Visitor Center to Wonder Lake). The number of buses and vehicles parked at one time at the Toklat and Teklanika Rest Stops and the Eielson Visitor Center was within standards. The number of vehicles visible in each of the four viewscapes at any one time was within standards in 2012 (McKenny et al. 2013).
Backcountry Use	Hiker wait time for a bus on park road		There are no monitoring results yet to confirm whether the VMP standard for hiker wait times is being met.
	Number of backcountry permits issued		The Backcountry Management Plan (BMP) set quotas for backpackers in each backcountry unit. A review of these quotas is needed to ensure the limit is based on current resource conditions and visitor experience expectations.
	Backcountry access		Park policy and regulations allow for a wide spectrum of visitor access to the backcountry.
Trail Use	Encounter rates with other hikers on wilderness trails		Based on a survey in 2012, the majority of visitors on the popular Triple Lakes Trail likely encounter 10 parties or fewer (within the standard); however, through-hiking parties may encounter more than 10 on a busy day (NPS unpublished data). No data are available for other trails in designated wilderness.

Recreational Opportunities (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Trail Use (continued)	Visitor satisfaction with the variety, quantity, and quality of trails		The amended GMP identifies the number and quality of trails that will be available to visitors. The degree of visitor satisfaction with these trails is determined from visitor survey results and the number of complaints received. In the Visitor Services Project (2011), only 8 percent of those surveyed indicated dissatisfaction with the existing trail network in Denali (wanted more, longer, or more difficult trails). Of the 9% who had a physical condition that made it difficult to access or participate in park activities or services, 84 percent mentioned difficulty accessing trails (Manni et al. 2012).
Wildlife Viewing	Average number of grizzly bear sightings per year; probability of seeing one or more bears on a trip to Eielson or further west		The average number of grizzly bear sightings (one or more bears per sighting) per trip showed a slight decrease during 1995–2009, but the decrease was not significant (Philips et al. 2012). The average probability of viewing bears from 2010–2012 (0.837) was not significantly different than during 1997–2009 (0.835). The park currently is gathering a robust dataset that establishes a baseline for what constitutes "good" viewability.
	Average number of wolf sightings per year; probability of seeing one or more wolves on a trip to Eielson or farther west		The average number of sightings of wolves per trip (one or more wolves per sighting) showed a slight increase from 1995 to 2009 (Philips et al. 2012). The probability of sighting wolves from 2010–2012 was not significantly different from that during 1997–2009. However there was a significant decrease in the probability of sighting wolves from 2010 to 2012 (from 0.45 to 0.12).
	Overall wildlife viewability; probability of seeing one or more of a given species on a trip to Eielson or farther west		Wildlife populations are healthy and viewability of wildlife has been consistent over a five-year period—aside from some species-specific cycles. Park staff currently is gathering a robust dataset that establishes a baseline for what constitutes "good" viewability. Concern exists that wildlife viewability may decline as shrub growth increases along the park road in association with climate change.
Mountain Use	Quality of mountaineering experience on McKinley and Foraker		Policies exist that specify how human wastes are disposed, and that limit the number of guided groups on the mountain at a time, the ratio of independent to guided climbers, and the number and noise of airplane overflights. These policies were created in response to feedback provided by climbers.
	Number of mountaineers attempting McKinley and Foraker per year		Denali is meeting the demand for climbing opportunities without degrading the resource, as indicated by no qualifying climbers being refused permits, and resource conditions being monitored and improved. A limit of 1,500 permits currently is in place.

Accessibility

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Mobility	Architectural Barriers Act (ABA) compliance		The 2011 Visitor Services Project (Manni 2012) reported that 9 percent of visitor groups had members with physical conditions affecting their ability to access or participate in activities and services. Of those, fewer than 10 percent reported any difficulty in accessing campgrounds, programs, visitor centers, food service, or information desk, and 16 percent had difficulty accessing or participating in bus tours, including park road rest areas. While 84 percent reported having difficulty accessing trails, in the last five years, the trails crew has constructed several new accessible trails (see list in Trails portion of Park Infrastructure reporting, page 45).
Visual Accommodation	ADA compliance		The various park films and displays at the DVC offer audio description. The park brochure is available in Braille. Few displays can be touched by the sight-impaired or offer a touchable version. Visitor centers do not have audio tours. Outdoor signage and trail guides do not have options for the visually impaired. The number of sight-impaired visitors is unknown.
Auditory Accommodation	ADA compliance		Assisted listening devices and audio descriptions are available for the various park films at the DVC, EVC, and Talkeetna. Despite efforts, hiring seasonal ASL certified interpreters is challenging as there are few available. By hiring outside entities, the park seeks to accommodate requests for ASL interpreters if made 48 hours in advance. The concessioner must provide ASL interpreters on tours upon request. Requests are rare. The number of visitors with hearing impairment is unknown.
Multi-lingual Resources	Audio, print and web materials in multiple languages		Many print materials (e.g., general information, safety information, permits) are available in multiple languages. Audio and website materials thus far are not multilingual.
	Bi-lingual staff		The park has hired seasonal interpretive staff fluent in ASL the past three years (2010–2012). Multi-lingual staff members have nametags indicating that they are language interpreters.

Safety

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Law Enforcement Incidents	Number of documented incidents		Most incidents that require law enforcement response relate to resource protection, general public safety, and vehicle traffic. Person-on-person crime is rare. In the last five years (2008–2012), the number of incidents recorded annually has remained 300–400.
Accidents or Injuries to Visitors	Number of reported incidents		Denali puts resources toward assuring park facilities and operations are safe for visitors. Significant education and orientation efforts also are taken to increase visitor awareness of the inherent hazards with the park environment, as well as how to mitigate those risks. From 2008 to 2012, the number of incidents reported annually (visitor accidents and injuries) has remained 19–24.
Accidents or Injuries to Park Staff	Number of recordable incidents		Since 2008, Denali has seen an overall decline in the number and severity of recordable and lost-time injuries. In 2012, there was only one lost-time injury compared to nine in 2010 and five in 2011. An active safety program and the introduction of the Operational Leadership program of risk management contribute to a culture of safety. A safety officer was on staff (again) beginning in 2011. The number of recordable incidents has remained relatively stable (7–9) in the last three years (2010–2012).

2.4. Park Infrastructure

Overall Facility Condition Index

web

The National Park Service uses a facility condition index (FCI) to indicate the condition of its facilities and infrastructure. FCI is the cost of repairing an asset, such as a building, road, trail, or water system, divided by the cost of replacing it. The lower the FCI number, the better the condition of the asset. The condition of the buildings and other infrastructure assets at each park is determined by regular facility inspections, or "condition assessments," including daily informal inspections and formal yearly inspections. Deficiencies identified from these assessments are documented in the NPS Facility Management Software System and the cost for each repair determined. Repairs that cannot be completed within the year count against the condition of a structure. The total cost of these deferred repairs divided by the total cost to replace the structure results in the FCI, with values between 0 and 1 (the lower the decimal number, the better the condition). The FCI is assigned a condition category of Good, Fair, Poor, or Serious based on industry and NPS standards. Deferred maintenance projects that require additional funding are identified based on FCI. Planned preventive maintenance on critical components occurs during the year, using a park's base budget. For additional information about how park managers use information about the condition of facilities and infrastructure to make decisions about the efficient use of funding for maintenance and restoration activities at the park, Click Here.

Asset Category	Number of Assets 2008 / 2012	FCI 2008 / 2012	Condition Status/Trend	Rationale
Buildings	285 / 320	0.077 / 0.033		In 2008 the new Eielson Visitor Center was completed. It is the first LEED Platinum (sustainable and energy efficient) NPS building in Alaska. A new emergency services building, also LEED certified, came on line in 2012. Over the past five years, 11 historic patrol cabins have been restored, 17 seasonal employee cabins have been replaced, 7 permanent and 3 seasonal employee houses have been rehabbed, numerous buildings have been repainted and had new roofs installed, and 5 maintenance facilities have been rehabbed. To improve the safety for employees and transient researchers, asbestos has been removed and egress windows have been installed in the five apartments of Building 51.
Campgrounds	6 / 6	0.181 / 0.034		Over the past five years, several projects have taken place at the six park campgrounds: rehabbing three comfort stations, 2 amphitheaters, 1 bus shelter, and 1 picnic pavilion. For visitor safety and satisfaction, 8 new food storage containers were installed along with 44 bear-proof waste containers, 25 picnic tables, 25 fire grates, and 38 vault toilets. At several campgrounds, staff completed upgrades to the water systems, which included new wells, tanks, and distribution lines.

Overall Facility Condition Index (continued)

web

Asset Category	Number of Assets 2008 / 2012	FCI 2008 / 2012	Condition Status/Trend	Rationale
Trails	43 / 54	0.186 / 0.255		Denali maintains 14 designated trails annually (often some type of new tread surface or drainage improvements). During the last five years, major funding and trails crew efforts were dedicated to the construction of the new four-mile Savage Alpine Trail (opening in 2013) and the completion of the 9.5-mile Triple Lakes Trail, which included the construction of a new suspension bridge over Riley Creek. The trails crew rebuilt the trail at Horseshoe Lake and constructed several new accessible trails (trails that access the dog kennels, a trail complex near Savage Campground/Mountain Vista, the eastern leg of Savage Alpine Trail, the northern mile of Triple Lakes Trail, and the 2-mile bike trail at the park entrance). Due to limited funding and the short summer work season, with the amount of wear the trails receive each year from use and erosion, it is difficult to keep the trails maintained to the highest standards.
Waste Water Systems	13 / 12	0.493 / 0.223		Over the past years, several projects have improved the condition of the waste water systems in the park. The red symbol of significant concern in 2012 primarily is an artifact of the NPS implementing a new financial system, rather than an actual degradation of building condition. Sewer lines have been replaced at Toklat and Wonder Lake. The lagoons in the frontcountry have been rehabbed. A new leach field has been installed. Throughout the park, 57 chemical toilets have been replaced with vault toilets. The frontcountry waste water system recently was redesigned and is scheduled for completion in 2013. The park has committed to funding the construction of a Toklat waste water system in 2015.
Water Systems	10 / 12	0.162 / 0.158		The park's water systems have received attention over the past few years: installation of a new frontcountry water plant and new wells at Wonder Lake and Teklanika (the pump for each of these new wells is powered by a new solar system), and a new water storage tank at Wonder Lake. The water tank at Teklanika was repainted. Funding in 2013 provides for the cyclic maintenance of frontcountry water system pumps. A future project will replace the water system at Eielson Visitor Center.

Overall Facility Condition Index (continued)

web

Asset Category	Number of Assets 2008 / 2012	FCI 2008 / 2012	Condition Status/Trend	Rationale
Unpaved Roads	29 / 13	0.305 / 0.028		In the last 4–5 years, more than 400 failing culverts were replaced. Annually, calcium chloride, a dust-suppressant, was applied to the park road to improve driving conditions, solidify the driving surface, and retain “fines” (fine sediments), reducing the need to transport gravel within the park. Each year, more than 4,000 cubic yards of gravel were processed and placed for road surface crowning and maintenance-related activities. Each year, roadside brushing and moving (of about six lane-miles of roadside) have improved the viewshed, increased shoulder integrity, and reduced washouts. More than 19 miles of park road were re-constructed through Federal Highway Administration-contracted projects (e.g., repairing serious subgrade issues, improving bus passing pullouts, and correcting dangerous overly steep and soft shoulders). Ditches were cleaned and lost gravel recycled and re-shaped to provide improved runoff away from the road. Three bridges along the park road were routinely maintained or repaired. All road signs and posts were replaced to meet NPS standards and the current Manual on Uniform Traffic Control Devices (MUTCD).

Overall Facility Condition Index (continued)

web

Asset Category	Number of Assets 2008 / 2012	FCI 2008 / 2012	Condition Status/Trend	Rationale
Paved Roads, Parking Areas, Bridges, Tunnels	105 / 124	0.103 / 0.125		In the last 4–5 years, the paved section of the park road underwent significant improvements. In preparation for repaving the park road in 2015, all worn culverts were replaced. A new parking lot and trailhead destination (Mountain Vista) were constructed at Mile 12 to improve public access. The park road was re-aligned around a major subgrade failure area at Mile 4, eliminating yearly repair costs and rough driving conditions. The ditch in the same area was increased in size to hold a winter's worth of overflow ice, reducing delays in spring road opening (and related costs) and reducing road surface damage. A new access road, parking lots, and visitor drop-off area for the kennels were constructed within the historic Headquarters area, alleviating shuttle bus traffic through the NPS administrative area and reducing noise and pedestrian-vehicle conflicts. Seven miles of pavement were crack-sealed each year. All road signs and posts now have been replaced to meet NPS and standards in the MUTCD. Centerline striping was reapplied every other year to the park road, and all worn parking lot and crosswalk striping was replaced. Several major frost heaves were shimmed with hot-mix asphalt to eliminate dangerous dips/bumps. All maintenance yards and the roads in the Riley Creek Campground were graded and paved, and a new access road into the C-Camp maintenance/residential facility was constructed.
Other Assets	76 / 85	0.155 / 0.047		• Steam plant: The current steam plant, which sends heat to the park's homes and offices, will be taken off line and replaced with individual heating units at each location. • Fuel transition: The park will convert its heating systems from fuel oil to propane to reduce spill hazards and lower emissions. • Kantishna airstrip: It was resurfaced in 2011.

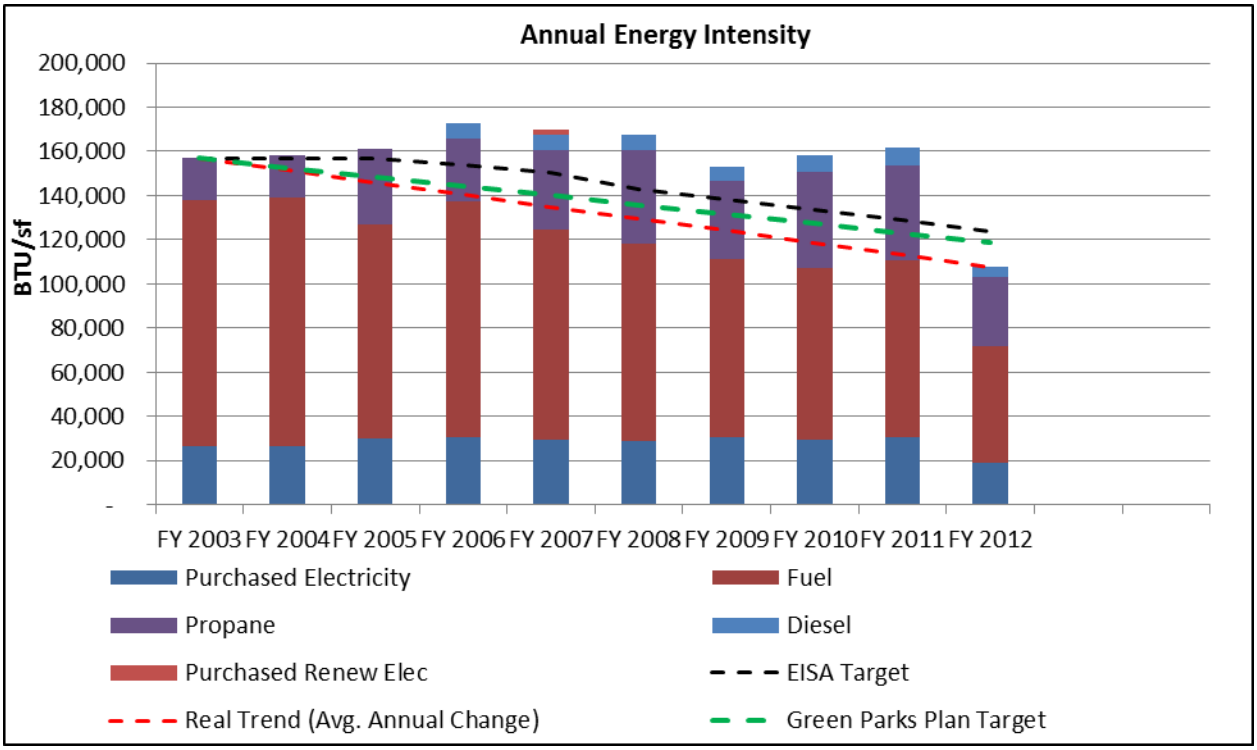
Energy Consumption

web

The production of energy to heat, cool, and illuminate buildings and to operate water utility systems is one of the largest contributors to greenhouse gas emissions in the United States. The NPS is committed to improving facility energy performance and increasing its reliance on renewable energy sources. The NPS goal is to reduce Servicewide building energy consumption per square foot of building space by 35 percent by 2016 from the baseline set in 2003 (NPS Green Parks Plan 2012).

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Energy Consumption	BTUs per gross square footage of buildings		Several photovoltaic systems have been installed throughout the park and a grid tie solar system was installed in Talkeetna. A hydroelectric plant was installed at the Eielson Visitor Center to provide the power required to run the facility. New bay doors and heaters were installed at the auto shop to increase energy efficiency. All appliances purchased in the park are energy star rated. Wherever possible, projects continue to install motion sensors and LED and CFL lights.

Historical data for energy consumption reported by Denali and available in the Energy Data Reporting Tool (EDRT) is shown below.



Water Consumption

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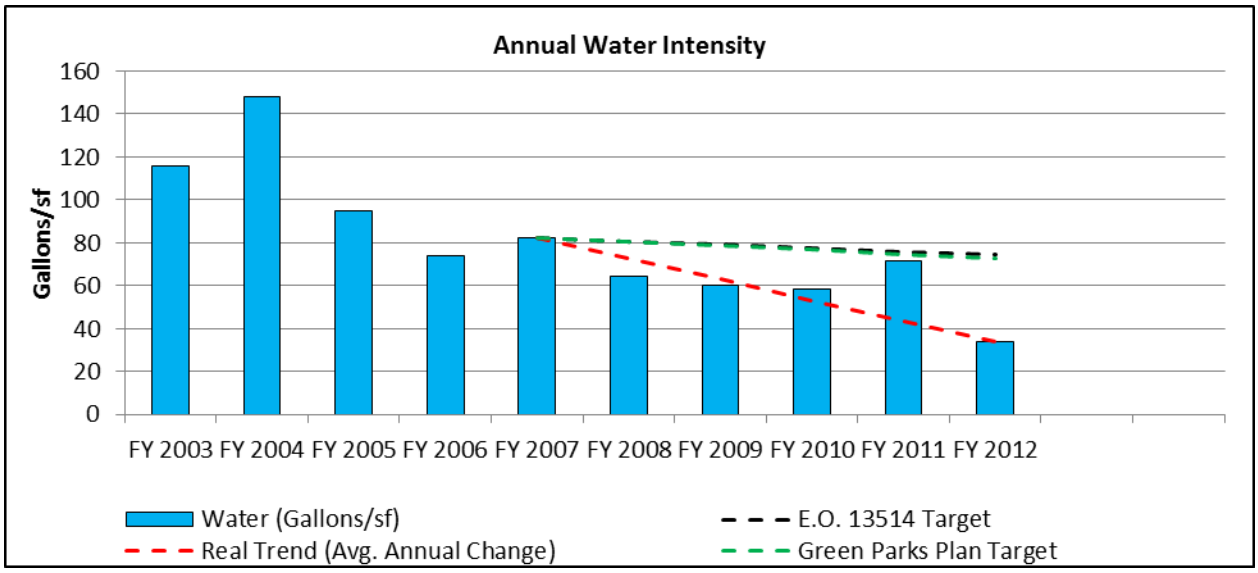
The national and global supply of fresh water has diminished in recent decades, and this trend is likely to continue due to drought and other climatic changes. To contribute to the responsible use of freshwater supplies, encourage groundwater recharge, and protect water quality, the NPS is improving its efforts to conserve water, reuse gray water, and capture rainwater. NPS has set a goal to reduce non-irrigation potable water use intensity by 30 percent by 2020 from the baseline set in 2007 (NPS Green Parks Plan 2012).

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Water Consumption	Millions of gallons		Water consumption at the park in 2012 was 14 percent lower than the 4-year average for 2008–2011 (NPS Annual Energy Report). Finding a leak in the water distribution system, and then repairing it, has saved 1.1 million gallons of water per month.

Historical data for water consumption reported by Denali and available in the EDRT is shown below.



Resource Brief: Commitment to Renewable Energy – Denali Exceeds Goals

The Green Parks Plan (GPP) defines a collective vision and a long-term strategic plan for sustainable management of NPS operations. Also, the *Call to Action*, issued by Jon Jarvis, Director of the National Park Service (NPS) in August 2011, challenged the NPS with 36 goals to achieve by 2016 in order to carry the Service into its second century. Denali has embraced and over-the-top exceeded the "Go Green" goal. This goal (Goal 23) says: *Reduce the NPS carbon footprint and showcase the value of renewable energy to the public by doubling, over 2009 levels, the amount of renewable energy generated within parks and used by park facilities.* To meet this goal in Denali, the park has expanded capability, production, and consumption of renewable energy in the park. Part of the park's success stems from the commitment of its managers to renewable energy even prior to the Director's Call to Action.

Solar panels on park facilities convert the sun's rays to useable energy

At the close of fiscal 2009 (the baseline year for the "Go Green" goal), Denali infrastructure included eight photovoltaic and one micro hydroelectric energy systems, and the production and consumption of renewable energy in the park was 2,644 Kilowatt Hours (KWh). The goal to double renewable energy at Denali was met and exceeded in 2011, a full five years ahead of schedule. In 2011, 34,898 KWh were produced and used in the park, about a 12-fold increase over 2009.

In 2012, the total of park-produced and park-used renewable energy was 39,463 KWh, which is approximately 15 times greater than the 2009 base line—far exceeding the "Go Green" goal of doubling renewable energy production. Denali achieved and exceeded this goal by the addition of six photovoltaic systems in 2010, the addition of five more photovoltaic systems and improvements to the hydroelectric facility in 2011, and the addition of two photovoltaic systems and increasing the low-flow capacities of the hydroelectric facility in 2012.

While Denali's managers take pride in having already exceeded the Call to Action's 2016 goal, the park is committed to continuing to grow its renewable energy capabilities. Denali is not, by any standards, the largest producer of renewable energy within the NPS, yet it is a shining example of what all parks can do to "Go Green."

2.5. Wilderness Character and Stewardship

The Wilderness Act of 1964 requires the NPS to maintain Wilderness character, including the qualities of being "untrammeled by man…undeveloped…natural," and allowing for "solitude or primitive and unconfined recreation." For a more detailed picture of the status of Denali's backcountry and wilderness character, see the Denali National Park and Preserve state of the backcountry 2012 report (Abbe and Burrows 2014).

Overall Wilderness Character

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Quality	Condition Status/Trend	Rationale
Natural		Most ecosystem components, including populations of plant and animal species, are healthy. The effects of climate change are of concern for glaciers, permafrost, and other ecosystem components. Wolf population size has decreased, while predator control pressures adjacent to the park have increased.
Undeveloped		Infrastructure (e.g., plot markers, weather stations) and new trails in wilderness have complied with NEPA requirements and minimum requirements analysis. However, the net number of installations has increased in the last five years, and more installations for scientific and administrative use are planned. The amount of aircraft use for park administration is stable; however, there have been efforts to reduce impacts over designated Wilderness. Anecdotal evidence of illegal snowmachine use is cause for concern.
Untrammeled		The amount of poaching and illegal taking of other park resources likely is stable at low levels. Human-wildlife incidents are few and minor (except for a bear-related fatality in 2012). Radio-collared animals are captured in a humane way—the collaring of wildlife allows park managers to be better stewards. Two small human-caused fires were suppressed in the last five years.
Solitude or Primitive and Unconfined Recreation		Visitors have the opportunity to experience outstanding opportunities for solitude or primitive and unconfined recreation (SPUR) in millions of acres of wilderness. Wilderness zones range from having a small quota of visitors per night to having no quota. Access to areas is as easy or difficult as the visitor desires. Numbers of aircraft overflights have remained about the same; however visitors in wilderness continue to experience visual and sound impacts of these overflights (Betchkal 2013). Opportunities for solitude are fewer in areas popular for day users along the park road, for climbers along the West Buttress route, and for visitors at air tour/taxi landing portals.
Other Features and Values		Additional sites important to Denali's paleontological and cultural resources continue to be found and documented. For example, a track from a therizinosaur, a dinosaur previously undocumented in Denali, recently was discovered in the park (Fiorillo and Adams 2012). As for cultural resources, in 2011 and 2012, archeologists conducted an inventory of cultural resources near Lake Minchumina (Holmes 2013).

Wilderness Stewardship

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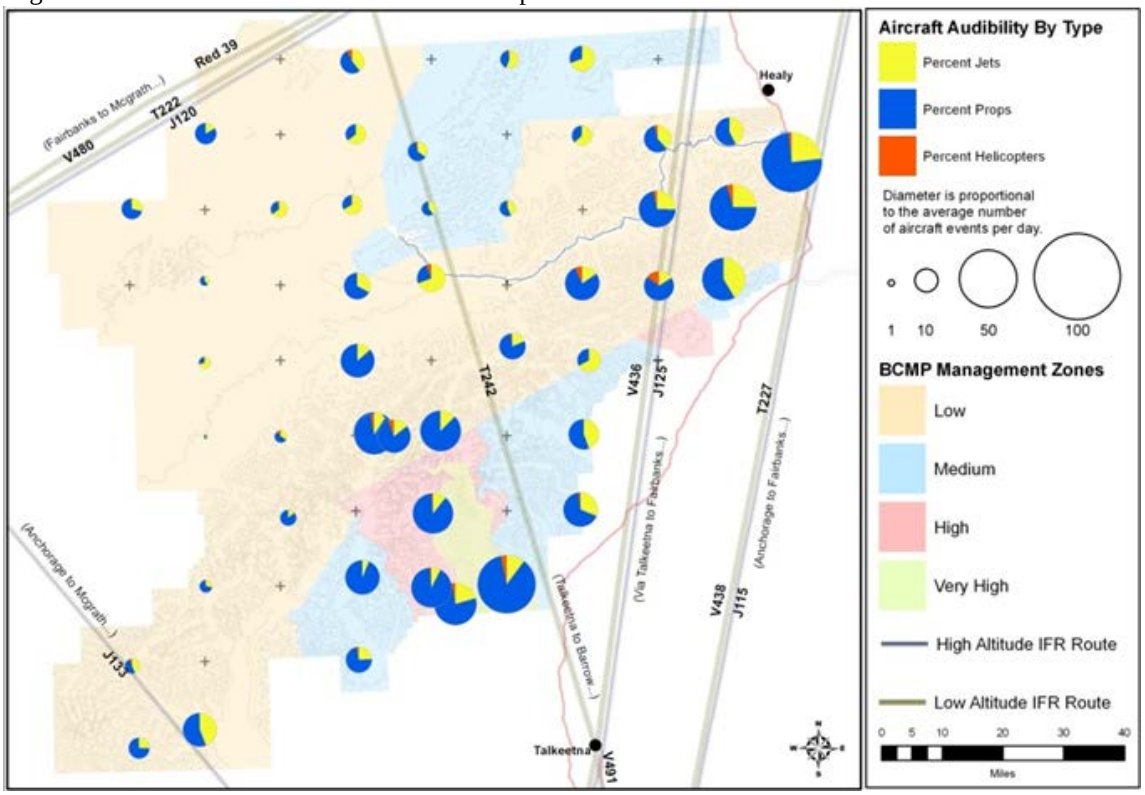
Actions and Practices	Condition Status/Trend	Rationale
Information		Informational support for wilderness stewardship, as of 2012, included having policy support from park management, science-based information, and a compilation of legislative direction and history.
Plans		A robust wilderness monitoring program is in place—gaining support both internally and with park partners. This program monitors soundscapes, aircraft overflights, wildlife and natural conditions, the number and type of installations, social trails, encounter rates with other hikers or backpackers, and other indicators of visitor experience in the backcountry. Implementation of the Backcountry Management Plan (BMP) will gain momentum in 2013 now that staffing changes have stabilized. There is a staff dedicated to wilderness stewardship. The wilderness character map (to be completed in 2013) and associated training were built from the foundation of the BMP.
Training		In 2012, key staff completed training through the Arthur Carhart Wilderness Training Center. A wilderness workshop for all park staff was scheduled for April 2013 to enhance wilderness knowledge and stewardship by both new and long-time park employees.

Resource Brief: “Listening in” to Denali’s Soundscapes

Soundscape research has been underway at Denali since 2001. Natural and human-generated sounds are being inventoried systematically across the entire landscape of the park, including popular backpacking areas, Mount McKinley climbing routes, and along the park road. From the 18,000+ hours of digital recordings and sound levels that have been documented, park staff can determine the percentage of time and the number of times per day that sounds are audible, as well as the sound level (loudness) of events important to park management. The sound-level data are used to compare the levels of human-made sounds to the natural ambient levels. Sound data also are converted into a visual representation, or spectrogram, from which a trained technician can identify and tally aircraft overflights by propulsion type (propeller plane, jet plane, or helicopter) for further understanding of daily traffic patterns.



Over a ten-year period, stations are being placed at six new locations each year—each randomly selected from a 10x10 km grid of 60 points spread evenly throughout the park.

From the acoustic data processed since 2006, Denali’s natural soundscape is characterized primarily by the energy of wind and water and, at certain times or locations, the striking absence of that energy. Overlain upon these steady physical sounds are seasonal or daily cycles, which are affected by temperature. For instance, singing birds and debris flows down steep-walled valleys follow a predictable daily pattern related to these temperature changes.

Human-caused noise also follows a definite spatial-temporal pattern. At locations near common flightseeing routes, traffic rates commonly exceed 30 overflights per day. At glacier landing strips, it is common to hear more than 100. On the other hand, locations farther away from common flightseeing routes rarely exceed 10 overflights per day. This variation in traffic becomes clearer when viewed spatially. The map above shows a pie-chart of traffic by aircraft type for every site sampled to date. The radius of the pie-chart circle is proportional to the average number of aircraft overflights per day.

Detailed soundscape data reports can be found on the Denali website.

2.6. Subsistence

Subsistence

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Hunting, Fishing, and Trapping of Wildlife	Number of animals taken by subsistence harvest in the new park and preserve		Subsistence harvest levels of moose and caribou have remained about the same. Harvests in Game Management Unit (Unit) 13E (new park), by Cantwell residents, and Unit 16B (south preserve), by Skwentna residents, are reported to the Federal Subsistence Permit System (harvest database). Harvests in Unit 20C (Kantishna area of new park) and in Unit 20C (north preserve), by Lake Minchumina residents, are self-reported to the Subsistence Program Manager at Denali.
	Numbers, sex ratios, and age distribution of species subject to subsistence harvest in new park areas		In 2008, park staff conducted the most recent surveys of moose that are subject to subsistence harvest near Yentna and Cantwell. The number, sex ratio, and age distribution of moose, subject to subsistence harvest in those areas, are known from this survey. The next surveys of moose are scheduled for 2013.
	Population sizes of harvested species		The Office of Subsistence Management (Federal Subsistence Permit System) keeps a database for moose and caribou harvested in Unit 13 (Unit 13E is in park additions, and it would be qualified Cantwell residents who would harvest moose and caribou there).
	Density (abundance) and distribution of furbearers		In 1978, trapping activities and uses were documented (Bishop 1978). The Denali Subsistence Resource Commission has requested that the NPS begin furbearer studies to investigate changes in the number of marten, which is the most important harvested species for subsistence trappers in the park additions.
	Density (abundance) and distribution of fish		According to a Traditional Ecological Knowledge (TEK) report (Williams et al. 2005), the abundance of fish (outside the park) is declining.
Uses of Timber	Density (abundance) and distribution of timber for firewood and cabin logs		There has been a timber survey in the Windy Creek area near Cantwell (Sanders 2009), where anecdotally the most timber is harvested for firewood. There has been no timber survey in the Lake Minchumina area where trapline cabins are located.
Opportunity for and Continuity of Subsistence Activities	Percentage of intergenerational trappers		Overall there are fewer youth involved in subsistence activities. Anecdotally, the population numbers (including youth) in subsistence communities are declining (Holen and Williams 2006).
	Percentage of people cutting firewood or cabin logs without a permit		The percentage of people cutting firewood without a permit is unknown. The percentage of people cutting logs for cabins without a permit is low (less than 5 percent). There is a known established process for applying to build trapline cabins.

Subsistence (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Opportunity for and Continuity of Subsistence Activities (continued)	Percentage of people who want to harvest timber for firewood or cabin logs who are able to do so		An Environmental Assessment is required to rebuild a cabin. A permit is needed to harvest firewood. No requests for cabin logs or firewood were denied during 2008–2012.
	Percentage of people who want to trap who are able to do so		There are no restrictions on trapping, so 100 percent of those who want to trap are able to do so.
	Percentage of people who want to subsistence fish who are able to do so		At this time, there are no known people who want to subsistence fish within the preserve.

Resource Brief: Successful Federal Subsistence Regulatory Changes

Prior to 2012, subsistence users traveling to Kantishna to hunt moose (in the portion of Game Management Unit 20C within Denali) legally were allowed to shoot ("harvest") 10 wolves that they might encounter during their moose hunt. In 2011, the Federal Subsistence Board approved Wildlife Proposal 10-95, which reduces the harvest limit for wolves by an individual hunter from 10 wolves to one wolf from August 10 to October 31, and from 10 wolves to five wolves from November 1 to April 30. The result of this regulatory change is that it is unlikely that the opportunistic shooting of wolves during moose hunting season would eliminate a substantial number of wolves, which might result in unfavorable publicity and increased pressure on the NPS to curtail subsistence wolf hunting later, when the pelts are prime.

Balancing wolf management and protection is an ongoing challenge

Chapter 3. Summary of Key Stewardship Activities and Accomplishments

Activities and Accomplishments

Denali National Park and Preserve has responsibility for managing natural and cultural resources of national significance to the American people. On-going management of these resources is vital to preserving the park's wildlife, scenic beauty, extensive natural ecosystems, historic and archeological sites, wilderness resource values and related recreational opportunities, and opportunities for subsistence activities. On-going management ensures that the park and these resources will remain for people's enjoyment and benefit. Denali maintains and promotes important partnerships with concessioners, organizations, and other agencies, in order to carry out the NPS mission in the park (see list of some park partners on page 39). This cooperation and interaction have led to the development and completion of numerous projects aimed at preservation and protection of these nationally significant resources.

Natural Resources

- Finalized Denali's new strategic document, the Resource Stewardship Strategy (RSS), which provides guidance for research, resource management, and resource education over the next 20 years, 2008–2027 (2009)
- Documented the first known occurrence of Tundra Swans nesting within the park (2011)
- Documented approximately 33 new paleontological sites in the Cantwell Formation
- Coordinated an international conference on human waste management in remote locations (2010)
- Recognized that the six-part series "The National Parks: America's Best Idea," which premiered on PBS in September 2009, showcased Denali's natural features

Cultural Resources

- Digitally formatted the 1932 film of the Lindley-Leik Expedition on Mount McKinley (2011)
- Published *Snapshots from the Road: a Roadside History of Denali National Park and Preserve* (2011)
- Completed a Determination of Eligibility for the Denali Park Road—it officially has been determined eligible for listing on the National Register of Historic Places (2009)

Visitor Experience

- Responded to the first bear-caused human fatality in the 95-year history of the park (2012)
- Completed the Vehicle Management Plan (2012)
- Supported a record 58,000 volunteer hours donated to the park (2012)
- Conducted the first annual Denali Music Festival, featuring the premier of the original composition *Denali* (2012)
- Received a second grant to test hybrid buses to help identify the best technology for reducing impacts buses have on the visitor experience and park resources (2011)
- Established web cams throughout the park, including the popular Denali Kennels' "Puppy Cam" (2011)
- Established the Alaska Region Emergency Communications Center; Denali Dispatch Office became a year-round, 24/7 operation to provide dispatch services to all Alaska NPS units (2010)
- Displayed *Ascension: Exploring the Art of Denali*, an exhibition of Denali's artist-in-residence work at the University of Alaska Museum of the North in conjunction with the showing of "The National Parks: America's Best Idea" (2010)
- Opened the new Eielson Visitor Center (2008)
- Recognized Pete Armington, Denali's Chief Ranger, for receiving the Harry Yount National Park Ranger Award (2009)

Park Infrastructure

- Completed construction of a new emergency services building and annex (2011), a new waste water treatment facility (2011), Mountain Vista Rest Area (2010), and the new Eielson Visitor Center (2008)
- Received a Leadership in Energy and Environmental Design (LEED) Platinum level rating for the Eielson Visitor Center—the first NPS-designed and NPS-constructed building to attain that goal (2009)
- Received an Environmental Achievement Award for incorporating high environmental standards into park operations (2009)
- Opened the reconstructed Triple Lakes Trail (2011)
- Installed water bottle fillers in support of a reduction in single-use water bottles in the park (2012)
- Completed the twelfth year of the school-to-work program, resulting in additional cabins for C-Camp (2012)
- Added three electric cars to the fleet of park vehicles (2012)

Chapter 3. Summary of Key Stewardship Activities and Accomplishments (Continued)

Wilderness

- Progressed significantly in developing a robust wilderness character monitoring program, based, in part, on the ongoing implementation of the Backcountry Management Plan (as of 2012)
- Collaborated with the Aldo Leopold Wilderness Institute to develop a Denali wilderness character map, an important tool for monitoring wilderness character, as part of the larger monitoring program (scheduled for completion in 2013)
- Recognized Joe Van Horn, the park's wilderness coordinator, who received the Wes Henry National Excellence in Wilderness Stewardship Individual Award (2008) and retired from his position (2011)
- Filled two new positions: Backcountry District Ranger and Wilderness Coordinator, and Wilderness Resource Specialist (2012)

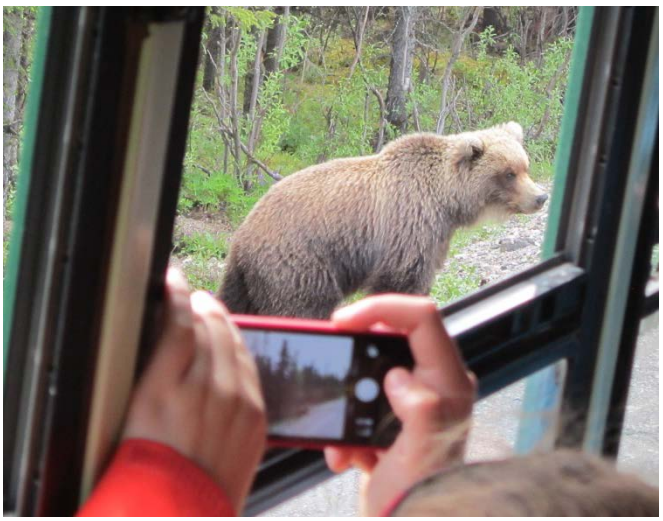
Subsistence

- Supported and acknowledged passage of Proposal WP10-95 to protect subsistence activity (2011)—see page 55
- Convened Denali's Subsistence Resource Commission at Lake Minchumina for the first time (2010)

Chapter 4. Key Issues and Challenges for Consideration in Management Planning

These are some of the major current issues and challenges at Denali National Park and Preserve:

Issue/Challenge #1:
Management of vehicles along the Denali Park Road to maintain wildlife protection and visitor satisfaction



Denali's shuttles provide a safe way to view wildlife

What is the issue?
Since 1972, park managers have balanced the need to ensure that park resources are protected and visitors continue to have a safe, high-quality experience by restricting the amount and type of vehicle traffic accessing the Denali Park Road beyond Mile 15. Due to these restrictions, most visitors access the park by touring the park road on a bus. Increases in Alaska tourism have resulted in an ever-increasing demand for visitor opportunities to tour the Denali Park Road.

What has the park done about this issue?
In 2006, park managers initiated a comprehensive study to identify how much traffic could be accommodated on the park road while protecting park resources and visitor experience. After more than six years of scientific study and four years of planning, analysis, and public input, the Denali Park Road Final Vehicle Management Plan and Environmental Impact Statement (VMP) was finalized and the Record of Decision signed by the Alaska NPS Regional Director in September 2012.

What's next?
For the next 15–20 years, the VMP will guide management of vehicle traffic during the summer regulatory season. The plan established an adaptive management approach that includes monitoring indicators of desired resource conditions to ensure that standards are being met. During 2013 and 2014, park staff will develop monitoring strategies and collect, analyze, and report on the status of indicators. Staff plans to integrate language into the Terms and Conditions of road access permits, and develop language for management of the transportation system under the next concessions contract.

Issue/Challenge #2
Impacts of trapping and hunting of wolves near the park on the population status and viewability of wolves in the park

One of Denali's wolves

What is the issue?
Since fall 2008, densities of wolves in Denali have been in the low range of previously recorded densities, with an apparent decreasing trend. The last three years of estimated wolf densities (2010, 2011, and 2012) have been the lowest recorded since 1986. Since 2007, there has been a number of factors that may signal or correlate with a decline in Denali's wolf populations: an increased proportion of Denali's collared wolves that have died due to trapping, an increased concentration of harvest in the eastern portions of the park, a higher take of wolves that are dominant individuals in the packs, increased liberalizations throughout the state in wolf hunting regulations, an increase in state predator control programs, and a removal of the wolf buffers in the important wolf habitat area of the Stampede corridor, which is surrounded by park land.

When comparing current wolf populations with those during a reference time period (1988–2007), it should be noted that there has been no significant change in natural conditions in the park. However, natural population fluctuations cannot be eliminated totally as a potential cause of these declines. The NPS also has documented substantial declines in the opportunities to see wolves occurring over the last three years and in mean pack size. These declines are consistent with a decline in wolf populations that has been documented.

What has the park done about this issue?
Denali supported the passage of Proposal WP10-95, which was passed at the May 2010 meeting of the Federal Subsistence Board. Other supporters of this Proposal were the Denali Subsistence Resource Commission and the Eastern Interior Regional Advisory Council. The new regulation restricts wolf hunting bag limits in GMU 20C (within Denali National Park and Preserve) to one wolf per person during the months of August, September, and October, to prevent excessive opportunistic harvest of wolves in conjunction with the subsistence moose hunt. After October, the wolf hunting bag limit increases to five wolves. The proposal does not affect wolf trapping regulations, for which there is no bag limit.

Following the removal of the wolf buffers adjacent to the park, Denali staff, in collaboration with the University of Alaska Fairbanks and with the cooperation of the Alaska Department of Fish and Game (ADFG), began a study of wolf movements, wolf survival, and wolf viewing opportunities along the Denali Park Road. It is hoped that this study will improve the understanding of the effects of wolf management outside of park boundaries on wolf populations and visitor experiences inside the park. Preliminary results from this study indicate that the probability of seeing a wolf along the park road on a trip at least as far as Eielson Visitor Center decreased from 45 percent in 2010 to 12 percent in 2012.

What's next?
The National Park Service is opposed to harvest strategies on NPS lands, which would allow the taking of wolves from aircraft or snowmobiles, the taking of wolves outside of traditional fur harvest seasons, and other expansions of seasons, harvest limits, and means and methods of harvest that would amount to predator control on NPS lands. The NPS recognizes that human predation is a traditional, but minor, component of the ecosystem. The NPS continues to express a willingness to work with state agencies and the Board of Game to achieve appropriate solutions.

The cooperative study of wolf movements, wolf survival, and wolf viewing opportunities along the Denali Park Road will continue at least into the short-term future.

Issue/Challenge #3:
Analysis of natural and human-induced floodplain changes on the Toklat River system

Toklat River floodplain

What is the issue?
Over several decades, park infrastructure has substantially impacted the natural form of the Toklat River floodplain. The Denali Park Road crosses over the Toklat River at about Mile 53. This crossing has narrowed the flow pathway from approximately 600 m to 200 m (≈2,000 feet to 650 feet) by the presence of an elevated causeway and associated bridge abutments. The Federal Highway Administration and NPS have built a system of sheetpile, revetments, stream barbs, rock gabions, and other structures to protect visitor and staff facilities that were built on and adjacent to the floodplain. The long-term impacts of these structures on the river system are not yet fully understood.

Additionally, the Denali Gravel Acquisition Plan authorizes gravel to be removed from the Toklat River floodplain to support maintenance needs of the Denali Park Road. The park excavates 22,200 cubic yards (≈17,000 cubic meters) of gravel every even-numbered year. To put this volume in perspective, this excavation is approximately 2,000 medium-sized dump-truck loads of gravel. Excavating gravel locally minimizes traffic on the park road, use of fossil fuels, and the potential for introducing invasive plants from external gravel sources. The long-term impacts of the excavations on the floodplain and on gravel availability from the Toklat are not yet adequately understood.

What has the park done?
Park staff, the U.S. Geological Survey, contractors, and university partners are monitoring natural and human-induced floodplain changes and are completing analyses of the Toklat River system. Through these analyses, staff is assessing the cumulative impacts to the river system from (1) the existing bridges and causeway, (2) bank reinforcement along the road system, and (3) gravel extraction. To aid in the analyses, in 2009 and 2011, the Park purchased LiDAR and high-resolution aerial photographs of the floodplain. Staff used computer models to compare the LiDAR data for the two years ("differenced" the two years' photos) to quantify change through time. NPS or contractors conduct annual precision GPS surveys of the floodplain to measure changes in the channel form and elevation. These analyses are helping to inform short- and long-term management decisions.

Chapter 4. Key Issues and Challenges for Consideration in Management Planning (Continued)

What's next?
Park staff plan to develop a Toklat River Plan, which would consider the short- and long-range needs in the Toklat area as they relate to the natural system of the Toklat River, the administrative road camp, gravel extraction from the river, and visitor services. The NPS will continue to apply active adaptive management practices to the gravel excavation to refine techniques and understand the complexities of this river system.

Hiking in the backcountry

Issue/Challenge #4:
Implementation of the Backcountry Management Plan, so that backcountry hikers and campers experience the wilderness within the standards developed for such indicators as natural soundscapes and numbers of visitor encounters

What is the issue?
Denali has approximately 2 million acres of designated wilderness, and has millions of acres eligible for wilderness designation in the future, that are being managed as wilderness.

The primary affirmative mandate of the 1964 Wilderness Act is that land management agencies preserve the wilderness character of all areas designated as wilderness. In the last four years, a framework for describing just what wilderness character is, has emerged and is proving to be a powerful tool in monitoring, mapping, planning, and clearly communicating wilderness issues.

In the framework wilderness character is divided into five qualities: (1) natural, (2) untrammeled, (3) undeveloped, (4) outstanding opportunities for solitude or a primitive and unconfined type of recreation, and (5) other features of ecological, geological, scientific, educational, scenic, or historical value. The definitions of these qualities are standard across all wilderness areas, but the indicators and measures that are used to represent each quality are chosen locally and are unique to each area.

Monitoring certain conditions and indicators using the best available science is an important effort in tracking and preserving wilderness character, protecting Denali's resources, and providing opportunities for high-quality visitor experiences in the backcountry.

What has the park done?
2012 marks the opening of a new chapter for wilderness and backcountry management and monitoring at Denali. The new Backcountry District Ranger position will be in charge of overseeing implementation of Denali's 2006 Backcountry Management Plan (BMP). This plan (page iii) defined backcountry as "all park and preserve lands, except the park road corridor and adjacent development zones and backcountry day use areas." Efforts are underway to implement monitoring of the indicators of visitor experience and resource conditions that are identified in the Backcountry Management Plan. This monitoring is an inter-divisional and interdisciplinary team effort. Below are the focus areas of park staff in 2012:

Informal (Social) Trail Monitoring – Park staff focused on implementing a new protocol for monitoring informal trails in the backcountry. This protocol was developed by Jeff Marion and Jeremy Wimpey of Virginia Tech and Denali's former Wilderness Coordinator, Joe Van Horn.

Triple Lakes Visitor Use and Encounter Rates – Denali's former social scientist designed a study to determine if the park is meeting the Backcountry Management Plan standards for encounter rates of other hikers and large groups on the Triple Lakes Trail. This study will gauge the impacts to visitors' opportunity for solitude on the trail without a survey. Numerous park staff will hike the trail to collect data on encounter rates with other hiking groups.

Monitoring Aircraft Overflights – The Denali Aircraft Overflights Advisory Council updated its best practices recommendations for air taxi and flightseeing operators. The best practices include avoiding the crest of the Alaska Range and the area immediately north of the crest between Refuge Valley in the Sanctuary River drainage and Anderson Pass. In order to measure any changes to impacts, park staff will monitor aircraft overflights using soundscape stations and direct observations by backcountry rangers when they are out on patrol.

Wilderness Character Map – In conjunction with Peter Landres and James Tricker of the Aldo Leopold Wilderness Research Institute, park staff is working to create a wilderness character map. This model uses digital map layers of various measures—which have been

chosen by park staff with long and deep experience in the Denali wilderness—that are thought to degrade each of the five wilderness character qualities. A draft map is being developed.

State of the Backcountry Report 2012 – The park has drafted a State of the Backcountry Report 2012 that summarizes the implementation of the Backcountry Management Plan, indicators of wilderness character, and other current and relevant data (Abbe and Burrows, *in preparation*).

What's next?
The park will finalize the wilderness character map, publish the State of the Backcountry Report 2012, and continue to monitor according to the Backcountry Management Plan.

Issue/Challenge #5:
Restart of a coal-fired power plant adjacent to the park

Healy Power Plant Unit 2

What is the issue?
Healy Power Plant Unit 2 is a 50 megawatt coal-fired power plant that has been in idle status since December 1999. Unit 2 and the adjacent Unit 1 (25 megawatts) are located only six kilometers (3.8 miles) from the northeastern boundary of the park. In 2009, the Alaska Industrial Development and Export Authority (AIDEA) and Golden Valley Electric Association (GVEA) announced their intention to restart Unit 2, which led to an interagency debate about whether or not the long idle time would trigger a requirement for full environmental review before the restart could be allowed under the existing operating permit.

Denali National Park and Preserve is a designated Class I area under the Clean Air Act, which gives the NPS an affirmative responsibility to protect the park's exceptional air quality. There is concern that the increased emissions from Unit 2 could potentially impact the park's air quality and related values, including visibility.

In addition, the NPS is mandated to protect soundscapes within the park. During the testing phase of Unit 2, GVEA attempted to mitigate an unexpectedly loud tone emanating from the power plant. Anecdotal evidence at the time indicated that the mitigation efforts may not have been completely successful.

What has the park done about this issue?
In collaboration with the NPS Air Resources Division, park staff assessed potential air quality impacts and submitted comments during several rounds of permit review. Park staff also provided input on the issue of whether or not full Prevention of Significant Deterioration (PSD) environmental review should be required before restart. The final resolution of this question occurred in October 2012 when the Environmental Protection Agency (EPA) signed a consent decree with GVEA and AIDEA. The consent decree requires new emission controls on Unit 2, sets lower emission limits, and applies new federal mercury regulations to both units, which otherwise would have applied only to Unit 2.

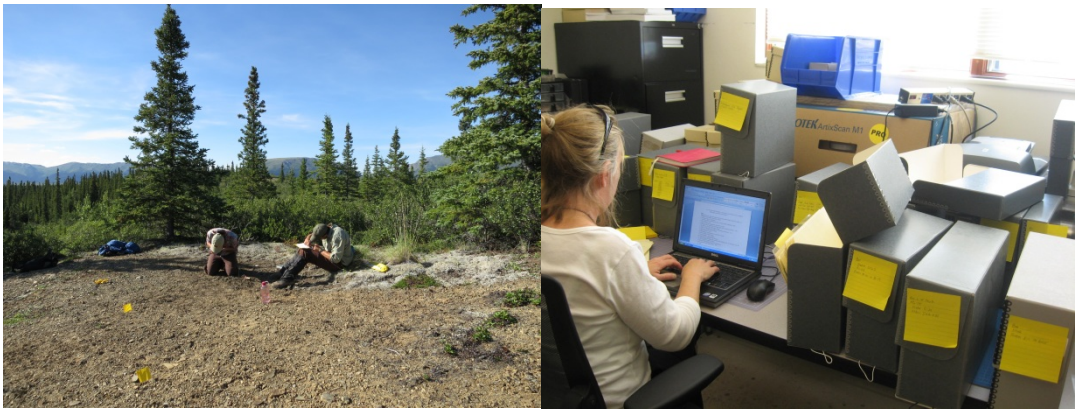
Park staff also collected baseline soundscape data during winter 2011–2012, to compare with ambient sound levels after Unit 2 restarts. The temporary soundscape monitoring station was installed near Bison Gulch, across the Nenana River Valley from the power plant.

What's next?
NPS air resource contractors are developing a protocol for determining whether any observed visibility impairment can be reasonably attributable to the Healy Power Plant. The protocol will be in place by the time Unit 2 restarts in 2015, and GVEA staff will be trained in protocol implementation alongside park staff. If visibility impairment occurs, a 1993 mitigation agreement between NPS, GVEA, and other interested parties would require GVEA to temporarily reduce emissions to pre-Unit 2 levels at the request of the park superintendent.

Ambient noise levels at the northeast corner of the park will be assessed when Unit 2 restarts. If it appears that soundscape impairment exceeds allowable levels set by the Backcountry Management Plan, park staff will install a soundscape monitoring station and investigate potential mitigation measures.

Chapter 4. Key Issues and Challenges for Consideration in Management Planning (Continued)

Issue/Challenge #6:
Documentation and evaluation of Denali's cultural resources



***Left*: Staff doing research in the field; *Right*: Working with archive files**

What is the issue?
Less than one percent of the park has been surveyed for cultural resources. Shortages in staffing and financial resources are resulting in the park's inability to complete cultural resource inventory surveys and condition assessments of known sites. Information on the known sites needs to be processed into determinations of eligibility for the National Register of Historic Places and entered into the appropriate databases and site files, but currently there is a backlog of raw data that needs to be processed to complete these tasks.

Lack of information on cultural resources in the park can impact management decisions. Alaska Native Elders are passing away and with them valuable knowledge of the area and ethnographic information are being lost forever.

In the museum collection, there has been an accumulated backlog of administrative files and of objects that researchers have collected. These collections need to be properly accessioned and catalogued into the museum. Additionally, as the park's central files, research collections, and research administrative files continue to grow, the park is in need of additional collections storage to house these objects and archival materials.

What has the park done?
The park is developing a plan for future cultural resource surveys in the park and initiatives to record oral histories with Alaska Native Elders.

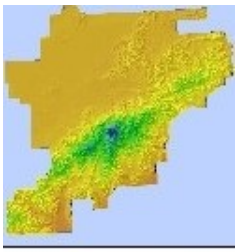
The museum collection backlog has been reduced in the last five years, but, due to limited staff and financial resources, it has not been eliminated. In late 2012, contractors processed 30 banker boxes of administrative files for the museum collection, but this processing will not be "counted" against the backlog until 2013. After processing, these archives are being stored at the NPS Alaska Regional Curatorial Center in Anchorage. The museum curator has increased communications with many researchers, who have collected objects to be curated, about their curatorial requirements. The curator also has reinforced these requirements with researchers, who collected in the park some years ago, in order to process loan paperwork for objects that currently reside at non-NPS repositories.

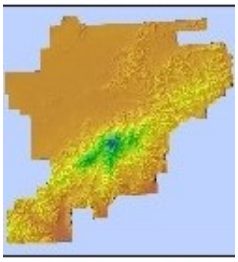
What's next?
The park has several cultural resource inventory surveys scheduled for completion in the next five years. The park is working to implement cooperative agreements with universities and other organizations, in order to enlist help in conducting cultural resource surveys in the park and assisting in providing information about the park's cultural resources to park management.

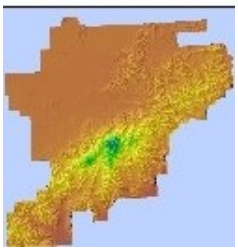
Additional projects with funding are needed to further reduce the museum collections' backlog of uncatalogued objects and administrative files. Some loan documentation from the 1980s needs to be updated, in addition to the completion of inventories and loan paperwork for museum property that is residing at non-NPS facilities. This is an ongoing process because outgoing loans expire and new loans are generated. A long-term storage solution will be to find additional spaces at the park that can house museum property.

Chapter 4. Key Issues and Challenges for Consideration in Management Planning (Continued)

Issue/Challenge #7: Climate change considerations in park management







Key to Average Annual Temperature maps at left from Scenarios Network for Alaska and Arctic Planning:
Top 1961–1990; Middle Projection for 2035–2044; Bottom Projected for 2075–2085.
Colors from warmest to coolest are: red-brown (42 degrees F), brown, yellow, green, blue (-10 degrees F)

What is the issue?
Retreating glaciers, thawing permafrost, and longer growing seasons present clear evidence of the park's changing climate. Scientists who observe the Earth's climate have documented a warming trend caused by human activity. Modeling results predict the park's climate will warm into the distant future. A recent down-scaled climate model predicts that, by 2080, wintertime average temperature in the park will increase by 10°C (± 1.2) and the summertime average will increase by 5.6°C (± 2.4). Not only does climate change transform the natural and cultural landscapes of national parks, but it also is very likely to impact the visitor's park experience by changing wildlife viewing opportunities. Increased wild-land fire frequency, severity, and area burned will increase the number of smoky days. These changes and impacts already are being experienced at Denali. As the scope and intensity of climate change increase, the historical or "natural" conditions in parks will be difficult or impossible to maintain. What will it mean to protect park resources "unimpaired for future generations" in the face of climate change?

In 2012, the NPS released a Climate Change Action Plan, which provides context, sets short-term priorities, and considers future planning for the Climate Change Response Program's four emphasis areas: (1) Science: using science to help manage parks, (2) Adaptation: planning for an uncertain future, (3) Mitigation: reducing the NPS carbon footprint, and (4) Communication: educating about climate change.

What has the park done?
Denali is responding to climate change in all four areas. Accomplishments within each area include the following by area:

(1) Science:

- Monitoring climate at eight weather stations that contribute year-round real-time data to national climate databases
- Monitoring two glaciers for cumulative mass balance, terminus location, and rates of reduction in area and thickness
- Determining topographic change due to glacier change or other processes using digital elevation models and GIS
- Developing a protocol to detect the effects of climate change on the extent, thermal properties, and carbon flux of permafrost
- Repeating photography of park landscapes after 50–90 years
- Repeating measurements of vegetation plots on the McKinley Bar (changes since 1958)
- Analyzing data from 1,500 vegetation plots to establish a baseline for future changes (Central Alaska Network)
- Documenting the phenology of aspen leaf-out and fall color change in relation to climate data
- Conducting social science interviews with rural community members and park staff to collect knowledge about how climate change has affected resources in Denali

(2) Adaptation:

- Incorporating climate change into Denali's Foundation Statement (planning document)
- Attending climate change Scenario Planning workshops
- Developing plant diversity maps for use in scenario planning and visualization, e.g., encroachment of woody vegetation upslope into tundra would pose a major threat to Denali's vulnerable tundra plant species that are already rare
- Planning sessions with the Landscape Conservation Cooperative for Interior Alaska—Northwestern Interior Forest LCC
- Discussing potential use of prescribed fire to decrease the probability for large severe fires and allow ecosystems to adjust to new climatic conditions

(3) Mitigation:
Ongoing

- Using mandatory shuttle and tour buses to reduce traffic and emissions on the park road
- Using solar and hydroelectric power at remote park visitor centers
- Encouraging employee use of buses to reach work locations
- Hiking to wilderness work sites when feasible instead of using a helicopter
- Showcasing green practices at the Murie Science and Learning Center (MSLC) Field Camp (e.g., reusable lunch bags)

Accomplishments Continue Next Page

(3) Mitigation: (continued from previous page)

2012 outcomes

- Highlighting accomplishments through an audit of Denali's Environmental Management System:
  - The NPS motor pool fleet includes 11 hybrid and three 100% electric vehicles
  - Savings from "smart" vehicle plug-ins in winter reduced electric use by 19,066 kilowatt-hours
  - Reuse or recycling of paper, glass, cans, and metal saved 46,326 pounds from the landfill
  - Additional water bottle-filling stations eliminate use of throw-away bottles in the park
  - Employee green commutes (walking, carpooling, biking) saved 23,785 pounds of emissions

(4) Communication:

- Offering training sessions on climate change for park rangers (interpreters) and bus drivers
- Providing climate change field seminar for teachers
- Including climate change messages in most interpretive programs and MSLC education offerings
- Creating new fact sheets (e.g., How to "Green" Your Visit to Denali, Permafrost Thaw and the N Cycle)
- Engaging citizen scientists in learning about climate change during MSLC field seminars
- Offering MSLC climate change programs (e.g., dinner and discussion)
- Planning web page updates to www.nps.gov/dena/learn/nature/climate-change.htm

What's next?

Denali will continue efforts in all four areas to address climate change: science, adaptation, mitigation, and communication. In particular, several long-term (25–30 years) wildlife and plant community monitoring programs, in conjunction with the park's climate monitoring data, are now well-positioned to detect climate change responses in key park resources. The park's partnership with the Murie Science and Learning Center and the Denali Education Center will provide new opportunities to incorporate climate science in curricula designed for multiple ages.

Issue/Challenge #8:
Energy, Water Usage, and Environmental Management System (EMS)

An electric vehicle

What is the issue?

The National Park Service is committed to improving facility energy performance and increasing its reliance on renewable energy sources. The National Park Service has a goal to reduce Servicewide building energy consumption per square foot of building space by 35% by 2016 from the baseline set in 2003. Energy usage (BTUs per gross square footage of buildings) at the park in 2012 was 14 percent higher than the average for the previous four years.

What has the park done?

In 2008 the new Eielson Visitor Center was constructed. It is the first LEED Platinum (sustainable and energy efficient) NPS building in Alaska. A new emergency services building, also LEED certified, came on line in 2012. Over the past five years, eleven historic patrol cabins have been restored, 17 seasonal employee cabins have been replaced, 7 permanent and 3 seasonal employee houses have been rehabbed, numerous buildings have been repainted and had new roofs installed, and five maintenance facilities have been rehabbed. To improve the safety for employees and transient researchers, asbestos has been removed and egress windows have been installed in the five apartments of Building 51. Energy efficiency was improved with the installation of new wells at Wonder Lake and Teklanika campgrounds, the pump for which are powered by photovoltaic systems. Several photovoltaic systems have been installed throughout the park and a grid tie solar system was installed at the Talkeetna Ranger Station. A hydroelectric plant was installed at the Eielson Visitor Center to provide the required power to run the facility. New bay doors and heaters were installed at the auto shop to increase energy efficiency. All appliances purchased in the park are energy star rated. Projects continue to be carried out which install motion sensors and LED and CFL lights wherever possible.

What's next?

Steam plant: The current steam plant, which sends heat to the park's homes and offices, will be taken off line and replaced with individual propane fired heating units at each location. The park will convert its heating systems from fuel oil to propane to reduce spill hazards and lower emissions.

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See the State of the Park Report for the Park website for a more complete list of references to documents and data sets upon which the assessments in this State of the Park report are based. References for several of the key documents cited in this report are as follows:

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See Also:

Collection of Natural Resource-Related References

Collection of Cultural Resource-Related References

Collection of Visitor Experience-Related References

Glossary

See the State of the Parks home page for a link to a complete glossary of terms used in State of the Park reports. Definitions of key terms used in this report are as follows:

Alaska Interagency Coordination Center (AICC)	The Alaska Interagency Coordination Center provides coordination for all state and federal agencies involved in wildland fire management and suppression in Alaska. These agencies are the Bureau of Land Management, State of Alaska Department of Natural Resources, USDA Forest Service, National Park Service, Bureau of Indian Affairs, and the Fish and Wildlife Service. AICC serves as the focal point for initial attack resource coordination, logistics support, and predictive services. The AICC is located near Fairbanks on Fort Wainwright.
Alaska National Interest Lands Conservation Act (ANILCA)	The Alaska National Interest Lands Conservation Act is a federal law passed by Congress and signed by the President (1980) that provided for more than 43 million acres of new national parklands in Alaska, the addition of more than 53 million acres to the National Wildlife Refuge Systems, and designation of other conservation and recreation areas. Under Title VIII, Subsistence Management and Use, Alaska Natives and other rural residents were granted certain continuing hunting and fishing rights on these federal lands. According to Congress, on federal land (60 percent of Alaska), subsistence hunting and fishing has priority over sport hunting and fishing on federal land. To qualify, subsistence users must live in rural areas, have a customary dependence on fish and game, use local stocks, and have limited availability of other sources of food. The state may be allowed to manage resources on federal land as long as the state of Alaska follows the rules set up by Congress.
Americans with Disabilities Act (ADA) and American Barriers Act (ABA)	Laws enacted by the federal government that include provisions to remove barriers that limit a disabled person's ability to engage in normal daily activity in the physical, public environment.
Archeological Sites Management Information System (ASMIS)	The National Park Service's standardized database for the basic registration and management of park prehistoric and historical archeological resources. ASMIS site records contain data on condition, threats and disturbances, site location, date of site discovery and documentation, description, proposed treatments, and management actions for known park archeological sites. It serves as a tool to support improved archeological resources preservation, protection, planning, and decision-making by parks, centers, regional offices, and the national program offices.
Baseline Documentation	Baseline documentation records the physical condition of a structure, object, or landscape at a specific point in time. A baseline provides a starting point against which future changes can be measured.
Carbon Footprint	Carbon footprint is generally defined as the total set of greenhouse gas emissions caused by an organization, event, product, or person.
Central Alaska Network (CAKN)	One of 32 Inventory & Monitoring (I&M) networks established as part of the NPS Inventory and Monitoring Program. The Central Alaska Network provides scientific data and expertise for natural resources in three parks located in Alaska.
Climate Friendly Park	The NPS Climate Friendly Park designation requires meeting three milestones: completing an application; completing a comprehensive greenhouse gas (GHG) inventory; and completing a Climate Action Plan, which is the actions, policies, programs, and measures a park will put into place to reduce its GHG emissions.
Cultural Landscapes Inventory (CLI)	A Cultural Landscapes Inventory describes historically significant landscapes within a park. The inventory identifies and documents each landscape's location, size, physical development, condition, characteristics, and features, as well as other information useful to park management.

Cultural Landscape Report (CLR)	A Cultural Landscape Report is the principal treatment document for cultural landscapes and the primary tool for long-term management of those landscapes. It guides management and treatment decisions about a landscape's physical attributes, biotic systems, and use when that use contributes to historical significance.
Curation	National parks are the stewards of numerous types of objects, field notes, publications, maps, artifacts, photographs, and more. The assemblage of these materials comprises a museum collection. Curation is the process of managing, preserving, and safeguarding a collection according to professional museum and archival practices.
Exotic Plant Management Team (EPMT)	One of the ways the NPS is combating invasive plants is through the Exotic Plant Management Team Program. The program supports 16 Exotic Plant Management Teams working in more than 225 park units. EPMTs are led by individuals with specialized knowledge and experience in invasive plant management and control. Each field-based team operates over a wide geographic area and serves multiple parks.
Facility Condition Index (FCI)	FCI is the cost of repairing an asset (e.g., a building, road, bridge, or trail) divided by the cost of replacing it. The lower the FCI number, the better the condition of the resource.
Fire Weather Index (FWI)	The Fire Weather Index is a numeric rating of fire behavior (fire intensity). It combines the Initial Spread Index (based on effects of wind and fine fuel moisture) and the Buildup Index (an index of fuel available for combustion based on moisture in shallow duff and deeper organic layers). It is suitable as a general index of fire danger throughout the forested areas of Canada and has been applied in Alaska.
Foundation Document	A park Foundation Document summarizes a park's purpose, significance, resources and values, primary interpretive themes, and special mandates. The document identifies a park's unique characteristics and what is most important about a park. The Foundation Document is fundamental to guiding park management and is an important component of a park's General Management Plan.
Fundamental and Other Important Resources and Values	Fundamental resources and values are the particular systems, processes, experiences, scenery, sounds, and other features that are key to achieving the park's purposes and maintaining its significance. Other important resources and values are those attributes that are determined to be particularly important to park management and planning, although they are not central to the park's purpose and significance. These priority resources are identified in the Park Foundation Document and/or General Management Plan. The short-cut name that will be used for this will be Priority Resources.
General Management Plan (GMP)	A General Management Plan is a strategic planning document that outlines the future management of a National Park Service site for the next 15 to 20 years. The plan will set the basic philosophy and broad guidance for management decisions that affect the park's resources and the visitor's experience.
Green Parks Plan (GPP)	The Green Parks Plan defines a collective vision and a long-term strategic plan for sustainable management of NPS operations. A critical component of the implementation of the GPP will be informing and engaging park staff, visitors, and community partners about climate change and sustainability to broaden opportunities to foster change.
Historic Integrity	Historic Integrity is the assemblage of physical values of a site, building, structure, or object and is a key element in assessing historical value and significance. The assessment of integrity is required to determine the eligibility of a property for listing in the National Register.
Historic Resource Study (HRS)	The historic resource study is the primary document used to identify and manage the historic resources in a park. It is the basis for understanding their significance and interrelationships, a point of departure for development of interpretive plans, and the framework within which additional research should be initiated.

Historic Structures Report (HSR)	The historic structure report is the primary guide to treatment and use of a historic structure and may also be used in managing a prehistoric structure.
Indicator of Condition	A selected subset of components or elements of a Priority Resource that are particularly "information rich" and that represent or "indicate" the overall condition of the Priority Resource. There may be one or several Indicators of Condition for a particular Priority Resource.
Integrated Resource Management Applications (IRMA)	The NPS-wide repository for documents, publications, and data sets that are related to NPS natural and cultural resources.
Interpretation	Interpretation is the explanation of the major features and significance of a park to visitors. Interpretation can include field trips, presentations, exhibits, and publications, as well as informal conversations with park visitors. A key feature of successful interpretation is allowing a person to form his or her own personal connection with the meaning and significance inherent in a resource.
Invasive Species	Invasive species are non-indigenous (or non-native) plants or animals that can spread widely and cause harm to an area, habitat, or bioregion. Invasive species can dominate a region or habitat, out-compete native or beneficial species, and threaten biological diversity.
List of Classified Structures (LCS)	LCS is an inventory system that records and tracks the condition of the approximately 27,000 historic structures listed in the National Register of Historic Places that are the responsibility of NPS.
Museum Collection	NPS is the steward of the largest network of museums in the United States. NPS museum collections document American, tribal, and ethnic histories; park cultural and natural resources; park histories; and other aspects of human experience. Collections are managed by professionally-trained NPS staff, who ensure long-term maintenance of collections in specialized facilities.
National Register of Historic Places (NRHP)	The National Register of Historic Places is the official list of the Nation's historic properties worthy of preservation. Authorized by the National Historic Preservation Act of 1966, the National Park Service's National Register of Historic Places is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America's historic and archeological resources. Listing in the National Register of Historic Places provides formal recognition of a property's historical, architectural, or archeological significance based on national standards used by every state. The National Register is a public, searchable database about the places.
Native American Graves Protection and Repatriation Act (NAGPRA)	A federal law passed in 1990. NAGPRA provides a process for museums and federal agencies to return certain Native American cultural items (e.g., human remains, funerary objects, sacred objects, objects of cultural patrimony) to lineal descendants and culturally-affiliated Indian tribes and Native Hawaiian organizations.
Natural Resource Condition Assessment (NRCA)	A synthesis of existing scientific data and knowledge, from multiple sources, that helps answer the question: what are current conditions of important park natural resources? NRCAs provide a mix of new insights and useful scientific data about current park resource conditions and factors influencing those conditions. NRCAs have practical value to park managers and help them conduct formal planning and develop strategies on how to best protect or restore park resources.
Priority Resource or Value	This term refers to the Fundamental and Other Important Resources and Values of a park. These can include natural, cultural, and historic resources as well as opportunities for learning, discovery, and enjoyment. Priority Resources or Values include features that have been identified in park Foundation Documents, as well as other park assets or values that have been developed or recognized over the course of park operations. Priority Resources or Values warrant primary consideration during park planning and management because they are critical to a park's purpose and significance.

Project Management Information System (PMIS)	A servicewide intranet application within the National Park Service to manage information about requests for project funding. It enables parks and NPS offices to submit project proposals to be reviewed, approved, and prioritized at park units, regional directorates, and the Washington Office.
Resource Management	The term “resources” in NPS encompasses the many natural, cultural, historical, or sociological features and assets associated with parks. Resource management includes the knowledge, understanding, and long-term stewardship and preservation of these resources.
Specific Measure of Condition	One or more specific measurements used to quantify or qualitatively evaluate the condition of an Indicator at a particular place and time. There may be one or more Specific Measures of Condition for each Indicator of Condition.
Subsistence	In the broadest sense, subsistence is the taking of fish, wildlife, or other wild resources for the sustenance of families, communities, and cultures. Subsistence has been a way of life for Alaska Natives for thousands of years. Subsistence activities also are vital to many non-Natives in Alaska. Subsistence is recognized by the United States and by the State of Alaska as the highest-priority consumptive use of fish and wildlife. In a regulatory and legal sense, subsistence is a protected set of uses of fish and wildlife, reserved for Alaska rural residents.
U.S. Army Corps of Engineers (USACE)	The U.S. Army Corps of Engineers provides public engineering services in peace and war to strengthen national security, energize the economy, and reduce risks from disasters.
Visitor and Resource Protection (VRP)	VRP includes, among other responsibilities, protecting and preserving park natural and cultural resources, enforcing laws that protect people and the parks, fire management, search and rescue, managing large-scale incidents, and on-the-ground customer service.
Volunteers In Parks Program (VIP)	The Volunteers In Parks Program was authorized by Public Law 91–357 enacted 1970. The primary purpose of the VIP program is to provide a vehicle through which the National Park Service can accept and utilize voluntary help and services from the public. The major objective of the program is to utilize this voluntary help in such a way that is mutually beneficial to the National Park Service and the volunteer. Volunteers are accepted from the public without regard to race, creed, religion, age, sex, sexual orientation, national origin, or disability.
Wilderness	A designation applied to certain federal lands set aside for preservation and protection in their natural condition, in accordance with the Wilderness Act of 1964.