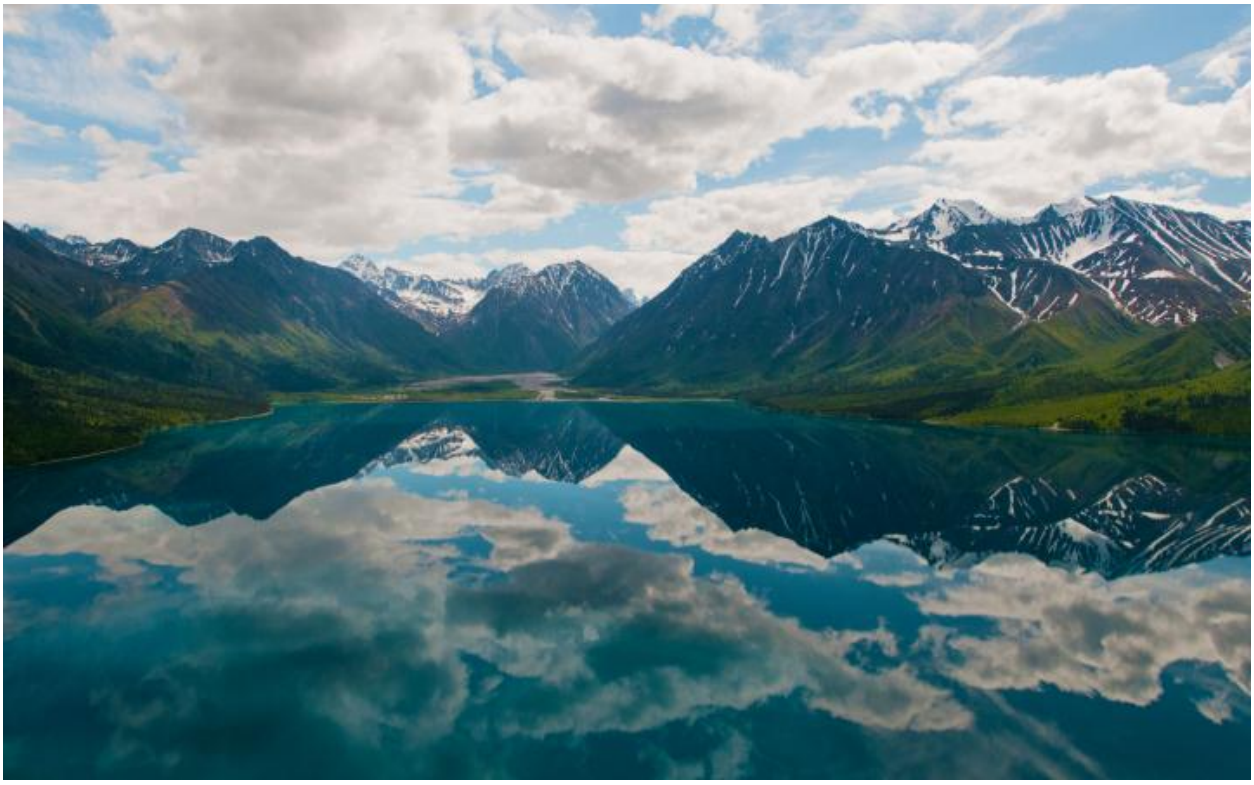
National Park Service
U.S. Department of the Interior

State of the Park Report

Lake Clark National Park and Preserve

Alaska



2016

National Park Service. 2016. State of the Park Report for Lake Clark National Park and Preserve. State of the Park Series No. 28. National Park Service, Washington, DC.

On the cover: Lake Clark National Park and Preserve is a place of countless opportunities, vistas, and landscapes, including this view of Telaquana Lake inlet.

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.

The purpose of this State of the Park report is 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.

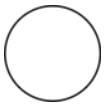
The purpose of Lake Clark National Park and Preserve (Lake Clark NP&P) is to protect a region of dynamic geologic and ecological processes that create scenic mountain landscapes, unaltered watersheds supporting Bristol Bay red salmon, and habitats for wilderness dependent populations of fish and wildlife, vital to 10,000 years of human history.

Significance statements express why the park unit's resources and values are important enough to warrant national park unit designation. Lake Clark NP&P is significant because it:

1. Protects extraordinary mountain landscapes dominated by two active volcanoes and cradles a system of turquoise-hued lakes and free-flowing rivers that epitomize Alaska's scenic beauty.
2. Protects a complex mosaic of landforms and ecosystems that continue to evolve from dynamic tectonic, volcanic, glacial, and climatic processes.
3. Protects critical spawning and rearing habitat at the headwaters of the world's most productive red (sockeye) salmon fishery.
4. Protects vast, undisturbed landscapes of coastal areas, mountain ranges, tundra, foothills, and lake regions that support a full complement of fish and wildlife species.
5. Protects a tapestry of cultural places woven from 10,000 years of human occupancy that is vital to the cultural and spiritual continuance of the Dena'ina culture.
6. Protects resources and provides opportunities for local rural residents to engage in the harvesting activities necessary to support a subsistence way of life.
7. Manages one of the largest wilderness areas in the United States providing visitors with superlative opportunities for solitude and self-reliance.

The summary table, below, and the supporting information that follows, provide an overall assessment of the condition of priority resources and values at Lake Clark NP&P based on scientific and scholarly studies and expert opinion. The internet version of this report, available at http://www.nps.gov/stateoftheparks/lacl/, 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 table 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**

State of the Park Summary Table

Priority Resource or Value	Condition Status/Trend	Rationale
Natural Resources		web ▸
Geologic Features and Processes		Geologic processes, such as volcanic eruptions, landslides, earth quakes, and plate tectonics, are all actively occurring within the park and a major driver of ecosystem processes and habitat changes. Geologic and soils mapping have been completed, geologic inventory is underway.
Landscape Dynamics and Seasonal Processes		Landscape dynamics and seasonal processes, in conjunction with geologic processes, are the major factors shaping ecosystems and associated habitat conditions and wildlife populations within Lake Clark NP&P. Most processes have remained intact and occur within their historic range of variability. However, some processes, such as glacial advance / retreat, may be shifting in response to climatic conditions.
Wildlife		Wildlife populations within Lake Clark NP&P continue to fluctuate naturally as predator / prey interactions and habitat conditions remain intact. Bear, Dall's sheep, and bald eagle populations are all stable. Moose populations have declined in the past ten years, possibly due to increased predation following a substantial decline and range shift in the Mulchatna caribou herd population. Wolf numbers continue to fluctuate in response to prey availability.
Fisheries		Fish populations within Lake Clark NP&P remain in good condition. Contaminant levels in some fish species remain of concern but no population level impacts have been detected. Sockeye salmon escapement goals have been met on the Kvichak River system since 2004; the Newhalen River (and subsequently Lake Clark) is part of the Kvichak system. Sockeye salmon continue to be the primary subsistence food resource in the Lake Clark area.

Priority Resource or Value	Condition Status/Trend	Rationale
Water Quantity and Quality		Water quantity and quality condition in Lake Clark NP&P is very good with natural system dynamics causing most variation observed in existing datasets. Long-term monitoring by the Southwest Alaska Inventory and Monitoring Network annually assesses a variety of water quality and hydrologic parameters.
Marine Nearshore		Condition of marine nearshore resources is currently unknown but assumed in good condition as most visitor use along Lake Clark NP&P's 120 mile coastline is confined to the Silver Salmon Creek and Chinitna Bay area. Bear viewing and recreational clam harvest remain popular activities at these locations. Emerging issues of concern regarding resource development in Cook Inlet may require additional management focus in upcoming years.
Air Quality		Air quality in Lake Clark NP&P is 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 may increase the number of hazy days.
Dark Night Sky		Night sky conditions in Lake Clark NP&P remain in near pristine condition. A night sky measurement at Telaquana Lake detected virtually zero anthropogenic light. Measurements on lower Lake Clark only detected small anthropogenic light from Nondalton and Newhalen.
Acoustic Environment		The Lake Clark NP&P soundscape is primarily in good condition. Increased aircraft traffic in recent years through Lake Clark Pass, Merrill Pass, and the Lake Clark NP&P coast has likely contributed to increased levels of anthropogenic noise. However, the vast majority of Lake Clark NP&P remains relatively free from human-caused noise.
Cultural Resources		web ▸
Archeological Resources		As of 2014, 5,299 acres within Lake Clark NP&P have been adequately surveyed, which represent approximately 0.14 percent of the parks 4 million acres. A majority of the area investigated is located in the vicinity of Lake Clark. 99 properties are deemed to have adequate National Register documentation, which represents approximately 46% of the 216 known archeological sites in the park and preserve. 55% of the sites are in good condition. Changing climatic conditions and melting snow and ice patches have impacted archeological resources and have resulted in the exposure and deterioration of previously frozen organic artifacts.
Cultural Anthropology		Multiple studies have been carried out for Lake Clark NP&P. One of the park's strengths for the ethnography program is the solid relationship with the local elders and tribes. This relationship has helped to incorporate more Native voices and perspectives into many significant park projects and programs. More work needs to be done regarding Traditional Environmental Knowledge (TEK) studies, Dena'ina language, and place names. Language is key to knowledge. Nondalton has the most fluent speakers of Dena'ina remaining; as elders pass away, knowledge will diminish.

Priority Resource or Value	Condition Status/Trend	Rationale
Cultural Landscapes		Eleven Cultural Landscape Inventories (CLIs) have been identified in Lake Clark NP&P; two have been completed, one CLI is 90% done, and eight have not been initiated. Significant research has been done on other landscapes. Of the 11 landscapes, three are on the National Register, and several other contributing properties have adequate National Register Documentation. One Cultural Landscape Report (CLR) is in the process of being completed, and another is scheduled to start in 2016.
Historic Structures		Of the 62 historic structures in Lake Clark NP&P, 90% have adequate National Register documentation, and 42% are in good condition. 95% of the structures have been evaluated using appropriate historical contexts.
History		Several outstanding publications and research have been written and undertaken to understand the significance of Lake Clark NP&P. The Historic Resource Study was completed in 1994, and the Administrative History is awaiting edits and final revision. A total of 99 properties are deemed to have adequate National Register documentation, which is 46% of the known sites. Generally, there is appropriate research preceding planning decisions involving archeological and historic resources; however, those with local knowledge need to be consulted during the planning process, and funding for processing curatorial specimens and archives need to be included in planning.
Museum Collections		Continued review of previous and on-going approved resource management projects and park planning initiatives to clearly identify the accessioning and cataloging backlog needs to continue. A draft Scope of Collections Statement (SOCS) exists for Lake Clark NP&P, it is well written, but needs to be finalized. 100% of the objects have been accessioned and 97.28% of the objects have been cataloged into the museum collection. Around 50% of the archives, while fully described and cataloged, were cataloged before the recent WASO-approved Lake Clark NP&P archival hierarchy. All baseline documentation is nearly complete and current. The overall condition of Lake Clark NP&P's museum collection based on condition surveys and improvement to storage is good.
Visitor Experience		web ▸
Number of Visitors		The number of visitors and visitor use days have both more than doubled in the previous five years. Increased visitation at Lake Clark NP&P's coastal areas has contributed to the majority of the growth. Visitor numbers are generated from commercial operator reporting, and do not reflect individuals accessing the park independently.
Interpretive and Education Programs – Talks, Tours, and Special Events		Professional and quality programming is offered to the public. Staff members in all divisions contribute to provide Ranger and Junior Ranger programs to visitors and park residents.
Interpretive Media – Brochures, Exhibits, Signs, and Website		The quality of interpretive media has increased significantly in the last few years. Virtual visitation is significantly larger than in-park visitation, and improving digital outreach is a priority.
Recreational Opportunities		The park offers a diverse range of recreational opportunities to visitors. A large Wilderness area provides for unique backcountry experiences. Popular activities include hunting, fishing, boating, photography, and bear viewing. An improved trail system near Port Alsworth benefits visitors and park residents. The park recognizes the need to better reach visitors guided by commercial operators.

Priority Resource or Value	Condition Status/Trend	Rationale
Accessibility		Significant work to the Visitor Center and interpretational media has improved compliance over the past two years. All new media produced is Americans with Disabilities Act (ADA) compliant.
Safety		Improvements in safety equipment, training, and communications lead to overall safer park operations. The park continues to work to identify potential hazards and mitigate risks.
Partnerships		All divisions in the park continue to benefit from the work of volunteers. The number of volunteers and hours contributed continued to grow in 2014. The park continues to work with a number of official and unofficial partners to accomplish various goals.
Park Infrastructure		web ▸
Overall Facility Condition Index		Changes in Facility Condition Indices have been significantly skewed during the last year by the addition of 31 backcountry cabins to the FMSS inventory. These cabins were selected, by cultural resource staff, from among more than 100 existing structures as having potential historic or cultural significance. Each of the cabins was assessed with a current replacement value based on square footage and construction. However, deferred maintenance needs have not been established through inspection or assessment. Therefore, all of these cabins appear in the facility database in perfect condition. Once we rectify this deficiency in our data through accurate condition assessment, the FCI will return to a more moderate level, possibly even falling below the current level.
Wilderness Character and Stewardship		web ▸
Overall Wilderness Character		As a whole, wilderness character in the Lake Clark Wilderness is in good condition. Ecological systems are generally free from the effects of modern civilization, with few intentional actions to manipulate or hinder natural processes. There are few developments in the wilderness. Visitor use, especially in the Lake Clark backcountry, remains low. Increased visitation is currently being addressed at some high use areas to mitigate resource impacts.
Wilderness Stewardship		Stewardship of the Lake Clark Wilderness continues, as the park has completed their Wilderness Basics and initiated a wilderness character monitoring strategy. Staff has received wilderness-specific training.

Priority Resource or Value	Condition Status/Trend	Rationale
Subsistence		web ▸
Subsistence		Park management responds to increased pressure on subsistence resources, by continuing to mitigate conflict and competition between sport and subsistence users. The number of chainsaw permits continues to increase as the population of Port Alsworth grows. During years where travel is restricted on Lake Clark due to poor ice conditions, harvest very likely exceeds the sustainable limit from the Port Alsworth wood lot. No known studies have been conducted for adequate baseline inventory of the effects of climate change on subsistence resources and impacts on subsistence users. Efforts of subsistence management need to be coordinated between the cultural and natural resource programs. Lake Clark NP&P should continue efforts to ensure that permitting is accessible to subsistence users, and that the process is effective and efficient. Continued development of communication with both visitors and subsistence users in ways that minimize conflicts between user groups is a priority.

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:

Natural Resources

- On-going annual monitoring of key wildlife and fisheries resources (e.g,. sockeye salmon, moose, Dall's sheep, brown bears) of high management and ecological importance.
- Long-term monitoring protocols and standard operating procedures established for vegetative communities, water resources, climate and weather, and wildlife species.
- Active engagement in research projects with U.S. Geological Survey, University of Alaska, Alaska Department of Fish and Game, University of Washington, Alaska Department of Environmental Conservation, Oregon State University, Bristol Bay Native Association, and U.S. Fish and Wildlife Service.
- Initiated Natural Resources Condition Assessment in cooperation with St. Mary's University to provide synopsis of key fish, wildlife, and physical science resources in Lake Clark NP&P.

Cultural Resources

- Publications of rich cultural histories (see Chapter 3 for list of those published).
- Oral history interviews and mapping key Dena'ina resource areas, as well as sacred and burial sites.
- Compiled place names, developed place name database with GIS maps, and published *Dena'ina Elnena, a Celebration: Voices of the Dena'ina* (2010). The names signify social and personal ties to the land and reference important subsistence and cultural sites. The book also provides helpful information on language and dialects, regional prehistory and history and annual subsistence patterns.
- Collaboratively produced the first ever museum exhibit on Dena'ina history, culture, and tradition with the Anchorage Museum.

Visitor Experience

- Lake Clark NP&P completed a GMP amendment in 2014, which provides guidance to park managers. The focus of the GMP is to protect resources and provide expanded visitor recreational opportunities. The GMP provides guidance regarding how Lake Clark NP&P will craft expanded opportunities in ways that will not significantly alter the current experience or quality of resources.
- Visitors are provided with compelling experiences at the Visitor Center in Port Alsworth throughout the summer. The Visitor Center experience has been recently upgraded through new exhibits, new programming, and new brochures. The station is open seven days a week in the summer. Visitation to the station has doubled in three years.
- New exhibits have been developed and installed: A new subsistence exhibit was installed in the visitor contact station in Port Alsworth in 2014. Exhibit features local Dena'ina subsistence users describing subsistence, telling stories, and using Dena'ina language. Redoubt and Illiamna Volcano waysides were installed on the Sterling Hwy in 2013 and 2014. New

waysides and bulletin boards were developed and installed at Silver Salmon Creek and Chinitna Bay in 2012. Backcountry trip planning tools were developed for the visitor center in 2013.

- The personal services interpretive program offers a wide variety of opportunities and is supported by staff throughout the park. Highlights include backcountry tours at the Richard L Proenneke site. In 2014 park volunteers provided 179 tours for 911 visitors at the Proenneke Cabin. The Junior Ranger program in Port Alsworth is also going very well. It is now well established and offers excellent opportunities for youth and families. Future plans work to leverage this model to reach additional local communities and their families.
- The park works with a variety of effective partnerships. One example of a highly functioning partnership is the 2014 partnership with Samaritan's Purse and Tanalian Bible Camp to receive an Active Trail Grant from the National Park Foundation to address high priority trail improvements. The park partnered with the Student Conservation Association and local volunteers to accomplish the work. Samaritan's Purse supported the project evaluation and visitor experience components of the project. Working with numerous partners Lake Clark NP&P was able to be responsive to visitor and partner trail improvement needs and accomplish priority work.

Park Infrastructure

Sustainability and environmental health were addressed through the following work:

- Increased efficiency of eleven heated structures using improved insulation techniques.
- Installed three high efficiency boilers to reduce fuel use and associated greenhouse gas emissions.
- Successfully mitigated radon in four park residences by sealing and modifying crawlspaces.
- Achieved power efficiency in utilities and buildings using alternative energy sources including wind and solar.
    - Installed a wind-powered air compressor to aerate the park wastewater lagoon, saving more than $300 each month in electric utility fees.
    - All backcountry cabins now have improved, sustainable communications due to solar power.
    - Increased our alternative energy capacity for operating the newly purchased aircraft hangar by installing a 2,750 watt solar array and associated battery storage.
- Bicycles and bike racks as well as kayaks are now provided as human-powered alternatives to motor vehicles.
- Diversion of waste has increased due to an efficient sorting and recycling facility.
- A safe, energy saving, clean burning, and efficiently used incinerator has improved productivity and reduced ash production.

Key Issues and Challenges for Consideration in Management Planning

Over the past eight years visitation to Lake Clark NP&P has increased steeply, intensifying operational needs and resource impacts. The highest growth in visitation is in the Port Alsworth area, the Richard L. Proenneke National Historic Site, and the coastal areas of Lake Clark. Restroom facilities are either primitive or not available at these highly visited locations and sanitation is an issue. Also, existing social trails have grown over time and require extensive work to maintain and manage for future use. Multiple new user groups contribute to the increase in use including a large number of disabled visitors who need accessible facilities and trails. A trail management plan and extensive trail improvements are required to protect the resources and to serve the visitors.

The majority of park facilities are located in Port Alsworth. Over the past two decades visitation has shifted from Port Alsworth, a hub for hunters traveling to the backcountry, to the Coastal District for bear viewing. Now the majority of visitation occurs on the coast where there is limited park service facilities and difficult access for the park staff.

Climate change is leading to dramatic decreases in glacier extent and is impacting various ecosystems. Existing data on climate changes are limited, making it difficult to measure the scope of these changes.

Chapter 1. Introduction

The purpose of this State of the Park report for Lake Clark NP&P 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.

The National Park Service Organic Act of 1916 states that units of the national park system are established to "conserve the scenery and the natural and historic objects and the wild life therein and to provide for enjoyment of the same in such manner and by such means as to leave them unimpaired for the enjoyment of future generations." This statement represents the most basic mission of Lake Clark NP&P.

Most of the national parks in Alaska, including Lake Clark NP&P, were established or expanded under the Alaska National Interest Lands Conservation Act (ANILCA), which was adopted on December 2, 1980. ANILCA's passage culminated more than 20 years of deliberation on federal land claims after Alaska statehood.

Prior to Alaska becoming a state in 1959, nearly all land was federal. The Alaska Statehood Act granted the state the right to select 104 million acres of federal land. Within a few years the state land selection process began to include lands traditionally used by Alaska Natives. This led to objections, which eventually resulted in a freeze on further state, land selections pending Congressional settlement of the Native claims.

In 1971 Native claims were resolved by passage of the Alaska Native Claims Settlement Act (ANCSA). This act, in addition to Native land claims, also provided for withdrawal of 80 million acres for possible designation as national parks, fish and wildlife refuges, national forests, and wild and scenic rivers. Lake Clark NP&P is among those park areas first established in 1978 by Presidential Proclamation by President Carter when he withdrew over 100 million acres of federal land, including 56 million acres as national monuments.

ANILCA mandates the specific purposes for each park established. Congress also provided that ANILCA would allow some key activities necessary to perpetuate the rural Alaskan lifestyle, such as subsistence uses, traditional uses, access, cabins, and hunting and trapping. Providing for ANILCA's mandates and special uses makes management of Alaska parks unique within the national park system.

The purpose of Lake Clark NP&P is to protect a region of dynamic geologic and ecological processes that create scenic mountain landscapes, unaltered watersheds supporting Bristol Bay red salmon, and habitats for wilderness dependent populations of fish and wildlife, vital to 10,000 years of human history.

Specifically, section 201 of the Alaska National Interest Lands Conservation Act (ANILCA) states that the park shall be managed for the following purposes, among others:

- to protect the watershed necessary for perpetuation of the red salmon fishery in Bristol Bay.

- to maintain unimpaired the scenic beauty and quality of portions of the Alaska Range and the Aleutian Range, including active volcanoes, glaciers, wild rivers, lakes, waterfalls, and alpine meadows in their natural state.

- to protect habitat for and populations of fish and wildlife including but not limited to caribou, Dall's sheep, brown/grizzly bears, bald eagles, and peregrine falcons.

- Subsistence uses shall be permitted in the park where such uses are traditional.

Significance statements express why the park unit's resources and values are important enough to warrant national park unit designation. Lake Clark NP&P is significant because Lake Clark NP&P:

1. protects extraordinary mountain landscapes dominated by two active volcanoes and cradles a system of turquoise-hued lakes and free-flowing rivers that epitomize Alaska's scenic beauty.

2. protects a complex mosaic of landforms and ecosystems that continue to evolve from dynamic tectonic, volcanic, glacial, and climatic processes.

3. protects critical spawning and rearing habitat at the headwaters of the world's most productive red (sockeye) salmon fishery.

4. protects vast, undisturbed landscapes of coastal areas, mountain ranges, tundra, foothills, and lake regions that support a full complement of fish and wildlife species.

5. protects a tapestry of cultural places woven from 10,000 years of human occupancy that is vital to the cultural and spiritual continuance of the Dena'ina culture.

6. protects resources and provides opportunities for local rural residents to engage in the harvesting activities necessary to support a subsistence way of life.

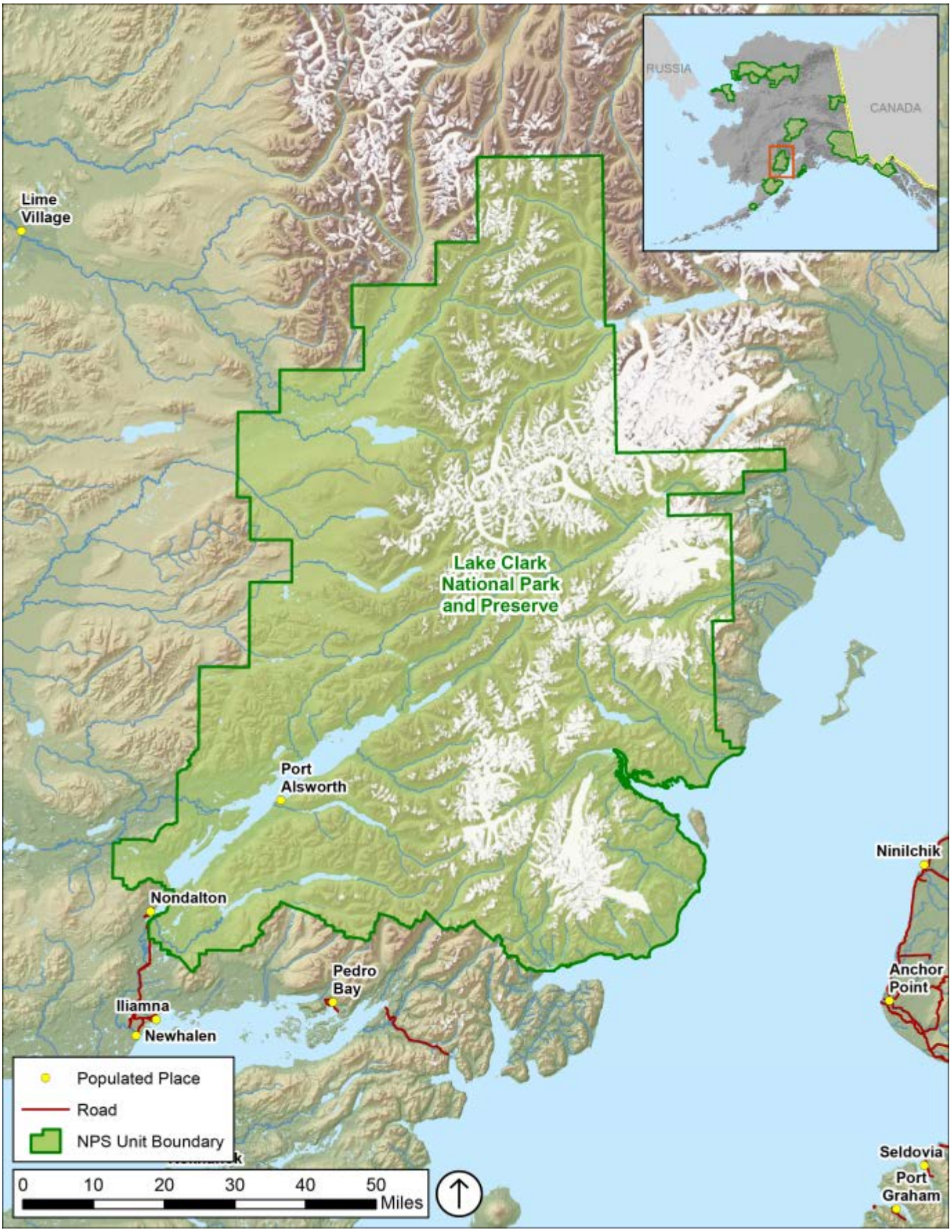
7. manages one of the largest wilderness areas in the United States providing visitors with superlative opportunities for solitude and self-reliance.

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 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 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 in 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 (Chapin et al. 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

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 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

Geologic Features and Processes

web ▸

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Geologic Inventory	Digital surficial geology map, geologic resources inventory completed		Geologic dynamics and processes, such as landslides, volcanic eruptions, and tectonic uplift, provide localized and widespread disturbances that actively shape terrestrial and aquatic habitats. Digital surficial geology map layer and metadata complete. A parkwide soil inventory was completed in 2011. A geologic resource inventory is scheduled for completion in 2015 (Wells et al. 2013, NPS Geologic Resources Inventory Program 2010).
Paleontological Resources	Fossil inventories		Fossil Point in Tuxedni Bay along the Lake Clark NP&P coast represents the most prominent and visible fossil exposure in the park. In August 2014 this location was surveyed, including specimen collection and identification, and stratigraphy mapping. A final report will be available on the Lake Clark NP&P website.

Landscape Dynamics and Seasonal Processes

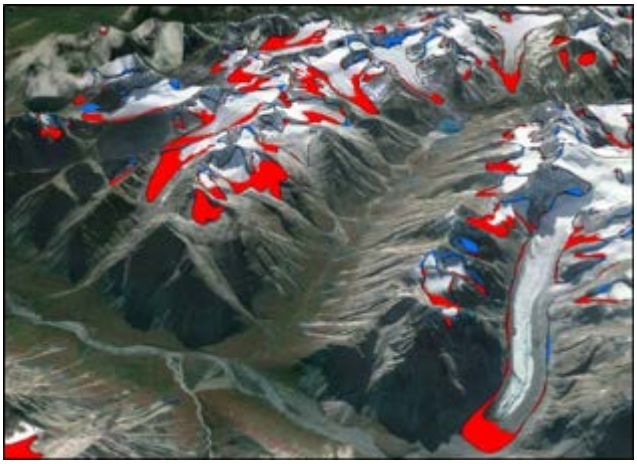
web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Glaciers	Glacial Extent		Glaciers are prominent features of the Lake Clark NP&P landscape. The retreat of glaciers started in the late 19th century, coinciding with the end of the Little Ice Age. Glacier extents are documented from aerial photographs and satellite images acquired in the mid-1950s, late 1980s, and late 2000s (Lindsay and Adema 2013). Between 1956 and 2009, glacier extent within the administrative boundary of the park was reduced by 328.5 km^2—a loss of 12.3%. Notable is the significant retreat and sometimes complete disappearance of small, but numerous higher elevation cirque glaciers in the park (Loso et al. 2014).
Forest Condition	Spruce beetle damage		Spruce beetle activity in Lake Clark NP&P peaked between 1995–1998, followed by a second wave of activity between 2008 and 2012. Total area affected is approximately 148,140 acres (59,950 ha), or roughly 35% of forested area in the park, as estimated from U.S. Forest Service aerial survey data (1989–2011). Affected areas are concentrated in Lake Clark Pass, the Crescent River, and the Lake Clark and Tazimina Lake basins, where beetle activity appears to have stabilized. White spruce stands outside of these areas have remained largely unaffected (Miller 2013).
	Seedling recruitment		Roughly 50% of sites had live sapling densities of <1,200 stems/ha, suggesting the potential for near-term recruitment limitation (into the forest canopy). However, coarse woody debris loads (downed logs) at some of the beetle-kill stands are roughly an order of magnitude greater than the average forest sites (0.0003 t/ha), and through time should provide nurse logs for new seedling establishment. Mean seedling (1,300 stems/ha) and sapling densities (3,130 stems/ha) for white spruce are low relative to stem densities for trees (>10,000 stems/ha) in mature spruce stands, as estimated from the Inventory and Monitoring forest data collected between 2009–2014. Seedling counts are similar between beetle-kill and undisturbed stands with comparable understory vegetation. Low seedling densities are not unusual in productive stands, where new seedling establishment often follows disturbance.
	Epiphytic lichen communities		Epiphytic lichen richness ranges from 13 to 38 species in forest monitoring plots (2012–2013) and species composition is similar to that described from a recent regional study (Root et al. 2014). The lichen communities include a number of species considered sensitive indicators of airborne contaminants, and their presence indicates relatively pristine air quality. Likewise, the low occurrence of nitrophilous (nitrogen-loving) lichens in Lake Clark NP&P reflects low levels of nitrogen (N) deposition, consistent with deposition data from regional NADP stations.

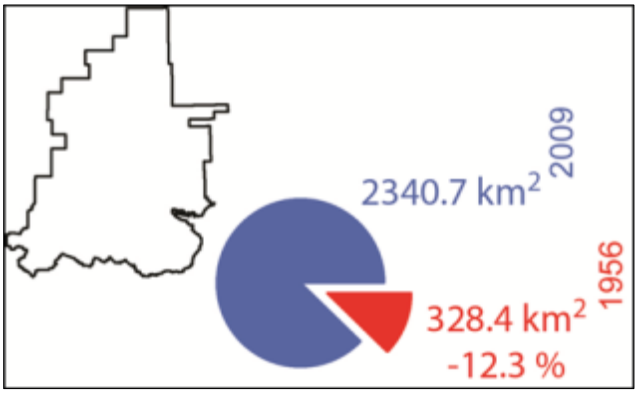
Landscape Dynamics and Seasonal Processes (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Invasive Plants	Invasive plants infestation		An EPMT inventory conducted in 2005 found a total of 30 non-native, invasive plant species occupying 22 acres (9 ha), or less than 0.0005% of the park area. Reed canarygrass (*Phalaris arundinacea*) and orange hawkweed (*Hieracium auranticum*) were the most invasive species, and common dandelion (*Taraxacum officinale* ssp. *officinale*), common timothy (*Phleum pretense*), and chickweed (*Cerastium fontanum*) were the most abundant. Populations were concentrated in Port Alsworth and areas of highest visitor use, including Twin Lakes and the outer coast. To date, no invasive species have been found in vegetation plots established in the backcountry (2007–2014). Invasive aquatic plants, such as Elodea, represent a concern due to the ease of which plant fragments are transported among waterbodies via floatplane and watercraft.
Lake Ice Season	Average lake freeze-up date		Lake freeze-up is one of the telltale phenological changes each year in Lake Clark NP&P. There is considerable year-to-year variability in freeze-up dates, duration, and extent of lake ice cover during the winters of 2001/2002 to 2011/2012. Trend reflects, in large part, that the winters of 2001/2002 to 2005/2006 were warmer than the winters of 2005/2006 to 2011/2012. Summary is average of metrics for four lakes (Chakachamna, Clark, Upper and Lower Twin, and Telaquana Lakes. During winters of 2001/2002 to 2011/2012, the date of final freeze-up (90% ice) is getting earlier (1.6 days earlier), the date of break-up (10% ice) is getting later (0.9 days later). Notably, large lakes like Lake Clark do not freeze completely in some years (2002/2003). Application for subsistence use as travel corridor for wood cutting. For more information, see the Southwest Alaska Network (SWAN) Lake Ice Map.
	Average lake ice out date		As with lake freeze-up, lake ice out signals a changing of the season. There is considerable year-to-year variability in freeze-up dates, duration, and extent of lake ice cover during the winters of 2001/2002 to 2011/2012. Trend reflects, in large part, that the winters of 2001/2002 to 2005/2006 were warmer than the winters of 2005/2006 to 2011/2012. Summary is average of metrics for four lakes (Chakachamna, Clark, Upper and Lower Twin, and Telaquana Lakes. During winters of 2001/2002 to 2011/2012, the date of final freeze-up (90% ice) is getting earlier (1.6 days earlier), the date of break-up (10% ice) is getting later (0.9 days later). Notably, large lakes like Lake Clark do not freeze completely in some years (2002/2003). For more information, see the SWAN Lake Ice Map.



Change in glacier extent near the headwaters of the Chilligan river in Lake Clark NPP (view is to the south). Modern (2009) glacier outlines are shown in black, red indicates glacier that has been lost since the 1950s, and blue indicates minor ice gain or glacier ice that was not recognized in the 1950s. The late 20th and early 21st century has witnessed the significant retreat and sometimes complete disappearance of small, but numerous higher elevation cirque glaciers in Lake Clark. NPS Photo.



Change in glacier extent between the 1950s and late 2000s in Lake Clark. Pie charts show the modern extent of ice within each park (in blue) and the extent of ice that has been lost since the 1950s baseline (in red).

Amy Miller, NPS ecologist, records canopy cover in a forest plot near Lachbuna Lake, July 2014. NPS Photo.

Wildlife

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Moose	Calf:cow ratio		Moose represent an integral component of terrestrial systems, influencing vegetative communities through browsing and proving an important food source for wolves, bears, and humans (Mangipane and Wilson 2011). Current calf:cow ratios in Lake Clark NP&P are below the level needed to maintain a stable population. Ratios estimated from surveys conducted in 2010–2013 were 11:100, 21:100, and 24:100, for southern, central, and northern surveys areas, respectively. The southern area calf:cow ratios declined from 18:100 in 2007 to 11:100 in 2010–11. Central area calf:cow ratios increased from 15:100 in 2005 to 21:100 in 2010. Northern area calf:cow ratio increased from 16:100 in 2008 to 24:100 in 2013. Degree of confidence is medium. Surveys are conducted under excellent survey conditions and use a sightability correction factor in estimating population parameters. Variability around the estimates is relatively large, limiting the confidence in assessing trend.
	Total count / survey unit		Moose represent an integral component of terrestrial systems, influencing vegetative communities through browsing and proving an important food source for wolves, bears, and humans (Mangipane and Wilson 2011). Current regional moose populations are low in Lake Clark NP&P. Total estimates were 166 in the southern area in 2010–11, 245 in the central area in 2010 and 146 in the southern area in 2013. In the southern area, total estimates were 154 in 2007 and 166 in 2010–11. The central area total estimates were 322 in 2005 and 245 in 2010. The estimated population in the northern area was 134 in 2008 and 146 in 2013. Population trends are uncertain but levels remain low due to poor recruitment from low calf:cow ratios. Degree of confidence is medium. Surveys are conducted under excellent survey conditions and use a sightability correction factor in estimating population parameters. Variability around the estimates is relatively large, limiting the confidence in assessing trend.
Brown Bears	Relative abundance of coastal brown bears		Viewing of brown bears in salt marsh meadows currently represents the most popular visitor use activity in Lake Clark NP&P. Salt marsh meadow counts are conducted twice each summer. The 2014 estimates were 208 and 164 brown bears for June and July, respectively. The 2014 estimates are higher than monthly averages, June 168 and July 131, for the period from 2004–2013. The degree of confidence is medium. Surveys are conducted under excellent conditions but no method of assessing bear sightability or data identifying the proportion of bears using the salt marsh areas available. Vegetative seasonality varies annually and influences bear numbers. Multiple surveys annually attempt to capture and account for seasonal variation (Mangipane and Wilson 2011).

Wildlife (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Wolves	# of established packs		Based on research conducted in 2008–2013, estimated number of established packs in Lake Clark NP&P was 4 in 2008–2009, 4 in 2009–2010, 3 in 2010–2011, 5 in 2011–2012, and 3 in 2012–2013. Wolf pack number in interior Lake Clark NP&P remains fairly stable, with 4 packs typically encompassing this region. Harvest and dispersal cause localized, temporary dissolution of packs reducing this number. Confidence is medium. From 2009–2012, most interior packs contained at least one radio collared wolf allowing accurate determination of pack size. Since 2013, lack of radio collared wolves has limited our ability to monitor packs and determine size. Currently, number of packs is unknown.
	Average pack size		Based on research conducted in 2008–2013, average pack size was 6.0 in 2008–2009, 5.5 in 2009–2010, 4.0 2010–2011, and 5.4 in 2011–2012. Average pack size in Lake Clark NP&P is smaller than elsewhere in Alaska. Wolf pack size in Lake Clark NP&P has been relatively stable with an average of 5.3 wolves per pack over the duration of the research project. Harvest and dispersal have caused noticeable, short-term reductions in pack size. Confidence is medium. From 2009–2012, most interior packs contained at least one radio collared wolf allowing accurate determination of pack size. Since 2013, lack of radio collared wolves has limited our ability to monitor packs and determine size. Currently, average pack size is unknown.
Dall's Sheep	Parkwide lamb: ewe-like ratio		A Dall's sheep population survey encompassing all sheep habitat in Lake Clark NP&P was flown in July 2012. Estimated lamb: ewe-like ratio was: 24.2:100. This ratio is at the low threshold required to sustain a population. Prior to the 2012 survey, the last survey estimating lamb:ewe-like ratio for all sheep habitat in Lake Clark NP&P was completed in 1995, so trend is difficult to assess. The average lamb:ewe-like ratio of the 5 previous parkwide surveys was 42.3:100. The 2012 estimate is below average and minimal for population maintenance. Confidence is high. The distance sampling survey technique used in 2012 is statistically robust and provides precise estimates for low density sheep populations in Lake Clark NP&P.
	Parkwide population estimate		A Dall's sheep population survey encompassing all sheep habitat in Lake Clark NP&P was flown in July 2012 and resulted in an estimated population of 1,010 sheep. Prior to the 2012 survey, the last survey estimating sheep population size for all sheep habitat in Lake Clark NP&P was completed in 1995, so trend is difficult to assess. The 2012 estimate is higher than the average of the 5 previous surveys, 723 sheep. Confidence is high. The distance sampling survey technique used in 2012 is statistically robust and provides precise estimates for low density sheep populations like Lake Clark NP&P.

Wildlife (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Dall's Sheep (continued)	% legal rams in GMU 9B		Dall's sheep minimum count survey was flown in July 2014 for GMU (General Management Unit) 9B. The % legal ram estimate was 81.0%. Lake Clark NP&P has a high proportion of mature rams in its ram population. The % legal rams in Lake Clark NP&P for GMU9B in 2014 was the highest ever recorded. Percent legal rams has increased from the lowest estimate of 42.2% in 2004 to 75.7% in 2013 and 81.0% in 2014. Confidence is medium. Minimum count surveys in Lake Clark NP&P do not account for sheep sightability and use of fixed wing aircraft limits the survey crew ability to identify young rams. Previous research in Lake Clark NP&P indicates that sheep are highly visible and a correction for sightability would be small.
Bald Eagles	Nest occupancy (# active nest/total nests)		Bald eagle surveys conducted in Lake Clark NP&P during 2014 found 57% and 45% nest occupancy for the coast and interior, respectively (Wilson 2013). Nest occupancy of 50% or greater is generally considered adequate for population stability. Nest occupancy in Lake Clark NP&P has been highly variable since surveys were initiated in 1992. The average from 1992–2013 for both coastal and interior regions is 56%. Estimates for 2014 for the interior fall slightly below the average and the level for population stability and have been below these levels since 2012. The coastal estimate is above average and the level needed for population stability, and was also above these levels in 2013. Confidence is medium. Changes to survey techniques in 2012 and 2013 resulted in improvements in assessing the number and temporal variability of nests that are classified as active (Witter and Mangipane 2011).
	Productivity (number of young/active nest)		Number of young bald eagles produced by active nests in 2014 on the coast was 1.13 and in the interior 0.86 (Wilson 2013). Productivity greater than 0.70 young per active nest is required for population stability. Both regions met that threshold in 2014. Productivity in Lake Clark NP&P has been highly variable since surveys were initiated in 1992. The average productivity from 1992–2013 was 0.74 and 0.78 young per active nest for the coast and interior, respectively. Both areas exceeded this threshold in 2014. The coastal region has exceeded this level for the past 5 years, while the interior has exceeded this level only twice. Confidence is medium. Changes to survey techniques in 2012 and 2013 resulted in improvements, but difficulties remain assessing productivity. Timing and success in fledging of chicks and nest visibility hinder accurate determinations of productivity (Witter and Mangipane 2011).

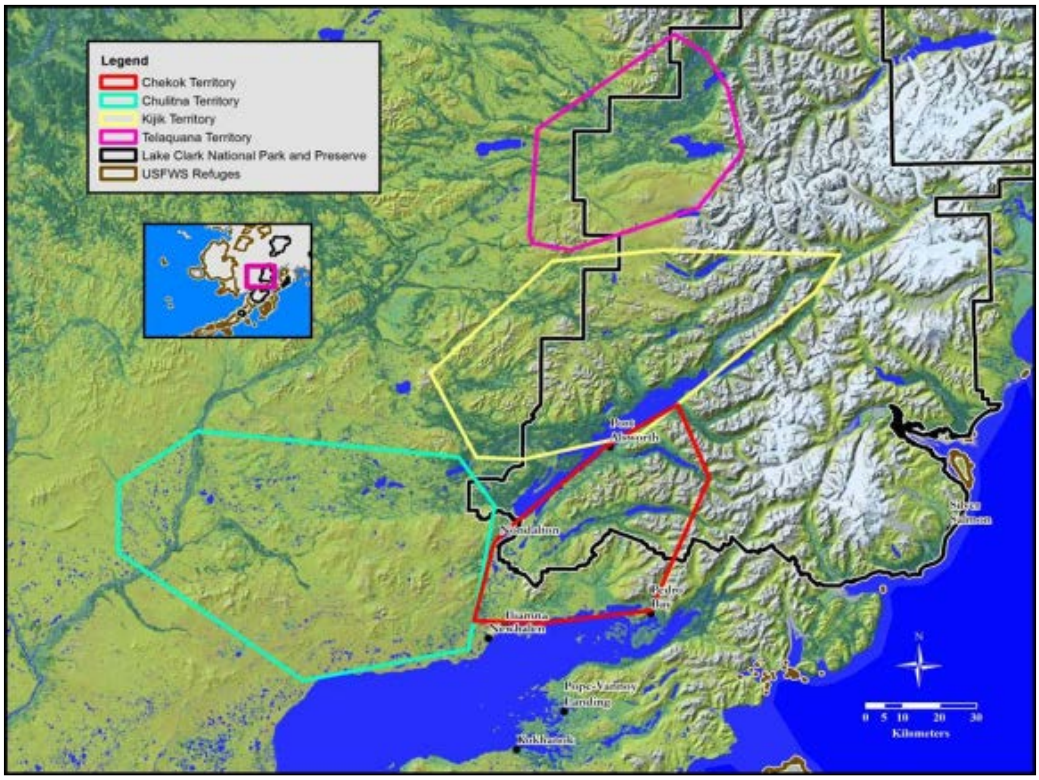
Resource Brief: Wolves in Lake Clark National Park & Preserve

Wolves are an important component of the predator-prey dynamics in Lake Clark NP&P and are highly sought by both park visitors and local trappers and hunters. As an apex predator, the wolf impacts many components of natural systems and those components have adapted to and evolved in the presence of wolves. Most notably, wolves influence the abundance of ungulates, which in turn affects the structure and composition of plant communities. Recent studies using radio-collared wolves have provided insight into this symbol of wilderness.

Over 5 years, 22 wolves from 6 packs were captured in Lake Clark NP&P. Captured wolves were fit with GPS radio collars, biological samples collected, and physical measurements taken. GPS radio collars were programmed to record at least one location daily, a location accurate to within 30 meters and collected regardless of time of day or weather conditions. Combined with aerial radio tracking, these data provide tremendous insight into the daily activities of wolves.

Wolves live in packs, allowing them to more safely, easily, and reliably kill prey much large than themselves. To maintain the pack's structure, strong social bonds are needed among members. In Lake Clark NP&P, fall wolf packs average 5.3 (range 3–7 wolves) animals per pack and typically 4 packs occupy the interior region of Lake Clark NP&P. This is a smaller pack size than documented in many other areas of Alaska. Packs are generally composed of a pair of breeding adults, pups, and extra adults, which may be previous year's pups or unrelated wolves, accepted into the pack. Most young adult wolves disperse from their natal pack, seeking a mate of their own, and thereby lessening food competition among pack members. Dispersal has functioned to keep Lake Clark NP&P packs small, with wolves travelling as far as 253km.

Packs maintain a territory, in which they den, raise pups, and hunt for the food. These areas are dynamic, changing with season, prey distribution, and the distribution and movements of adjacent packs. Territories in Lake Clark NP&P are large, even by Alaska standards. The average territory in Lake Clark NP&P encompasses 1,750 km^2 (range: 683–3,261 km^2). Density of prey is one factor that affects territory size, fewer prey requires more travelling to increase encounter rates. Currently in Lake Clark NP&P, the primary prey of wolves, moose, are at low densities throughout the interior of the park (0.15 moose/km^2). This likely contributes to the large territories Lake Clark NP&P wolves travel.



Wolf pack territories in the interior of Lake Clark National Park and Preserve.

Wolves strongly influence ecosystem components, structure, and processes. Currently in Lake Clark NP&P, approximately 30 wolves in 4 packs roam the interior of the park which is a relatively small number considering the expansive size of Lake Clark NP&P. While not numerous, their impact on the ecosystem and contribution to the spirit of wilderness of Lake Clark NP&P is great.

Fisheries

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Sockeye Salmon	Estimated escapement		Newhalen River: 168,000 sockeye salmon in 2014. Telaquana River: 24,000 sockeye salmon in 2014. Crescent River: 58,838 sockeye salmon in 2012 (33 yr avg – 72,894 sockeye salmon) (Bartz and Young 2014). During the early 1980s, the Newhalen River escapement ranged from a low of 147,000 to a high of 3,100,000 salmon. Since 2000, the Newhalen River escapements have ranged from 168,000 to 700,000 fish. The 2014 escapement was the lowest since 2000 and was 55% below the 2000–2013 average (372,000). The Telaquana escapement was 40% below the 2010–2013 average (39,000). Confidence for Newhalen River is high (20 year record), whereas Telaquana River is medium due to a shorter period of record (5 year record). The Crescent River record is 33 years.
	Peak run timing		In 2014, the mid-point of the Newhalen River escapement was on July 13th (Bartz and Young 2014). The mid-point of the Telaquana River escapement was on July 21st. Since monitoring began in 1980, the mid-point of the Newhalen River escapement has ranged from July 15th to August 3rd and averaged July 21st. Since 2000, the mid-point of the Newhalen River escapement has been on July 21st or earlier in 12 of 14 years. The 2014 Newhalen River escapement was 8 days earlier than average and the earliest on record. The mid-point of the Telaquana River escapement has ranged from July 14th to July 31st and averaged July 21st. No trend is apparent in the Telaquana River sockeye escapement. Confidence for Newhalen River is high (20 year record), whereas Telaquana River is medium due to a shorter period of record (5 year record).
Contaminants	Mercury Contamination in Lake Trout		A recent study found elevated mercury levels in lake trout from three lakes in Lake Clark NP&P (Bartz et al. 2014). The mean total mercury concentration in Lake Clark (365.2 nanograms per gram wet weight [ng/g ww]) was more than 3-fold higher than that in Telaquana Lake (109.0 ng/g ww) and 1.8 than that in Lake Kontrashibuna (204.0 ng/g ww). At the lower end of this range, total mercury concentrations pose limited risk to park wildlife and human users. However, the concentrations observed in Lake Kontrashibuna exceeded the benchmark for reproductive impairment to piscivorous birds, and the tissue-based criterion for fish toxicity. Fish from Lake Clark exceeded these benchmarks and the EPA criterion for protection of human health (Eagles-Smith et al. 2014). High mercury concentrations in birds, mammals, amphibians, and fish can result in reduced foraging efficiency, survival, and reproductive success. Human health effects from elevated levels of mercury can affect the brain, kidneys, and reproductive function (Eagles-Smith et al. 2014).

Fisheries (continued)

web

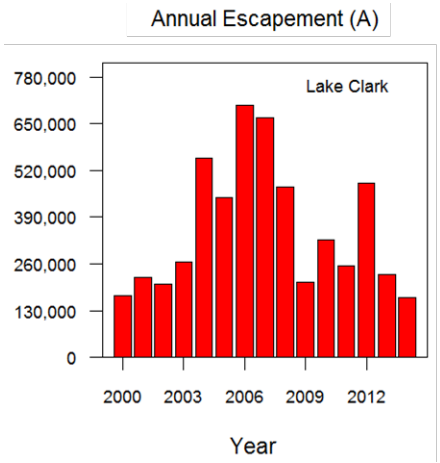
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Contaminants (continued)	Semi-volatile organic compounds (SOCs) in Lake Trout		Historic use compounds, such as dieldrin, chlordanes, HCB, PCBs, and DDT were found at significantly higher rates in Lake Clark NP&P than other western parks (Flanagan Pritz et al. 2014). Recent data collected provide a baseline but no trend can be assessed at this time (Flanagan Pritz et al. 2014).

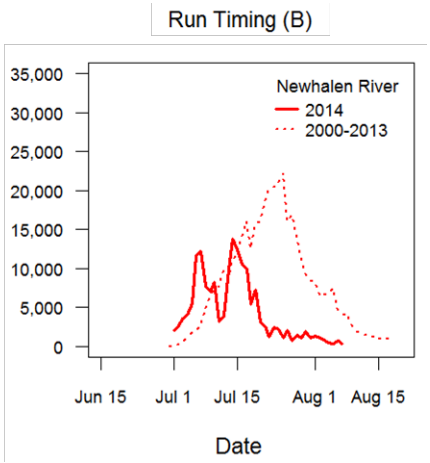
Resource Brief: Sockeye Salmon Escapement in Lake Clark NP&P

Sockeye salmon, also known as red salmon, are the life blood of the Bristol Bay region. Each year millions of sockeye salmon return to Bristol Bay, infusing life into the culture, economy, and ecosystem. Since prehistoric times sockeye salmon have been an integral part of Alaskan Native culture. Today, salmon continue to sustain local people and provide for the majority of their subsistence diet. In the Lake Clark country, residents continue to set nets, fill smokehouses, and can salmon for the coming winter. Bristol Bay sockeye also support the world's largest and most valuable commercial sockeye salmon fishery. Annually, the Bristol Bay fleet of drift gillnetters and set-netters harvest around 20 million sockeye salmon valued at more than 100 million dollars. Ecologically, the influx of sockeye salmon provides a significant source of marine-derived nutrients that help sustain fish and wildlife populations in the region. In the fall, streams, rivers, and lakes are hubs of activity with bears, bald eagles, and even wolves feasting on the abundant resource.

Sockeye salmon are also an integral part of Lake Clark NP&P, which was established in part to protect the habitats and populations supporting the sockeye salmon fishery in Bristol Bay. Each year, 0.2–3.1 million sockeye salmon migrate to Lake Clark NP&P in July and early August, having survived to adulthood, navigated the gauntlet of commercial and subsistence nets in Bristol Bay, and ascended the rapids of the Newhalen River.

Counting towers located along the Newhalen River are used by the Lake Clark NP&P fisheries program to estimate the number of migrating adult sockeye salmon that "escape" the commercial fishery to spawn in Lake Clark NP&P. Estimates of salmon escapement provide managers and subsistence users with the information necessary to craft management strategies to ensure conservation of the resource while providing for subsistence needs. In 2014, the estimated annual escapement to the Newhalen River was 167,664 sockeye salmon. This escapement was 55% below the average since 2000 (372,000 sockeye salmon). The timing of the return was approximately one week earlier than average with peak counts on July 6th and July 13th.





***Left*: Annual escapement (A) and run timing (B) of sockeye salmon in the Newhalen River system of Lake Clark NP&P. Data are based on hourly counts compiled from two towers (one on each river bank); *Right*: A biologist counts sockeye salmon as they pass the tower on the Newhalen River, Lake Clark NP&P. NPS Photo.**

Water Quantity and Quality

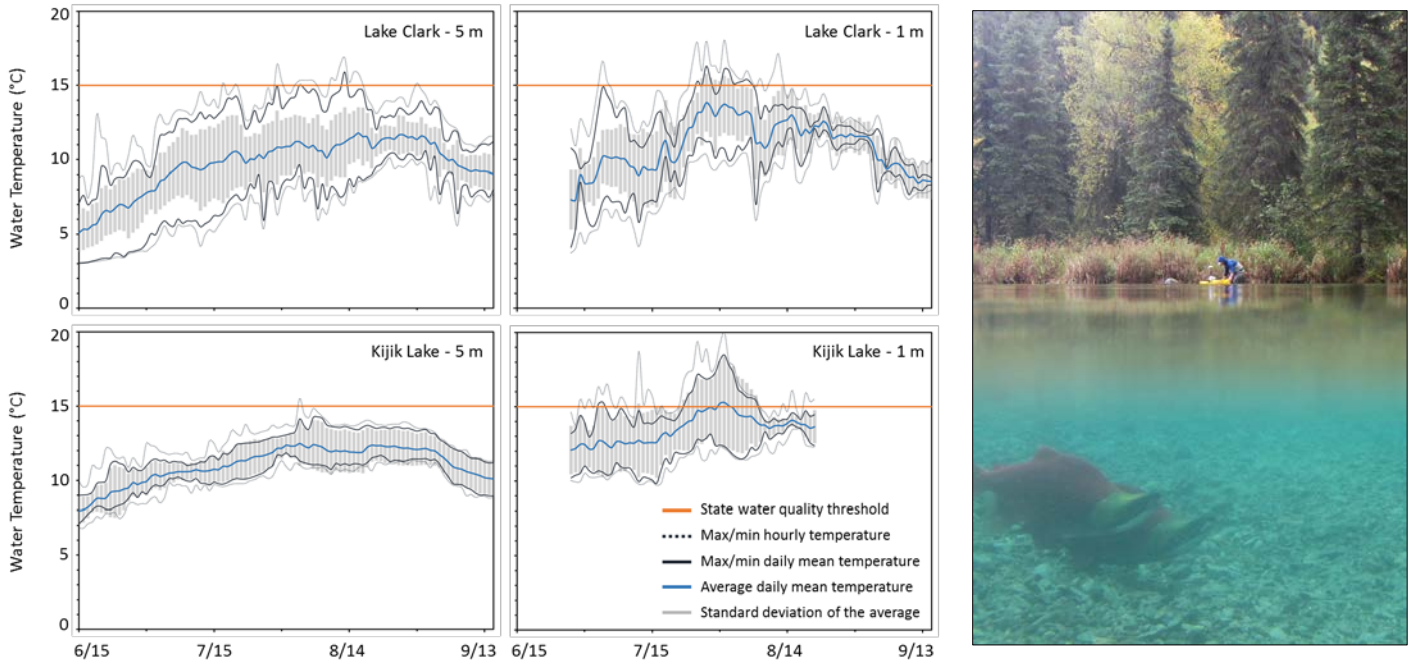
web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Water Quality	Near-surface lake temperature – Lake Clark and Kijik Lake		Water temperature has been monitored hourly year-round at multiple depths in two Lake Clark NP&P lakes: Lake Clark and Kijik Lake (Bartz 2014). In Lake Clark, the highest mean daily temperature at 5 m depth, calculated for each year on record (2007–2014), ranges from 11.23 C in 2010 to 15.91 C in 2007, with no apparent trend. In Kijik Lake, the range is 12.04 C (in 2012) to 14.27 C (in 2013) for the 3 years on record (2011–2013). Mean daily temperatures at 5 m depth rarely exceed the state's surface water quality threshold of 15 C, for the migration routes and rearing areas of anadromous and non-anadromous fish. However, mean daily temperatures at ≈1 m depth exceed the 15 C threshold more frequently. The graph below provides a synopsis of mean daily near-surface temperature for Lake Clark and Kijik Lake.
	Water clarity – Lake Clark		Glacial and non-glacial inputs into Lake Clark generate a longitudinal turbidity gradient each year that is influenced by precipitation and snowmelt, winds, and volcanic ash. Water clarity has been measured in Lake Clark once per year since 2008 via Secchi depth readings throughout the lake. Within years, water clarity tends to increase along the length of the lake from the upper basin (more turbid) to the lower basin (less turbid). Across years, water clarity exhibits the lingering effects of volcanic ash from the March 2009 eruption of Mt. Redoubt. For example, the average Secchi depth in the lower basin decreased from 5.63 m in 2008 (pre-eruption) to 1.36 m in 2009 (post-eruption), and then increased each year thereafter, with the exception of 2013 when a wind event increased turbidity throughout the lake.
Lake Level	Mean daily discharge (June–September) – Lake Clark		Discharge at the outlet of Lake Clark has been estimated through an empirical relationship with lake elevation, which in turn, is derived from "tape-down" measurements in Hardenburg Bay. Tape-down measurements have been recorded daily during summer months since 1999. The peak summer discharge for years from 1999 to 2014 ranges from 18,458 cfs (on 17 August, 2007) to 31,322 cfs (on 1 July, 2001). No trend is apparent in either the magnitude or timing of the peak (Brabets 2002).

Resource Brief: Water Temperature in Lake Clark NP&P

Lakes function as integrators of water, energy, sediments, nutrients, and pollutants from the surrounding land and air. Therefore, lake water quality parameters can serve as indicators of broad scale stressors, such as climate change. High latitude lakes are projected to become not only warmer as a result of climate change, but also more turbid, more enriched in nutrients and organic matter, and more productive (Wrona et al. 2005). These changes have the potential to impact the growth, survival, and reproduction of aquatic organisms, such as sockeye salmon—and also the terrestrial organisms that depend on them. In the case of water temperature, average surface lake temperatures during July are projected to increase by 2 to 6 °C by the year 2100 in other Alaskan lakes near Lake Clark NP&P (Jones and Arp 2014).

The NPS monitors lake temperatures hourly, year-round in two lakes within the park (Lake Clark and Kijik Lake) in order to evaluate water temperature status and trend. This monitoring records temperatures at incremental depths ranging from 1 to 100 m through the use of moored vertical "temperature arrays." Results to date are summarized in the figure below.



***Left*: Summer water temperatures in Lake Clark and Kijik Lake at two near-surface depths (5 m and 1 m). Years included differ by location: 2007–2014 for Lake Clark and 2011–2013 for Kijik Lake; *Right*: Water temperature is also monitored at the Kijik Lake outlet, where sockeye salmon spawn. NPS Photo.**

Marine Nearshore

web ▸

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Bivalves	Abundance		The intertidal zone represents an extremely productive interface between upland terrestrial and coastal marine environments. Along the Lake Clark NP&P coast, brown bears rely heavily on intertidal bivalves as a food resource. Subsequently, brown bear viewing along the Lake Clark NP&P coast represents the highest visitor use activity in the park. Bivalve abundance is currently unknown. Recreational sport harvest of razor clams and other bivalves is popular at several Lake Clark NP&P coastal locations, harvest levels and use unknown.

Air Quality

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Visibility	Haze Index		Average visibility is in good condition. This condition is based on NPS Air Resource Division benchmarks and the 2008–2012 estimated average visibility of 1.6 deciviews (dv) above estimated natural conditions (NPS-ARD 2015). For 2003–2012, the trend in visibility remained relatively unchanged (no statistically significant trend) on the 20% clearest days and improved on the 20% haziest days. See IMPROVE Monitor. The Clean Air Act visibility goal requires visibility improvement on the 20% haziest days, with no degradation on the 20% clearest days. See IMPROVE Monitor.
Deposition	Mercury Concentrations in Lake Trout		A recent study found elevated mercury levels in lake trout from three lakes in Lake Clark NP&P. The mean total mercury concentration in Lake Clark (365.2 nanograms per gram wet weight [ng/g ww]) was more than 3-fold higher than that in Telaquana Lake (109.0 ng/g ww) and 1.8 than that in Lake Kontrashibuna (204.0 ng/g ww). At the lower end of this range, total mercury concentrations pose limited risk to park wildlife and human users. However, the concentrations observed in Lake Kontrashibuna exceeded the benchmark for reproductive impairment to piscivorous birds, and the tissue-based criterion for fish toxicity. Fish from Lake Clark exceeded these benchmarks and the EPA criterion for protection of human health (Eagles-Smith et al. 2014). High mercury concentrations in birds, mammals, amphibians, and fish can result in reduced foraging efficiency, survival, and reproductive success. Human health effects from elevated levels of mercury can affect the brain, kidneys, and reproductive function (Eagles-Smith et al. 2014).

Resource Brief: Climate Changes and Impacts

The Lake Clark region is geographically located in southcentral Alaska with two distinct climate regimes that are divided southwest to northeast by the mountains of the Alaska and Aleutian Ranges. To the southeast the Cook Inlet and the Pacific Ocean significantly influence the climate of the region by moderating the transfer of energy and water vapor to and from the atmosphere resulting in a maritime influence. To the northwest the mountains form a barrier to this influence resulting in climate patterns more typical of Alaska's western interior that is sometimes influenced by the moderating influence of Bristol Bay to the Southwest. Examples of how mean annual monthly temperatures vary relative to these locations can be seen in NPS climate observations from Silver Salmon (maritime, moderate), Chigmit Mountains (mountain, higher and colder) and Snipe Lake (interior, greater extremes) (see figure below).

Maritime climates are typically wetter with more moderate temperatures than the interior because they are influenced by transfers of energy and moisture from the ocean. However both are affected by persistent seasonal to multi-decadal patterns of sea surface temperatures from particular locations, specifically, the distribution of warm versus cool water in the central northern Pacific and coastal areas along the Gulf of Alaska. In addition, other periodic and persistent patterns of sea surface temperatures (e.g., El Nino) connect the region to global patterns that influence climate over large geographic regions of the Pacific and are called teleconnections (Namias 1953, 1959).

The most significant of these regional patterns, known as teleconnections, is the Pacific Decadal Oscillation, or PDO. The PDO typically shifts over 10 to 30 year time spans from negative (cool coastal water) to positive (warm coastal water) phases (see figure below) (Mantua and Hare 2002). A relationship between a positive PDO and the southward shift of the persistent low pressure over

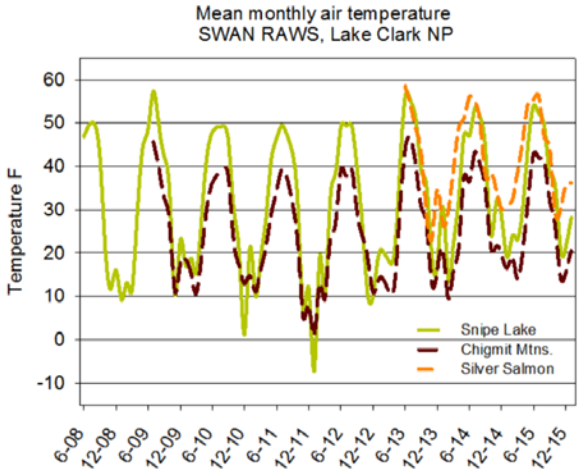
the northwestern Pacific (the Aleutian low) and a change in the course of the jet stream in the upper atmosphere have also been observed (Trenberth and Hurrell 1994). The combined effect of these patterns can intensify or mute the long-term warming trend in the land-surface temperatures. These effects have been observed globally and contribute to greater extremes in temperature and precipitation that are most pronounced in the Arctic (NCA 2014). The phase of the multi-decadal PDO shifted abruptly in the late 1970s to a warm phase and then to shorter oscillations of warm and cool phases. This pattern exerts a strong influence on land surface temperatures and at times may mask a global warming trend in the local instrumental record during cool phase years.

Recent winter temperatures are frequently out of the normal range, with 2014 and 2015 the warmest years on record for this region. The recent temperatures for winter and spring months are often maximums for the period of record in Port Alsworth, where 2014 and 2015 water years have been the hottest on record (see figure below). Notably, three of the 10 warmest winter seasons, one of the 10 warmest spring seasons, and seven of the 10 warmest maximum three-day temperature extremes since 1960 have occurred in the last 10 years (Lindsay 2014). Outside of Port Alsworth, the NPS maintains three stations with 3–8 years, of continuous climate records from the recent period of greater variability in the PDO and land surface temperatures (see figure below). Because of this variability and the brief length of these climate records, we can only observe the short term patterns. However, these stations provide valuable insight into how these patterns and greater extremes may affect park resources and annually provide us with additional data to understand these processes over longer time scales.

Climate and weather are among the largest drivers of ecosystem processes in Lake Clark NP&P (Lindsay 2013, Lindsay and Shephard 2014). Evidence suggests that the 20th century was the warmest in the past 1,300 years (IPCC 2007). Instrumental climate records from the park are only available beginning in 1960. During 1960–2013, mean annual temperatures at Pt. Alsworth have increased 3.0 °C. The trend is non-linear, a significant step-wise increase in temperature occurred in the mid-to late 1970s. Most of the temperature increase has occurred during winter and spring. Mean winter (Dec–Feb) temperatures have increased by 5.1 °C, mean spring (Mar–May temperatures have increased by 2.8 °C, mean summer (Jun–Aug) temperatures have increased by 2.2 °C, and mean fall (Sep–Nov) temperatures have increased by 1.0 °C. Notably, three of the 10 warmest winter seasons, one of the 10 warmest spring seasons, and seven of the 10 warmest maximum three-day temperature extremes since 1960 have occurred in the last 10 years (Lindsay 2014).

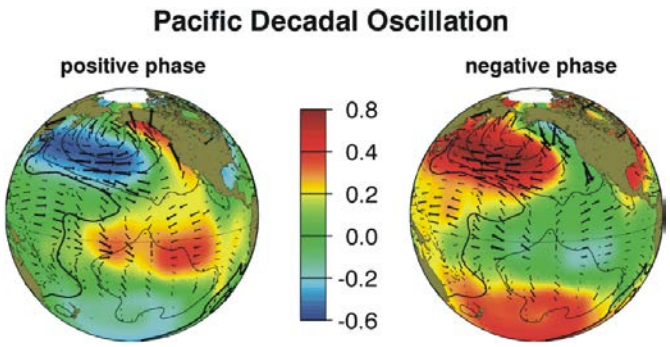
Due to the difficulty of accurately measuring the amount of precipitation and the lack of historic data, predictions for precipitation are more difficult to make than those for temperature. However, there is general consensus among models that there will be slight increases in precipitation over the coming century with less predictability as to timing and amounts of precipitation (SNAP 2016). However, the greatest impact our warming Alaska climate has on precipitation is how much of it falls as snow and how long it stays before melting. Shifts in this process can occur over many ecological gradients including elevation, latitude and continental versus maritime. The change in precipitation and frequency of melt has profound implications for park resources including, the distribution of landscape defining features, such as permafrost and glaciers, to the location of plant and animal species, and the frequency of landscape level disturbance (Stewart et al. 2013). Winter temperatures (Dec – Feb) from Port Alsworth, plotted over the 55 year period of available data, show a steady increase in the number of days at or above freezing (see figure below).

Predictions of future climate, based on conservative model projections, indicate a 3–6° F (1.5–3°C) warming trend over the next 100 years in addition to the warming trend already observed (see figure below) (Monahan and Fisichelli 2014, SNAP 2016). The most warming is predicted to occur during the winter months and will continue to increase the number of days when the temperature is at or above 32° F (0° C); thus, over the long term precipitation will continue to fall more frequently as rain vs snow, snow elevations will rise and snow will melt earlier and more often, a pattern seen in much of southwest Alaska over the past two years.

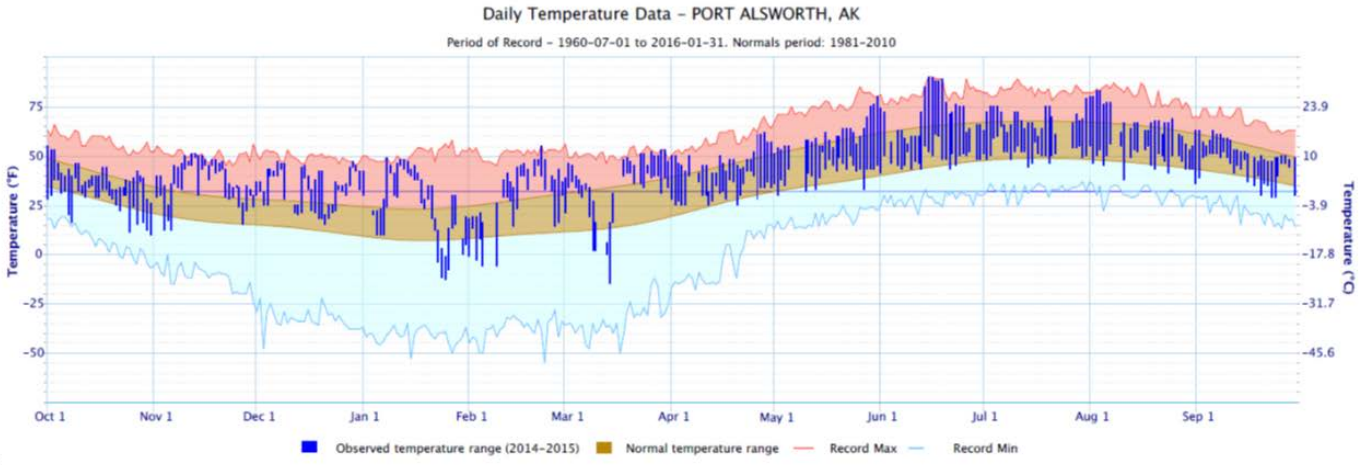


Mean monthly air temperatures for Lake Clark remote automated weather stations (RAWS) show climatic differences from three locations in the park and a distinct warming trend, especially in winter over the past 5 years (Western Regional Climate Center).

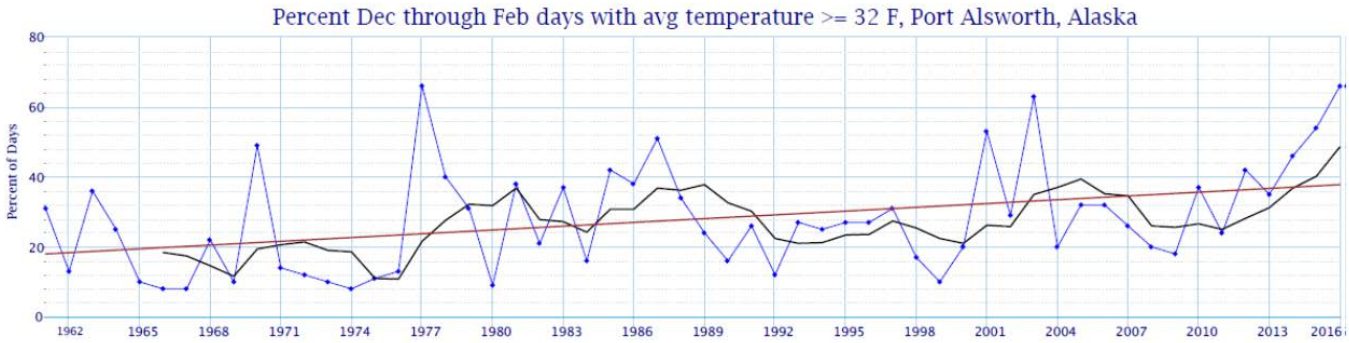
Climate Changes and Impacts (continued)



Typical wintertime sea surface temperature (colors), barometric pressure (black lines) and surface wind (arrows) for phases of the PDO (Joint Institute for the Study of the Atmosphere and Ocean).

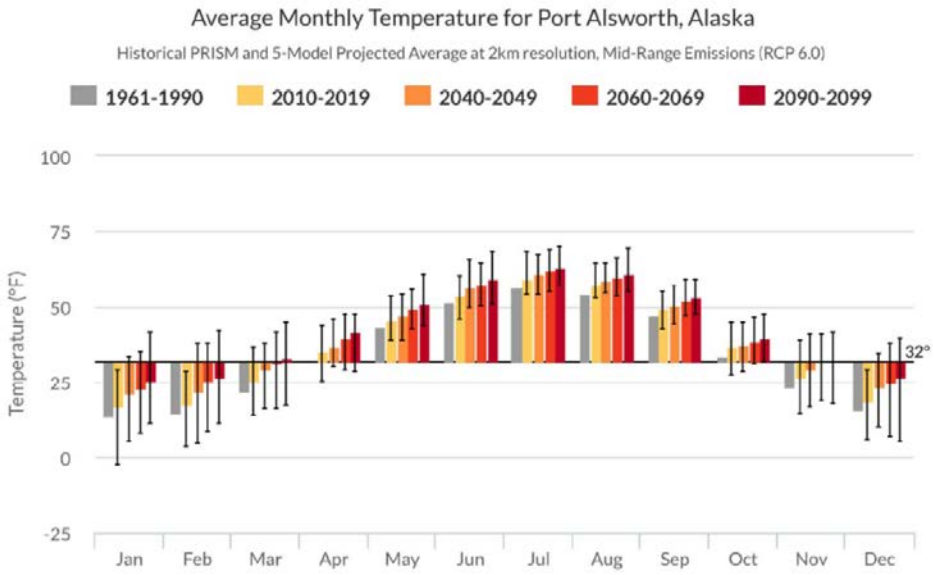


Daily temperature data depicted here with the normal and record minimum and maximum temperatures demonstrate the frequent maximum records and above normal temperatures for 2014–2015 water year.



The increase in the percentage of winter days with temperatures above freezing is shown as a five year running mean (black line) and a linear trend (red line). In the 55 year record shown here the linear trend show a 20% increase in the number of days above freezing (from 18 to 38 percent).

Climate Changes and Impacts (continued)



100 years of average monthly temperature changes, and quantified ranges, based on modeled climate projections (Scenarios Network for Alaska and Arctic Planning 2016).

Dark Night Sky

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Anthropogenic Light	Sky Quality Index (SQI)		Natural lightscapes are critical for nighttime scenery, such as viewing a starry sky, but are also critical for maintaining nocturnal habitat. Many wildlife species rely on natural patterns of light and dark for navigation, to cue behaviors, or hide from predators. Lightscapes can be cultural as well, and may be integral to the historical fabric of a place. SQI represents an index from 0 to 100 with 100 being a natural sky. In April 2013, Telaquana Lake scored a 97.8, one of the highest values recorded by the Night Sky Program. Keyes Point (Lake Clark) scored a 92.5.
	Anthropogenic Light Ratio (ALR)		Natural lightscapes are critical for nighttime scenery, such as viewing a starry sky, but are also critical for maintaining nocturnal habitat. Many wildlife species rely on natural patterns of light and dark for navigation, to cue behaviors, or hide from predators. Lightscapes can be cultural as well, and may be integral to the historical fabric of a place. Natural lightscapes represent the ratio of artificial light to natural sky. In April 2013, Telaquana Lake scored a 0.05 while Keyes Point (Lake Clark) scored a 0.15.

Resource Brief: Night Sky Resources at Lake Clark National Park & Preserve

The night sky has been a source of wonder, inspiration, and knowledge for thousands of years. Unfettered night skies with naturally occurring cycles of light and dark are integral to ecosystem function as evident by the fact that nearly half the species on earth are nocturnal. The quality of the nighttime environment is relevant to nearly every unit of the NPS system as the nighttime photic environment and its perception of it by humans (the lightscape) are both a natural and a cultural resource and are critical aspects of scenery, visitor enjoyment, and wilderness character.

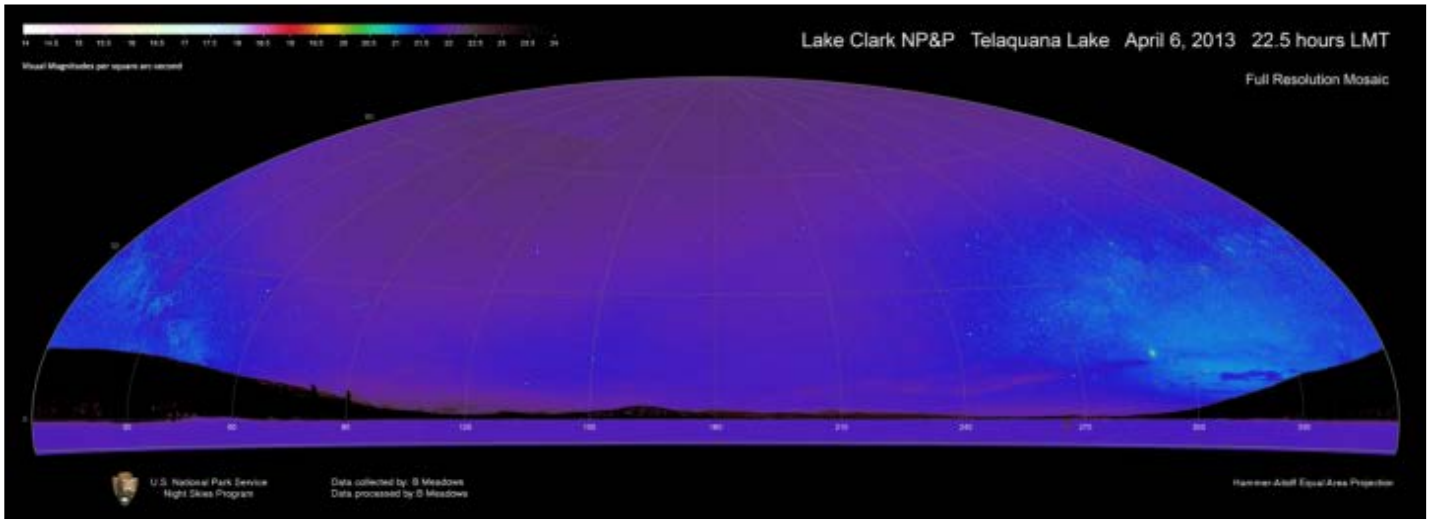
Condition

Night sky quality at Lake Clark National Park is in good condition. One way the Natural Sounds & Night Sky Division (NSNSD) scientists measure the quality of the photic environment is by measuring the median sky brightness levels across a park and comparing that value to average natural night sky luminance. This measure, called the Anthropogenic Light Ratio (ALR), can be directly measured with ground based measurements, or when these data are unavailable are modeled. Ground based measurements are collected using calibrated high resolution night sky brightness measurements over the entire hemisphere of the sky using a wide-field CCD camera and optics approximating the Johnson-Cousins V photometric band (Duriscoe et al. 2007). In addition, a model of the natural sky brightness for a given location, date, and time of observation, estimated airglow brightness at the zenith, and atmospheric extinction coefficient is constructed in order to estimate the anthropogenic component of sky brightness (Duriscoe 2013). The GIS model, calibrated to ground based measurements in parks, is derived from the 2001 World Atlas of Night Sky Brightness, which depicts zenith sky brightness (the brightness directly above the observer). A neighborhood analysis is then applied to the world atlas to determine the anthropogenic sky brightness over the entire sky. Anthropogenic light up to 200 kilometers from parks may degrade a park's night sky quality, and is considered in the neighborhood analysis.

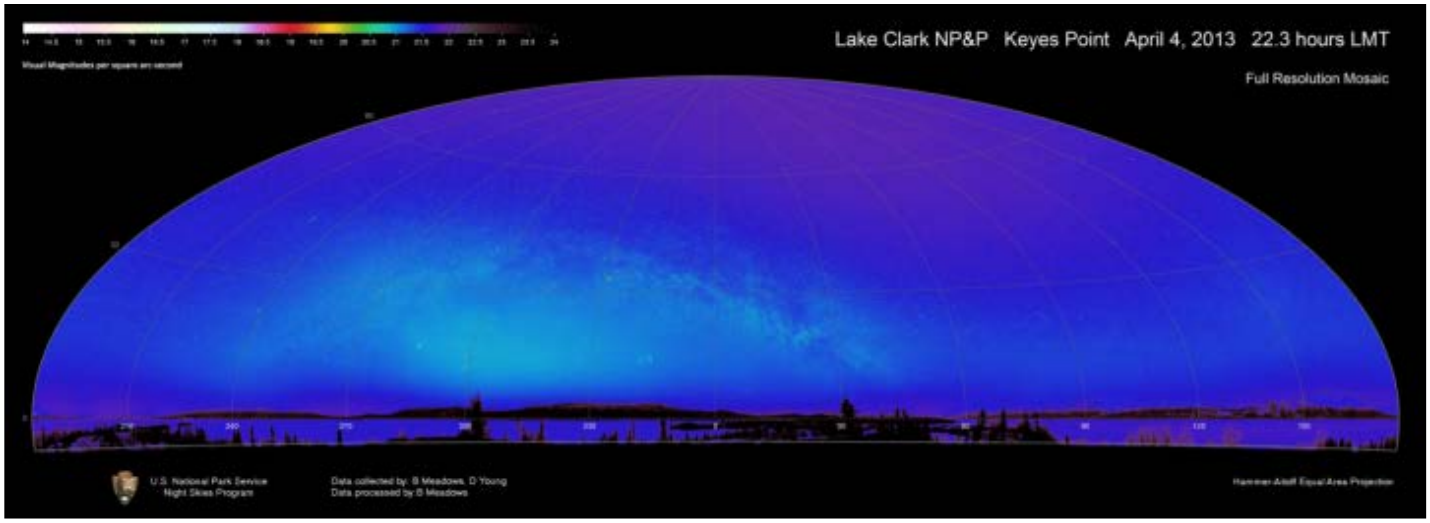
ALR is a ratio of anthropogenic to average natural conditions and describes the percentage above average natural conditions due to anthropogenic light. For example, an ALR of 0.00 indicates 0% difference between actual and reference conditions, or no impact from anthropogenic light. An ALR of 1.00 would indicate a 100% increase in actual sky brightness over the resource condition due to anthropogenic light. The ALR thresholds are applied spatially to the park. For both urban and non-urban parks, the designated condition (green, amber, red) corresponds to the ALR level that exists in at least half of (median condition) the park's landscape. Thus it is probable that a visitor will be able to experience the specified night sky quality. It is also probable that the majority of wildlife and habitats found within the park will exist under the specified night sky quality. For parks with lands managed as wilderness, the designated condition is based on the ALR level that exists in more than 90% of the wilderness area.

Impact Criteria

Two impact criteria were established to address the issue of urban and non-urban park night sky resources. Parks within urban areas, as designated by the U.S. Census Bureau, are considered less sensitive to the impact of anthropogenic light and are assessed using higher thresholds of impact. Parks outside of designated urban areas are considered more sensitive to the impact of anthropogenic light and are assessed using lower thresholds of impact. Lake Clark is categorized as non-urban, or more sensitive. Learn more in the document Recommended Indicators of Night Sky Quality, and the NPS Natural Sounds & Night Skies Division website.



Panoramic Image of natural and anthropogenic sources of light as observed from Telaquana Lake in Lake Clark National Park 2013.



Panoramic Image of natural and anthropogenic sources of light as observed from Keyes Point in Lake Clark National Park 2013. NPS Photo.

Acoustic Environment

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Acoustic Impact Level	Mean acoustic impact level (L_{50} dBA) – a measure of the noise contributed to the acoustic environment by man-made sources.		Anecdotal observations indicate increased aircraft traffic through Lake Clark and Merrill Passes in recent years. However, due to remote nature of most park areas, aircraft traffic remains low. No soundscape monitoring is currently taking place in Lake Clark NP&P. The acoustic conditions in Lake Clark NP&P are largely driven by aircraft traffic in recent years (Federal Aviation Administration 2010) and indicate a downward trend. For more information, see the NPS Natural Sounds website.

2.2. Cultural Resources

Archeological Resources

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Archeological resources are identified and evaluated using appropriate anthropological and historical contexts.		All sites in the park were recently evaluated using appropriate anthropological and historical contexts in the park's recent Archeological Overview and Assessment, K'etniyi (Tennessen 2014).
	The distribution and types of archeology sites is understood.		K'etniyi, goes into great detail about archeological site distribution and type—both are well understood for the park (Tennessen 2014: 136–171)
	The mechanisms affecting site stability and taphonomic influences are understood.		A great deal is understood about the environment of Lake Clark NP&P and how this affects site stability and taphonomy (Tennessen 2014: 28–49; 186–214).
	Percentage of sites with known date ranges associated with a research theme.		At the present time, radiocarbon dates have been obtained from 40 of the 216 known sites in the park and preserve (Tennessen 2014: Appendix B). Three of these sites have been associated with two of the ten research topics defined in the Archeological Overview and Assessment for the park and preserve (Tennessen 2014).
	Percentage of park intensively surveyed.		As of 2014, 5,229 acres within Lake Clark NP&P have been adequately surveyed (Tennessen 2014:231). This represents approximately 0.14% of the park's 4 million acres. The majority of the area investigated (approximately 3,100 acres) is located in the vicinity of Lake Clark (Tennessen 2014: Table 4.8). There is increasing visitor use in areas that have not been surveyed.
Inventory	Percentage of archeological resources with complete, accurate, and reliable data in the Archeological Sites Management Information System (ASMIS).		75% of Lake Clark NP&P's sites (163 of the 216 known sites on park land) are in ASMIS, and have complete, accurate, and reliable data.
	Percentage of known sites with adequate National Register documentation.		31%, a total of 68 properties, are deemed to have adequate National Register Documentation. This total includes 15 contributing sites in the Kijik NHL Archeological District (Lynch and Worthington 1990:3) and 53 sites in three archeological districts whose nominations are currently in preparation (Tennessen 2012a, 2012b, 2013, 2014:Table 3.26). These 68 sites represent approximately 31 percent of the 216 known archeological and historic properties in the park and preserve (Tennessen 2014: Appendix A).

Archeological Resources (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Documentation	Percentage of known sites with Determination of Eligibility (DOE) documentation.		22%, a total of 47 properties are deemed to have adequate DOE documentation. 20 sites have been determined eligible, and 27 have been determined ineligible.
	Percentage of archeological materials cleaned, conserved, studied, cataloged, and properly stored.		95% of the archeological materials from Lake Clark NP&P are clean, conserved, studied, cataloged, and properly stored. Two collections were recently rehoused and cataloged.
	Percentage of records documenting archeological resource conservation, cataloging, and storage maintained as a part of the archeological collection.		90% of the records that document archeological resource conservation, cataloging, and storage are maintained as part of the archeological collection in the Lake Clark NP&P museum collection and are fully cataloged into ICMS. The remaining 10% are accessioned into the museum collection, but are not fully cataloged into ICMS. An archival survey needs to be done on electronic resources on CR staff computers to ensure we are fully capturing it in the museum collection.
	Percentage of archeological resources certified as complete, accurate, and reliable in the Archeological Sites Management Information System (ASMIS) in good condition.		At the present time ASMIS condition values have been recorded for 145 sites in Lake Clark National Park and Preserve. Seventy-nine of these 145 sites, or approximately 55 percent, are in good condition (Tennessen 2014: Table 4.81).

Resource Brief: K'ETNIYI, Settlement Patterns and Prehistory in Lake Clark National Park and Preserve – An Archeological Overview and Assessment

Jeanne Schaaf, Lake Clark NP&P Archeologist consults with Dena'ina elder advisors on location of pre-historic house pits at historic Kijik, 2013. NPS Photo.

K'etniyi "it is speaking to us," is a Dena'ina word referring to the spirit of the landscape and all things being alive. This sacred word was a respectable fit for the name of the newly published book that captures an archeological overview and assessment for Lake Clark National Park. Archeology sites are K'etniyi and very important to park-affiliated Dena'ina and Yupik people. The book is a comprehensive examination of our current knowledge of archeological resources in the park and preserve. It is a baseline resource management document meant to describe and evaluate known archeological resources and the potential for future discovered resources and to identify the need for additional research. The document contains sensitive and confidential site information. It is not intended for public distribution. Sites described are important to park-affiliated tribes who have a vital interest in the management of ancestral archeological resources and in the use of the data included in the report.

Cultural Anthropology

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research exists to understand the relationship of the park's ethnographic resources and the historic contexts.		Multiple studies have been carried out for Lake Clark NP&P (Ellanna-Balluta 1992, Stanek et al. 2006, Gaul 2007, Evanoff 2010). Ethnographic data gaps were identified through the studies and various projects including: document information regarding Dena'ina and Yupik resource management, TEK and sustainability, further develop place names and meaning, and elder and youth gatherings for compilation of information. Language is key to knowledge. Nondalton has the most fluent speakers of Dena'ina remaining; as elders pass away, knowledge will diminish.
	The scope of resources significant to affiliated groups associated with the park is understood and a determination has been made whether or not they are a fundamental resource or other important resource or value.		The 2009 Foundation Statement for Lake Clark NP&P listed Historic and Archeological Resources associated with the Dena'ina, Kijik NHL, Prehistoric Rock paintings, the Telaquana Trail, and Ethnographic Resources as Fundamental Resources. These resources and their connection and importance to affiliated groups are well understood and provide guidance to cultural resource managers.
Inventory	Appropriate studies and consultations document resources and uses, traditionally associated people, and other affected groups, and cultural affiliations.		One of the park's strengths for the ethnography program is the solid relationship with the local Elders and tribes. This relationship has helped to incorporate more Native voices and perspectives into many significant park projects and programs (Evanoff 2010, Balluta 2008, Gaul 2007, Ellana and Balluta 1992, Stanek et al. 2006; Stickman et al 2003). This can be enhanced by the revival of the park village liaison program to recruit, train, and engage tribal members and other local residents in park operations and planning.
	Traditionally associated groups, and the legislative, regulatory, or policy basis for relationships with them, are identified.		Lake Clark NP&P has identified traditional associated groups and the basis for relationships with them; the park continues to work with and consult with these groups in order to foster meaningful relationships and partnerships.
	Resources eligible for the National Register of Historic Places as traditional cultural properties are identified.		Lake Clark NP&P is currently working on several projects (Chulitna/Six Mile Traditional Use Study, Telaquana Trail Cultural Landscape Report) that will highlight cultural resources eligible for the National Register as traditional cultural properties.

Cultural Anthropology (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Inventory (continued)	Research results are disseminated to park managers, planners, interpreters, and other NPS specialists and incorporated into appropriate park planning documents.		When new publication or study results are published, they are distributed to all managers, interpreters, planners and other NPS specialists. However, this research and those with local knowledge need to be consulted during the planning process.

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 historic contexts of the park.		Two Cultural Landscapes Inventories (CLI) have been completed, Kijik and the Telaquana Trail. One CLI, the Proenneke site, is incomplete (slated to be finished in 2015) and eight additional CLIs have been identified but not initiated (CLI database). There is a vast array of cultural landscapes in Lake Clark NP&P including subsistence campsite, historic corridors, mining districts, and post WWII settlements.
	Cultural landscapes are identified and evaluated using appropriate historical contexts.		Regional Office Cultural Landscape staff works with the regional and park historians, archeologists, cultural anthropologists, and curators to ensure that all the identified and evaluated cultural landscapes in Lake Clark NP&P have all used appropriate historical contexts.
	Percentage of cultural landscape baseline documents with current and complete information.		100% of the cultural landscape baseline documents for Lake Clark NP&P have current and complete information in them.
	Adequate research exists to document and preserve the cultural landscape's physical attributes, biotic systems, and uses when those uses contribute to historical significance.		Lake Clark NP&P has significant research on Chulitna, Kasna Creek, Tanalian Point, Twin Lakes, and the early 20th century; we need more research on Kontrashabuna, and Kennedy-Rasmussen.

Cultural Landscapes (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Inventory	Percentage of landscapes eligible for the National Register in the Cultural Landscapes Inventory (CLI) with certified complete, accurate, and reliable data.		Of the 11 landscape records in the CLI database, two (18%) have been evaluated and determined eligible for nomination to the National Register of Historic Places with accurate, complete, and reliable CLI data. The Proenneke CLI, slated to be finished in 2015, will bring this total up to 27%.
	Percentage of Cultural Landscapes Inventory (CLI) data included in the Geographic Information System (GIS) meeting current cultural resource standards.		0% of Lake Clark NP&P's CLI data is in GIS—but there has only been a very recent push to get CLI data into Enterprise, hence the yellow circle instead of red.
Documentation	Percentage of cultural landscapes with adequate National Register documentation.		Of the 11 landscapes in the CLI database, three, Kijik, Kasna Creek, and the Proenneke cabin, are on the National Register. Several properties that would contribute to the early 20th-century CLI have adequate National Register documentation (Bly House, Trefon Cache, Double Ender are on register and nomination forms have been completed for at least 15 other properties).
	Percentage of cultural landscapes with Determination of Eligibility (DOE) documentation.		Seventeen properties that would contribute to the early 20th-century CLI have DOE documentation, and several more that could contribute to the Portage Historic Mining District, Tanalian Point, and the Telaquana/Kijik parent landscape.
Certified Condition	Percentage of cultural landscapes certified as complete, accurate, and reliable in the Cultural Landscapes Inventory (CLI) in good condition.		Only 2 of the 8 landscapes in the CLI database have complete, accurate, and reliable information (the park only has 2 CLIs finished); of those, 100% are in good condition.

Historic Structures

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research is conducted to understand the relationship of the park's historic structures to the historic context(s) for the park.		95% of the 62 historic structures in Lake Clark NP&P are either on the LCS, National Register, have been determined eligible or ineligible, or included in CLIs. An exhaustive report on 46 of the structures was included in the report *Cabins of Lake Clark National Park and Preserves Vol. 1+ 2* (Tobey 2003), and recent publications such as *Canneries, Cabins and Caches of Bristol Bay* (Branson 2009) and *A 20th Century History of Lake Clark, Alaska 1900–2000* (Branson 2014) have further illuminated historic structures in the park.
	Historic Structures are identified and evaluated using historical contexts.		95% of the 62 historic structures in Lake Clark NP&P have been evaluated. 15 are on the LCS (4 of these are pending), 5 are on the National Register, 22 have been determined eligible, 27 have been determined ineligible, three have been included in a CLI, and two nomination forms are with the Keeper.
Inventory	Percentage of historic structures eligible for the National Register in the List of Classified Structures (LCS) with accurate, complete, and reliable data.		Minus the four pending structures, only 27% (3 of 11) of Lake Clark NP&P's properties on the LCS have accurate data. However, the arrow is yellow due to the fact that the only reason they are inaccurate is all 8 are due to be re-inspected in 2015.
	Percentage of List of Classified Structures (LCS) data included in the Geographic Information System (GIS) meeting current cultural resource standards.		0% of Lake Clark NP&P's LCS data is in GIS—but there has only been a very recent push to get LCS data into Enterprise, hence the yellow circle instead of red.
Documentation	Percentage of historic structures with adequate National Register documentation.		11% of the historic structures in Lake Clark NP&P have adequate NR documentation. Five structures are on the National Register (8%), and two have been nominated (3%).
	Percentage of historic structures with Determination of Eligibility (DOE) documentation.		79% of the historic structures in Lake Clark NP&P have DOE documentation. 22 have been determined eligible (35%), and 27 have been determined ineligible (44%).

Historic Structures (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Certified Condition	Percentage of historic structures certified as complete, accurate, and reliable in the List of Classified Structures (LCS) in good condition.		8 of 11, or 73%, of the historic structures on the LCS are in good condition. Of the four pending structures, 100% are listed as good condition in the LCS.
	Percentage of historic structures in the Facility Management Software System (FMSS) with a Facility Condition Index (FCI) indicating good condition.		83% of the historic structures in FMSS (10 of the 12 in FMSS) have a FCI indicating a good condition.

History

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research is conducted to understand the national significance and historical contexts for the park.		Several outstanding publications and research have been written and undertaken to understand the significance of Lake Clark NP&P. Specifically the ethnohistory *Nuvendaltin Quhtana: The People of Nondalton*, the comprehensive 1994 Historic Resource Study, *Dena'ina Elnea, A Celebration*, by Karen Evanoff and *A 20th Century Portrait of Lake Clark, Alaska, 1900–2000* by John Branson. Research into the history of NPS employees during the Monument days, or during the Alaska Task Force and the first few years of the park's existence is needed. The history of sport hunting and fishing would be appropriate.
	Sufficient research is conducted to establish the reasons for park establishment and a history of the NPS management of the site.		The Historic Resource Study was completed in 1994 and the Administrative history has been largely written, and is awaiting edits and final revision. John Branson's *The Canneries, Cabins, and Caches of Bristol Bay, Alaska* covers the influence of the Bristol Bay commercial salmon industry on the region and Lake Clark in particular, salmon were part of Lake Clark NP&P's enabling legislation.
	Research supports cultural resource management.		Generally, there is appropriate research preceding planning decisions involving archeological and historic resources; however, those with local knowledge need to be consulted during the planning process, and funding for processing curatorial specimens and archives need to be included in planning.

History (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge (continued)	Research is conducted by qualified scholars.		All park and regional staff members that contribute to historical research are qualified scholars and experts in their field. Not only are the park staff members qualified on paper, they are well respected in the local communities. Lake Clark NP&P's historian is a local resident of over 45 years, and the park's cultural anthropologist is a local Dena'ina who was born and has lived all her life in and near the park.
Inventory	Percentage of cultural resources listed in appropriate Service-wide inventories, including the National Register.		46%, a total of 99 properties, are deemed to have adequate National Register Documentation, i.e., have been documented in National Register Nominations or Determinations of Eligibility. This total includes 15 contributing sites in the Kijik NHL Archeological District (Lynch and Worthington 1990:3), and 53 sites in three archeological districts whose nominations are currently in preparation (Tennessen 2012a, 2012b, 2013, 2014: Table 3.26). These 99 sites represent approximately 46 percent of the 216 known archeological and historic properties in the park and preserve (Tennessen 2014: Appendix A).
	Research data are accessioned as part of the park's museum collection.		All hard copy historical research data are accessioned as part of Lake Clark NP&P's museum collection. An archival survey needs to be done on electronic resources on CR staff computers to ensure we are fully capturing it in the museum collection.
Documentation	Percentage of historic properties with adequate National Register documentation.		11% of the historic properties in Lake Clark NP&P have adequate NR documentation. Five structures are on the National Register (8%), and two have been nominated (3%).
	Percentage of historic properties with adequate Determinations of Eligibility (DOE) documentation.		79% of the historic properties in Lake Clark NP&P have DOE documentation. 22 have been determined eligible (35%), and 27 have been determined ineligible (44%).

Resource Brief: Conduct a Historic Kijik Cemetery Cultural Affiliation and Lineal Descent Study

The goals of this 4-year project were to locate grave sites at historic Kijik using remote sensing equipment (Ground Penetrating Radar – GPR) and recording oral history from local Dena'ina residents. In addition a review of existing literature, oral history recordings, and historic documentation (published and unpublished) was conducted. The multiple partnerships we had with Kijik Corporation, the Pratt Museum, U.S. Forest Service, Nondalton Tribal Council and Keniatze Tribe was an additional benefit by sharing the GPR technical skills and cultural exchange between community, agency, and visiting student interns within and outside the Lake Clark region. We also had Elders advisors at camp. Work completion includes a map of burial locations and lineal descendent list of those buried at the cemetery—this is by no means a final list but provides some information on who might be buried at the Kijik cemetery. Another final outcome of this project and one of Lake Clark NP&Ps Call to Action goals was a partnership with Nondalton Tribal Council and Kijik Corporation to support a healing ceremony at the homelands of their ancestors located at historic Kijik. Over 70 people from surrounding communities attended this one-day event which included an introduction of the project and grave locations, blessing of the gravesite, traditional Dena'ina dancing, speeches and lots of food and fun!

***Left*: Collaborative research team locating grave sites using Ground Penetrating Radar (GPR) at Historic Kijik in 2010. NPS Photo; *Right*: Local Dena'ina dance group at the Historic Kijik Healing Ceremony and Celebration, August 2014 NPS Photo.**

Museum Collections

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research and analysis exists to understand the relationship of the park's museum collection to the historic context(s) for the park.		A draft Scope of Collections Statement (SOCS) exists for Lake Clark NP&P. It is well written but recommendations from the 2012 Museum Management Plan need to be incorporated. Resources turned into the curator are surveyed and determined for the appropriateness of inclusion in the collection. Continued review of previous and on-going approved resources management projects and park planning initiatives to clearly identify the accessioning and cataloging backlog needs to continue. Incorporation of this backlog and related workload must be identified in funding requests and workload plans (Bohnert 2012).
	Scope of museum collection in the park is understood and a determination has been made whether or not they are a fundamental or other important resource.		The scope of museum collections in the park is well understood. In the 2009 Foundation Statement for Lake Clark NP&P, Museum collections are listed as a fundamental resource and value.
	Affected Native Americans are consulted concerning items of cultural affiliation.		Local Dena'ina are frequently consulted with questions or identification of objects in the museum collection; the curator also provides tours and pulls objects and archives for traditionally associated peoples, as well as anyone else who is interested. Local Dena'ina and park staff have worked in concert for the Anchorage Museum's exhibit *Dena'inaq' Huch'ulyeshi: The Dena'ina Way of Living*. So far, Lake Clark NP&P has had no items under any NAGPRA categories in their museum collections.
	Museum curator is included in permit review and informed about park resource projects that may affect collections.		The curator is included in permit review and informed about park resource projects when objects are collected; however, projects that don't collect specimens still produce objects for the museum collection (archives). The curator spends a lot of time backtracking and making call backs years after the projects are complete when PIs haven't turned in the products they stated they would have.

Museum Collections (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Inventory	Archival and manuscript collections are surveyed and described in the Interior Collections Management System (ICMS) and finding aids are produced.		A vast majority (98%) of the archival collections are surveyed in described in ICMS according to the 2014 CMR. Finding aides exist for all of these and are kept on a share drive for the park.
	Percentage of existing collection that is accessioned and cataloged.		100% of the objects have been accessioned into the collection, and according to the 2014 CMR, 97.28% of the objects have been cataloged. Around 50% of the archives, while fully described and cataloged, were cataloged before recent WASO-approved Lake Clark NP&P archival hierarchy. Curatorial workload covering archiving assorted records, specimens and/or records and data and associated costs should be included in all resource management, historic preservation, and planning projects.
	Scope of Collection is consistently implemented; items or objects are researched to determine their appropriateness for inclusion in the museum/archive collection.		There is no collections committee in Lake Clark NP&P, but every object that is received is researched by the curator with help from other NPS staff if needed before inclusion into the museum and archival collections.
Documentation	Accession and deaccession files are complete with all appropriate signatures.		All accession and deaccession files are complete, and all have appropriate signatures.
	Percentage of cataloged records with completed descriptive fields (beyond required fields).		96% of cataloged records have completed descriptive fields.
Certified Condition	Percentage of museum collection reported in CMR and checklist report in good condition.		5,246 records are in ICMS, of those, 3,448 (66%) are in good condition. 1,761 (33%) are in excellent condition. 99% of the collection that is cataloged into ICMS is in excellent or good condition.

Resource Brief: Birch Bark Basket

Museum objects often hold interesting stories. This basket, at first glance, is not very exciting. It is hastily constructed, falling apart, and parts are clearly missing. Once the history is known, however, it becomes much more than just an object.

On July 4, 1953, children setting off fireworks started a forest fire near Port Alsworth. A BLM official in Homer traveled to Nondalton to recruit a crew to fight the fire. However, since most of the men were in Bristol Bay commercial fishing at the time, the crew was nearly all women. This mostly all-woman crew came to Port Alsworth and fought the fire along with Port Alsworth residents and visitors. This birch bark basket was hastily made by a woman from Nondalton to carry water to fight the fire. While it is obvious this basket was made quickly over 60 years ago, the skill of the basket maker is still obvious to the modern day viewer. The purposeful folds, the wooden splints holding the basket together, the placement of a handle on the top (now missing), and the overall construction is clear evidence the maker was very good at what she did. Together, everyone spent a week trying to suppress the fire—in the end, the fire burned until the fall rains came.

This basket, which was never intended to be saved for posterity, became a symbol of many things: adaptive use of traditional Dena'ina knowledge; the power of aircraft flight; the beginning of a tradition that continues to this day of Nondalton fire crews traveling around Alaska and the lower 48 to fight fires; and most importantly, the coming together of people—men and women, Dena'ina and Euroamericans, residents and visitors—to help their neighbors and better their community.

Left: Birch bark basket that was used to fight a forest fire near Port Alsworth in 1953. NPS Photo; Right: Historic photo of the 1953 forest fire. NPS Photo.

2.3. Visitor Experience

Number of Visitors

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Number of Visitors	Number of visitors per year		Total visitation to the park is increasing. The total of 8,411 visitors to the park in 2013 represents a significant increase over the 2007 total of 2,164 visitors. Visitor data information is based on commercial services reporting and does not capture visitors who independently access the park. The number of independent visitors is also believed to be increasing.
Visitor Use Days	Number of visitor use days		Visitor use days are combination of visitors and guides and the number of days they utilized the park. The visitor use day total of 10,891 in 2013 is a significant increase from the total of 3,944 in 2007.

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

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Education Programs	Number and quality of programs, and number of participants		The park had one program in 2014. No established program exists. Teacher Ranger Teacher developed 4 secondary science labs and experience based lessons for the NPS Education Portal in 2014. The Teacher Ranger Teacher model provides a useful tool for the Lake Clark NP&P Education Program.
Ranger Programs	Number and quality of programs and attendance		Lake Clark NP&P delivered 326 programs, reaching 4,327 visitors in 2014. The programs were designed specifically for park visitors, local residents, local employees, youth, and partnership programs. Programs are generally delivered by knowledgeable staff and volunteers in professional ways.
Junior Ranger Programs	Number of programs and attendance		Lake Clark NP&P delivered 15 Junior Ranger Programs in both 2013 and 2014. Junior Ranger Programs are well established and attended in Port Alsworth by local youth. The park is looking at opportunities to use this program to expand outreach to surrounding villages.
Special Events	Variety and longevity of events, community involvement		Lake Clark NP&P regularly hosts special events related to important occasions, community interests, and partnerships. These events are a valuable community engagement tool. Recent events include: Student Conservation Association (SCA) partnership trail work celebration, logistical support for community partnership events such as the Kijik ceremonies, and the Superintendent's community potluck.

Resource Brief: In 2013 Lake Clark hosted a Special Event Celebrating the Completion of the Accessibility Ramp to the Visitor Center

Lake Clark NP&P hosted a ribbon cutting ceremony to dedicate the new accessibility ramp for the park's visitor center in Port Alsworth, Alaska.

USMC Corporal Jedediah Morgan, accompanied by his wife Anna, cut the ribbon. The ramp will allow improved accessibility to the center, which provides visitor information and educational programs about the four million acre national park.

Park Superintendent Margaret L. Goodro and Franklin Graham of Samaritan's Purse spoke at the ceremony. The international relief organization Samaritan's Purse supports Operation Heal Our Patriots to provide wounded veterans and their spouses the opportunity for spiritual refreshment, physical renewal, and marriage enrichment. Retired Brig. Gen. Jim Walker, executive director of the program, attended with many of the Port Alsworth participants along with their spouses and staff. The park dedicated the ramp in honor of the organization.

"This is an amazing opportunity for these veterans and spouses to get out an enjoy the splendor of our national parks and build lifelong memories together while kayaking, fishing, flying, boating and hiking," Goodro said. "We are proud to provide more opportunities for our injured soldiers and veterans to recreate in national parks and we are honored to have a partnership with Operation Heal Our Patriots."

Jedediah Morgan, a park visitor with Samaritan Lodge Alaska cut the ribbon on the new accessibility ramp. NPS Photo.

Resource Brief: Successful Junior Ranger Programs

Youth programming is a core piece of Lake Clark's interpretive programming. Junior Ranger programs in Port Alsworth run weekly all summer long, are popular with local youth, and are a wonderful opportunity for local families to interact with park staff on a regular basis. In 2014 the park hosted 9 Junior Ranger programs in Port Alsworth and 6 Junior Ranger programs in Homer. The summer Junior Ranger program is a cornerstone of the Lake Clark NP&P effort to maintain positive local relationships. This program is almost universally attended by local families and is well received by visiting families.

Junior Ranger programs offer a wide variety of programs. Local Artist Tish Bowman joins the park annually to offer an Art in the Park program. NPS Photo.

Programs range the spectrum of topics from bird migration survival, hands on archeological digs, forest plant explorations, to map and compass navigation. These programs focus on positive and creative engagement with the park and the development of personal connections with park stories and resources. Youth funds such as YPP and PLC have been instrumental in the development and on-going delivery of these 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		Lake Clark NP&P has 12 waysides that provide interpretation at the Visitor Contact Station, on the coast, and along the Sterling Highway. Four are new, five are in good condition, and three need replacement.
Park Directional and Informational Signs	Usefulness, quantity, and placement		Signs at the Chinitna Bay Trailhead and the Tanalian Trails system are informative and in good condition. In 2014 the park increased facilities signage in the Port Alsworth area and installed two park signs to better orient visitors and employees.
Exhibits	Subsistence exhibit		This exhibit was created in 2014 and features local residents sharing a traditional meal and discussing Dena'ina place names and subsistence traditions. Developed by the Anchorage Museum with support from the park, the exhibit now resides at the Contact Station in Port Alsworth.
	Outdoor exhibit		Lake Clark NP&P outdoor exhibits include a traditional fish cache from Lake Clark, a historic double-ender fishing boat from Bristol Bay, and Charlie Denison's steam engine from Tanalian Point. The double-ender and cache are on the National Register of Historic Places. Exhibits are well developed and in good condition.
	Visitor Center exhibits		This exhibit space has been identified as natural resource interpretation space. Currently there are cultural resource exhibits that were developed by the park. The Visitor Contact Station lacks natural resource interpretation. A project is on track for 2016/2017 funding to address this deficiency.
Print Media	Accaccuracy and availability of primary park publications		Lake Clark NP&P has a variety of print materials for visitors; including brochures, site bulletins, and science resource briefs. Complete sets of Visitor Trip Planning and Youth Engagement materials were created in the previous two years. The park has identified informational gaps requiring the development of new materials, which is currently in process.
	Books		Numerous book length publications about the people of Lake Clark, past and present, have been written for the public. These range from investigations into the prehistory of Alaska Natives, to first-hand accounts of Alaska Native culture and the experiences of other Americans seeking to make a living, through industry or self-sufficiency, in this remote part of the world.

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

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Audio-visual Media	Orientation Films		In 2014 a contract was awarded for the development of an orientation film covering the Cook Inlet Coastal area of Lake Clark NP&P. The park lacks an overall orientation film.
	Other digital media material		The park has a number of cultural resource films. There is a need to develop short productions addressing resources and park messaging. The bear safety video, *Staying Safe in Bear Country*, is shown regularly to visitors and staff.
Websites	Currency and scope of website; number of website visitors		The park web site had 339,000 views in 2014, a 15% increase from 2013. The web site needs constant attention but has improved greatly since 2012. In 2014 the park developed a Web Inventory and Content Strategy to guide work planning.
	Social media: Facebook updates and "likes," overall activity		Lake Clark NP&P's number of Facebook and Twitter followers doubled from 2013 to 2014. Select posts have reached over 100,000 viewers. The park plans to use Instagram to reach a younger audience.

Recreational Opportunities

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Backcountry Experiences	Quality, quantity, and diversity of range of opportunities		Lake Clark NP&P offers a wide range of high quality backcountry wilderness experiences including numerous backpacking, rafting, basecamping, kayaking, and boating options. Backcountry experiences take place primarily in undeveloped wilderness areas and offer visitors unparalleled opportunity for solitude and unconfined outdoor recreation. A large majority of these visitor experiences are facilitated in some capacity by commercial operators such as air taxis and guide services.
Trail Experiences	Quality and range of opportunities		The Tanalian Trails system around Port Alsworth offers a diversity of hiking experiences, from short strolls to the river, a moderate hike to Tanalian waterfall, or a challenging climb up the mountain. Significant improvements were made to the Tanalian Trails system in 2014, and future work is planned. Park staff annually works with SCA Trail Crews to improve the safety and sustainability of existing trails.

Recreational Opportunities (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Bear Viewing	Quality and quantity of opportunities		Bear viewing and photography are now the most popular activity amongst visitors arriving with third-party (Commercial Use Authorization-CUA) operators. Lake Clark NP&P's coastal brown bear population boasts one of the highest densities in the state. Salt marsh meadows at Silver Salmon Creek and Chinitna Bay offer different and numerous bear viewing opportunities. An orientation film for coastal visitors is in development to further enhance the bear viewing experience.
Sport Fishing	Quality and quantity of opportunities		There is a wide array of sport fishing opportunities in Lake Clark NP&P. Lakes, rivers, and streams support various populations of resident fish, including popular sport fish species such as lake trout, northern pike, and Arctic grayling. Sockeye and silver salmon returns attract numerous anglers to several locations in the park. High metal toxicity levels in Lake Clark lake trout and heavy fishing pressure in select areas are causes for concern.
Commercial Services	Quality and delivery of park information and message		More than 80 percent of visitors access the park through a Commercial Use Authorization holder to engage in activities including bear viewing, fishing, flight seeing, and more. The park provides brochures and information to CUAs for visitors; however the line of communication between the park and CUAs is inconsistent, disrupting messaging to the visitor. The park is redesigning the commercial services program to address this disconnect. The creation of new informational materials like the Proenneke site bulletin and the coastal orientation film are the first steps toward improved messaging through CUAs.

Resource Brief: Active Work is Improving the Trail Experience

Improving the experience on the Tanalian Trails is a park priority. A variety of efforts have led to on the ground improvements. Lake Clark NP&P, with the support of Samaritan's Purse and Tanalian Bible Camp, applied for and received an Active Trail Grant from the National Park Foundation to address high priority trail improvements. Lake Clark NP&P partnered with the Student Conservation Association and local volunteers to accomplish the work. Samaritan's Purse supported the project evaluation and visitor experience components of the project. Working with numerous partners Lake Clark NP&P was able to respond to visitor and partner trail improvement needs and accomplish priority work.

The most heavily impacted trails have been improved with features such as 140 stone stairs on the most problematic portions of the Tanalian Mountain Trail. In addition, 1,500 feet of improvements, including puncheon and broken rock tread in bog areas of the Kontrashibuna and Beaver Pond Loop trails, have been accomplished while several hundred feet of existing trail features were replaced and repaired. Public Land Crews have contributed significantly to Lake Clark trail improvements during the last 5 years. Finally, Lake Clark National Park has added four trails to their management inventory that now contribute to the overall condition indices.

All of these improvements will lead to a higher quality trail experience for all users.

***Left*: NPS Trail Crew members lead a volunteer work crew to stabilize the trail on the steep slope down to the Tanalian Falls. NPS Photo. *Right*: An SCA trail crew worked to build bog bridges. NPS Photo.**

Resource Brief: Visitors Engage in a Diversity of Recreational Opportunities

Visitors engage in a wide range of recreational activities facilitated by commercial operators. Recreational opportunities are spread unevenly across the park. Visitor concentrations reflect these opportunities. Bear viewing/photography and sport fishing primarily take place at Silver Salmon Creek, Chinitna Bay, and Crescent Lake. These areas receive the highest visitation. A wider range of recreational opportunities available in the interior part of the park are enjoyed by a smaller number of visitors.

Bear viewing and photography are popular visitor activities on the Cook Inlet Coastline. NPS Photo.

Accessibility

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Mobility	Architectural Barriers Act (ABA) compliance		The Visitor Center and exhibits have been retrofitted in the past 18 months to improve accessibility. Improvements include doorway and bathroom modifications and the construction of an access ramp. The Visitor Center Information desk is planned for reconstruction in 2016.
Visual Accommodation	ADA compliance		The top ten most used PDFs (e.g., park brochures) on the park's website were made Americans with Disabilities Act (ADA) compliant in 2014. Others are identified for upgrades. Newly produced PDFs are compliant. All Alt-text on Lake Clark NP&P's website has been upgraded.
Auditory Accommodation	ADA compliance		Many park experiences and tactile exhibits are able to be experienced without auditory accommodation. Fifty percent of the park's films are captioned, including the three most popular films, which were captioned in 2014. A plan exists to caption the remainder.

Safety

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Visitor Safety	Recordable incidents on park land		The safety of visitors is a park priority. The park works to quickly identify and mitigate potential hazards, and the number of accidents is very low. The park's emergency medical program has expanded over the last few years with increased training for staff and the acquisition of new medical equipment. The Alaska Region Communications Center now provides a 24-hour emergency point of contact for visitors. Increased visitation leads to a higher potential for negative bear-human interactions and greater aviation risks. Visitor safety concerns need constant vigilance.
Staff Safety and Training	Number of staff trained		Operational Leadership Training has been completed by all park staff, and CPR, First Aid, and AED training are offered. The Alaska Region Communication Center now provides 24-hour dispatch with float and flight following support. Park aircraft are equipped with Automated Flight Following equipment. A Job Hazard Analysis is conducted before jobs throughout the park. Regular safety messages are given and distributed to staff members.

Partnerships

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Volunteers	Number and hours contributed		Lake Clark NP&P has a strong volunteer tradition with several long-term volunteers serving in remote locations. Number of volunteers and hours contributed has increased over the last few years, to a high of 54 volunteers providing 11,565 hours in 2014.
Partnerships	Number of official and unofficial partnerships		Lake Clark NP&P has high quality and effective partnerships working with a wide range of official and unofficial external partners. The park has formal partnerships with local villages, Samaritan's Purse, Alaska State Troopers, Student Conservation Association, and others. The park also works extensively with informal partnerships including the Port Alsworth Area Improvement Corporation and Tanalian Bible Camp. The natural and cultural resource programs work with universities and through interagency partnerships to accomplish a wide range of projects.

Resource Brief: Partnership with Samaritan's Purse is Maturing

Lake Clark National Park has had a formal partnership with Samaritan's Purse since they opened a lodge for wounded veterans and their spouses on the shores of Lake Clark in 2012. Veterans and their spouses spend a week together fishing, hiking, paddling, and visiting the Proenneke National Historic Site. Staff has been working with Samaritan's Purse to ensure participants have meaningful park experiences including providing formal programing both at the lodge and at the Proenneke Cabin on Upper Twin Lake.

Wounded veterans and their spouses show their Access Passes after their interpretive program and invitation to visit parks across the country. NPS Photo.

New to the partnership in 2013 Lake Clark NP&P is issuing Access Passes to qualified disabled veterans. Following a weekly interpretive program passes are issued with an invitation for veterans to continue to spend time with friends and family in the National Parks and public lands throughout the country. This program is possible through the support of the Alaska Public Lands Information Center's fee program. In 2014 Samaritan's Purse supported Lake Clark NP&P's application for a trail improvement grant from the National Park Foundation. Lake Clark subsequently received $25,000 to work on improvement of specific parts of the Tanalian Trails. This work took place with local volunteers, Student Conservation Association trail crews, and NPS trail crew employees. This new work represents a broadening and responsive partnership between the park and Samaritan's Purse.

Resource Brief: Volunteers Provide Valuable Work

The park has a thriving volunteer program with volunteers providing assistance throughout the park and across multiple divisions. Volunteers work on trails, staff resource monitoring projects, provide visitors and staff with field assistance, staff the visitor center, historic cabin rehabilitation, and provide interpretive programming at the Proenneke National Historic Site.

K Shubeck and Monroe Robinson have been summer volunteers at Twin Lakes for 15 years. In 2014 they, along with other long-time volunteers at the site, conducted 179 tours for 911 visitors. They also contacted visitors at the Hope Creek Campsite and along the shores of Twin Lakes.

K and Monroe with a group of visitors from Samaritan Lodge Alaska in front of the Richard L. Proenneke cabin on Upper Twin Lake. NPS Photo.

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 2009 / 2014	FCI 2009 / 2014	Condition Status/Trend	Rationale
Buildings	64 / 95	0.211 / 0.062		Cyclic maintenance planning has contributed to some improvement of building conditions. Documentation of existing historic buildings has increased Lake Clark NP&P inventory by 31 structures in the last year, all of which have current replacement values but no condition assessment. As a result, we see an unrealistic improvement in Facilities Condition Indices (FCI) for Buildings. It is possible that FCI may even drop once deferred maintenance needs are identified for these newly identified structures.
Trails	6 / 10	0.336 / 0.156		Estimated trail traffic has increased tenfold during the last five years. Social trail development and erosion have degraded conditions. In addition, documentation of trails deficiencies has lowered the apparent condition. A trails management plan is under development, but not in place. In addition, four previously unassessed trails have been inventoried and now contribute to our FCI.
Waste Water Systems	4 / 4	0.231 / 0.135		A major upgrade is in the project planning system to address substantial deficiencies in the wastewater system. The current planned year for work is 2018.
Water Systems	3 / 3	0.102 / 0.111		A major cyclic project is in the planning system to address deficiencies in the water system. The current planned year for work is 2016.

Overall Facility Condition Index (continued)

web

Asset Category	Number of Assets 2009 / 2014	FCI 2009 / 2014	Condition Status/Trend	Rationale
Unpaved Roads	6 / 13	0.017 / 0.035		Improved inventory and identification are the only substantial changes identified for roads conditions.
All Others	46 / 58	0.057 / 0.003		Recent improvements of boat and seaplane docks and related marine systems as well as solid waste facilities have improved selected infrastructure at Port Alsworth.

Resource Brief: Practical Wind Power Succeeds at Lake Clark

Lake Clark NP&P has made a significant change to our wastewater management system that reduces energy consumption and cuts expenses. Alternative energy and efficiency are priorities in the park's strategic plan. Installation of an inexpensive aerating windmill that pumps air into the wastewater lagoon replaced an electric pump that had consumed 353 kwh of diesel-generated electric power each month. The windmill, and the tower it stands on, paid for itself within the first year of operation. This alternative energy system continues to save more than $300 each month in utility costs and prevents 600 pounds of diesel generated CO_2 from entering the atmosphere during that time frame. We look forward to more creative, low cost efficiencies as we continue to pursue our sustainability goals.

A wind driven pump now efficiently aerates Lake Clark's wastewater lagoon at Port Alsworth NPS Photo.

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." Wilderness character for the park is summarized below.

Overall Wilderness Character  web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Wilderness Character Qualities	Natural		The park has four major ecosystems: Boreal in the northwest, Subarctic in the western Bristol Bay basin, a Maritime fringe on the Cook Inlet coast, and the Montane spine of the park. Ecosystem processes and dynamics are intact and functioning within natural bounds. Major threats to Lake Clark's natural character at this time include impacts from climate change and external developments.
	Undeveloped		In general, developments that have occurred in the Lake Clark Wilderness are barely noticeable across the huge landscape. There are 37 installations in wilderness including equipment used to improve communication, aviation safety, and to monitor the park's volcanoes, climate, and geologic dynamics. The park actively preserves the undeveloped quality by administering its commercial services program in a manner that allows people with an existing connection to the place to continue to work here but without adding structures or facilities. In addition, while the park continues to make significant progress acquiring inholdings, there still exist numerous parcels within the park where development could occur. No new cabins or structures constructed within park wilderness in recent years. Mining districts around the border of the park could introduce pollution to the water, air, fish, and wildlife.
	Untrammeled		The park resists wildlife manipulation and water flows through intact ecosystems. Dynamic ecological processes continue as they have for millennia, unimpeded by park management. The park's attitude reflects a culture of restraint and humility. Predator control efforts outside the park boundary threaten to manipulate natural predator/prey systems. Mining districts around the border of the park could introduce pollution to the water, air, fish, and wildlife. Climate change could create higher incidences of fire and perhaps a corresponding rate of suppressing fires in order to protect private property.

Overall Wilderness Character (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Wilderness Character Qualities (continued)	Solitude or Primitive and Unconfined Recreation Opportunity		Lake Clark is largely void of recreational developments and management restrictions on visitor behavior. The immensity of the land makes people feel small and insignificant, which can be both a profoundly humbling and empowering experience. Use of technology from satellite phones, web cams, or personal tracking devices can diminish solitude for some. Developments outside the park boundary could degrade the feeling of remoteness. Visitation has increased at high use areas and staff is trying to mitigate impacts; however, overall wilderness use levels remain low. Opportunities for unconfined recreation remain high.
	Other Features and Values		The legacy of unseen footprints of the Dena'ina people has sustained the place now called Lake Clark Wilderness for centuries. Participation in traditional subsistence activities continues today as it has in previous generations. Prehistoric and historic features lend a sense of timelessness to the Lake Clark Wilderness. Park Management is consistent in consulting tribal leaders and attempting to mitigate the loss of traditional knowledge, place names, stories, and traditional practices that are practiced on the wild landscape.

Wilderness Stewardship

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Stewardship to Preserve Wilderness Character	Key Information		Lake Clark NP&P is currently managing 2.47 million acres of federally designated wilderness. Given low level of visitor use and remote nature of Lake Clark NP&P wilderness, condition is good. • Legislative direction and history of wilderness is compiled • GIS Wilderness boundary layer is available • Wilderness Character Narrative is written • A Wilderness Eligibility Reassessment was completed in 2014 in tandem with the GMP Amendment. This proposal would add 1.149 million acres of eligible wilderness to Lake Clark NP& Preserve. A final decision on an eligibility determination must be approved by the NPS Director and published in the *Federal Register*.
	Management Operations		Wilderness is considered an interdisciplinary field at Lake Clark NP&P; however, it is currently being managed under the Visitor and Resource Protection Division. • Wilderness character is incorporated into MRA, NEPA, and 106 processes • Wilderness character is incorporated into science proposal review process • Wilderness character is incorporated into extent necessary determination process for commercial services
	Status of Plans		• The park has developed a Backcountry Management Team that will be working on a Management Plan for the wilderness / backcountry at Lake Clark NP&P. This will include strategic planning for places with increased visitation like Upper Twin Lake. Managing food storage, human waste, and both public use and trespass cabins will also be addressed. • Lake Clark NP&P has a draft Wilderness Character Monitoring Plan.
	Completed Training		• Staff attended Wilderness Character Narrative/Unit Training with Peter Landres in 2012. • Chief Ranger has completed numerous Arthur Carhart Wilderness training modules and just finished serving 3 years on the Wilderness Leadership Council. • Superintendent slated for Wilderness Training 06/2015 however was diverted for special assignment. TBD 2016 • Backcountry Maintenance Lead attended Historic Preservation and Wilderness: Fall/2015

2.6. Subsistence

Subsistence			web
Indicators of Condition	**Specific Measures**	**Condition Status/Trend**	**Rationale**
Use of Timber	Volume of firewood and cabin logs cut in Port Alsworth woodlot		The number of chainsaw permits continues to increase as the population of Port Alsworth grows. Although there are no reporting requirements or restrictions on the amount of firewood cut, a 1999 report suggests 21 cords of birch is the sustainable limit that may be harvested on an annual basis from the Port Alsworth "wood lot." During years when travel is restricted on Lake Clark due to poor ice conditions, harvest likely exceeds 21 cords from the Port Alsworth wood lot. Subsistence fire wood harvest throughout the rest of Lake Clark area and Lake Clark NP&P is currently at sustainable levels. Current number of chainsaw permits issued: 54. Approximately doubling in past 5 years. See: Lake Ice indicator under Landscape Dynamics and Seasonal Processes.
Hunting, Fishing, and Trapping of Wildlife	Number of animals taken by subsistence harvest		Subsistence harvest of Dall's sheep in GMU 9B is restricted to 5 rams (3/4 curl or greater). 2014 was the first year since the sheep quota was implemented that 5 rams were harvested. Subsistence harvest has averaged less than 1 ram / year since 2010. Subsistence harvest for brown bear in GMU 9B has averaged less than 1 bear since 2005 (a harvest quota of 10 bears, 4 of which may be female, has been in place since 2000). There are no harvest reporting requirements for moose; however, anecdotal reports suggest harvest averages less than 2 moose / year in GMU 9B. Sockeye salmon subsistence harvest on the Newhalen River system was 26,600 fish in 2012. Park management responds to increased pressure on subsistence resources, by ensuring that concerns about trespass on Native and other private lands are mitigated through outreach efforts and distribution of land status maps to sport hunters.
Gathering of medicinal and edible plants	General production of consumable plants and berries		Local knowledge suggests that reduced success in gathering of plants including berries due to climate change. No known studies have been conducted for adequate baseline inventory of the effects of climate change on plant resources and impacts on subsistence users.

Subsistence (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Manage Subsistence	Monitor Subsistence Resources		Lake Clark NP&P plans to continue to hold biannual subsistence meetings and, in collaboration with local communities and tribes SRC, park biologists, and local subsistence users develop TEK projects that utilize Subsistence Advisory Council regional funding. Continue efforts monitoring natural resources, including harvest assessments, and impacts to subsistence resources remains a priority. Subsistence management is coordinated between the cultural and natural resource programs and permitting is accessible, effective, and efficient.
Education and Outreach	Education and outreach		Lake Clark NP&P plans to continue to develop communication with visitors and subsistence users in ways that minimize conflicts between user groups. Interpretive themes in Lake Clark NP&P present subsistence information to visitors promoting stewardship of subsistence opportunities for the future, subsistence values and ways of life, and information about how ANILCA applies to Lake Clark NP&P. Current examples include the new subsistence exhibit in the visitor's center, active dialogue on our social media accounts and addition of the topic on the website.

Chapter 3. Summary of Key Stewardship Activities and Accomplishments

Activities and Accomplishments

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:

Natural Resources

The natural resources program continues to focus on key wildlife and fisheries topics, especially those of subsistence importance, in recent years by implementing a series of monitoring and research projects internally and in cooperation with university, federal, and state agency partners. These monitoring and research projects have the primary objective of understanding population level dynamics, species' movements on the landscape, and predator / prey interactions. Implications of this work are far ranging from enhancing the park's resource baselines to management decision support to contributing to scientific understanding.

- On-going annual monitoring of key wildlife and fisheries resources (e.g., sockeye salmon, moose, Dall's sheep, brown bears) of high management and ecological importance.
- Long-term monitoring protocols and standard operating procedures established for vegetative communities, water resources, climate and weather, and wildlife species.
- Active engagement in research projects with U.S. Geological Survey, University of Alaska, Alaska Department of Fish and Game, University of Washington, Alaska Department of Environmental Conservation, Oregon State University, Bristol Bay Native Association, and U.S. Fish and Wildlife Service.
- Initiated Natural Resources Condition Assessment in cooperation with St. Mary's University to provide synopsis of key fish, wildlife, and physical science resources in Lake Clark NP&P.

Cultural Resources

The long tenure and genuine commitment of Lake Clark NP&P's cultural resource staff, along with the fact that members of the Den'ina community are on staff, have helped to build strong relationships between the park, traditionally associated peoples, local resident zone communities and remote park residents. Lake Clark NP&P has a rich cultural history, going back over 10,000 years. The cultural resource program is committed to sharing this rich history with the public, through many publications and outreach efforts. Focusing on the Dena'ina in the park's historical studies, publications, and interpretation programs helps foster in traditionally associated peoples a sense of connection to the park, as well as educates visitors and the public. Some highlights of the program include:

- Publications of rich cultural histories, such as *Where We Found a Whale, A History of Lake Clark National Park and Preserve* (2008) and *A 20th Century Portrait of Lake Clark, Alaska* (2014) as well as in-depth ethnographic studies like *Nanutset ch'u Q'udi Gu Before Our Time and Now: An Ethnohistory of Lake Clark National Park and Preserve* (2007), and sweeping overviews and assessments such as *K'etniyi, Settlement Patterns and Prehistory in Lake Clark National Park and Preserve: An Archeological Overview and Assessment* (2014), and *West Cook Inlet Ethnographic Overview and Assessment for Lake Clark National Park and Preserve* (2007) .
- Funding received for a Cultural Landscape Report (CLR) for the Telequana Trail Corridor.
- Funding received for a Traditional Use Study for Chulitna/Sixmile watersheds.
- Oral history interviews and mapping key Dena'ina resource areas, as well as sacred and burial sites.
- Compiled place names, developed place name database with GIS maps, and published *Dena'ina Elnena, a Celebration: Voices of the Dena'ina* (2010). The names signify social and personal ties to the land and reference important subsistence and cultural sites. The book also provides helpful information on language and dialects, regional prehistory and history and annual subsistence patterns.
- Collaboratively produced the first ever museum exhibit on Dena'ina history, culture, and tradition with the Anchorage Museum.
- Increased knowledge of archeology through surveys and testing projects including work at Tanalian Point, Historic Kijik, and a high altitude Ice Patch survey.
- Upon request from the Nondalton Tribal Council, assisted with writing a grant proposal for an Integrated Tribal Resource Management Plan (IRMP). The project was funded and Lake Clark NP&P CR staff provided technical assistance to the project. The main objective for this three-year project is to begin the planning process and implementation of the IRMP for the Chulitna River-Sixmile Lake watershed. Lake Clark NP&P is currently completing a Traditional Use Study (TUS) for the watershed, which will document the entire array of historic and current resources in the watershed and evaluate historic and current significance, which fits nicely with the IRMP.
- Annual update of the community contacts guide for affiliated tribes and ANCSA corporations.

- Final year for Whitefish/Traditional Ecological Knowledge study, a partnership with BBNA, ADF&G, NND Tribal Council. This project responds to two information needs identified in the "Priority Information Needs" document by the Office of Subsistence Management and the Bristol Bay Regional Advisory Council. These are "patterns in whitefish harvest and use from Lake Clark communities," and the multi-regional priority information need to document "changes in subsistence fishery resources and uses, in the context of climate change where relevant including but not limited to fishing season, species target, fishing locations, fish quality, harvest methods and means, and methods of preservation." Lake Clark NP&P's role in the project included acting as the liaison to several of the communities; providing support for the TEK component; and acting as lead advisor for the educational component.

Visitor Experience

- Lake Clark NP&P completed a GMP amendment in 2014, which provides guidance to park managers. The focus of the GMP is to protect resources and provide expanded visitor recreational opportunities. The GMP provides guidance regarding how Lake Clark NP&P will craft expanded opportunities in ways that will not significantly alter the current experience or quality of resources.
- Visitors are provided with compelling experiences at the Visitor Center in Port Alsworth throughout the summer. The Visitor Center experience has been recently upgraded through new exhibits, new programming, and new brochures. The station is open seven days a week in the summer. Visitation to the visitor contact station has doubled in three years.
- New exhibits have been developed and installed: A new subsistence exhibit was installed in the visitor contact station in Port Alsworth in 2014. Exhibit features local Dena'ina subsistence users describing subsistence, telling stories, and using Dena'ina language. Redoubt and Illiamna Volcano waysides were installed on the Sterling Hwy in 2013 and 2014. New waysides and bulletin boards were developed and installed at Silver Salmon Creek and Chinitna Bay in 2012. Backcountry trip planning tools were developed for the visitor center in 2013.
- The personal services interpretive program offers a wide variety of opportunities and is supported by staff throughout the park. Highlights include backcountry tours at the Richard L Proenneke site. In 2014 park volunteers provided 179 tours for 911 visitors at the Proenneke Cabin. The Junior Ranger program in Port Alsworth is also going very well. It is now well established and offers excellent opportunities for youth and families. Future plans work to leverage this model to reach additional local communities and their families.
- The park works with a variety of effective partnerships. One example of a highly functioning partnership is the 2014 partnership with Samaritan's Purse and Tanalian Bible Camp to receive an Active Trail Grant from the National Park Foundation to address high priority trail improvements. The park partnered with the Student Conservation Association and local volunteers to accomplish the work. Samaritan's Purse supported the project evaluation and visitor experience components of the project. Working with numerous partners Lake Clark NP&P was able to be responsive to visitor and partner trail improvement needs and accomplish priority work.
- In 2014 the park moved to a field management model, which will provide on-site ranger staffing at high use backcountry sites throughout the summer. In 2014 Lake Clark NP&P provided on-site full-season staffing at Chinitna Bay, Silver Salmon Creek, and Upper Twin Lakes and expanded staffing at Crescent Lake. Staff worked through CUAs, local lodges, and direct visitor contacts to communicate park messages such as interpretation, safety, and resource protection. Rangers at Silver Salmon and Chinitna Bay provided informal interpretation for visitors (682 people contacted at Chinitna Bay), on-site eyes and ears information to law enforcement, supported field research operations, conducted interpretive programs, handled critical incidents, and kept management informed of park activity on the coastline. The work at Chinitna Bay and Silver Salmon Creek led to improved relations with on-site CUA holders. Upper Twin Lake staff greeted every camping group to Hope Creek campsite and handed out bear resistant food containers in addition to providing tours of the Proenneke Cabin. Additional Law Enforcement was provided at Crescent Lake.
- The park maintains a thriving social media presence supported by an active interdisciplinary team. Audience and engagement is growing. National and regional outlets are regularly used to leverage content to larger audiences. In 2014 a Lake Clark social media based wilderness photography contest reached well over 100,000 on Facebook alone. DOI Instagram then picked up a winning photograph where it went viral. Time magazine featured the photo as one of the top ten DOI photos of the year.
- The park website has undergone substantial review, planning, and upgrades in the past three years. Improvements are consistently reflected in improved analytics. In 2014 the website received 339,000 page views, a 15% increase from 2013.
- Park publications were recently upgraded. All park publications now meet NPS design standards. Complete mail out information and youth engagement packets are now available along with a variety of site bulletins for use in the visitor center.
- Park safety training and organizational strategy continues to improve. The park improved EMS response through higher level training and updated equipment, increased dispatch capacity and emergency communications throughout the park, and improved staff risk mitigation through Operational Leadership Training.
- Accessibility upgrades are a priority for Visitor Services: Visitor Contact Station access was improved with the construction of an accessibility ramp and retrofitted restroom. The films, *No Place like Twin Lakes* and *Windfall Fishing Sail Boats of Bristol Bay* were captioned in 2014 to meet accessibility guidelines. The park conducted an analysis of website accessibility, fixed high use PDFs, and upgraded Alt-text throughout the website.

Park Infrastructure
Sustainability and environmental health were addressed through the following work:

- Increased efficiency of eleven heated structures using improved insulation techniques.
- Installed three high efficiency boilers to reduce fuel use and associated greenhouse gas emissions.
- Successfully mitigated radon in four park residences by sealing and modifying crawlspaces.
- Achieved power efficiency in utilities and buildings using alternative energy sources including wind and solar.
- Installed a wind-powered air compressor to aerate the park wastewater lagoon, saving more than $300 each month in electric utility fees.
- All backcountry cabins now have improved, sustainable communications due to solar power.
- Increased our alternative energy capacity for operating the newly purchased aircraft hangar by installing a 2,750 watt solar array and associated battery storage.
- Bicycles and bike racks as well as kayaks are now provided as human-powered alternatives to motor vehicles.
- Diversion of waste has increased due to an efficient sorting and recycling facility.
- A safe, energy saving, clean burning, and efficiently used incinerator has improved productivity and reduced ash production.
- Accessibility Upgrades are a Priority in:
    - Park Infrastructure: Visitor Contact Station access has been improved by construction of an accessibility ramp and retrofitted restroom. All current facility plans include accessibility work orders as specified by a 2012 Accessibility Audit.
    - Trails: Lake Clark has made a commitment to planning for and improving trails conditions throughout the park. The most heavily impacted trails have been improved with features such as 140 stone stairs on the most problematic portions of the Tanalian Mountain Trail. In addition, 1,500 feet of improvements, including puncheon and broken rock tread in Bog areas of the Kontrashibuna and Beaver Pond Loop trails, have been created while several hundred feet of existing trail features were replaced and repaired. Public Land Crews have contributed significantly to Lake Clark trail improvements during the last 5 years. Finally, Lake Clark National Park has added four trails to their management inventory that now contribute to the overall condition indices.

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

Visitor Use Management:
Visitor use numbers, locations, and activities have dramatically changed in the past decade. Lake Clark National Park and Preserve's visitation has tripled in the past ten years. The highest growth in visitation has been at Crescent Lake, Silver Salmon Creek, and Chinitna Bay, all on the park's coastline. The Port Alsworth area and the Richard L. Proenneke National Historic Site on Upper Twin Lake have also seen substantial increases in visitor numbers.

Visitation to the Richard L. Proenneke National Historic Site on Upper Twin Lake has doubled just in the past three years. Historical park visitation was primarily comprised of hunters visiting the western portion of the park. Today, seventy percent of the park's visitation is on the Cook Inlet coastline and at Crescent Lake with visitors primarily engaged with bear-viewing/photography and fishing. Visitation to the Port Alsworth area is also increasing with the expansion of the community. The park's main trail system in Port Alsworth has seen a dramatic increase in use over the past five years including visitors with disabilities. Park staff is actively working to address needs associated with changes in visitation in order to still provide high quality visitor experiences and to protect the park's resources.

Providing Accessible Facilities for Better Experiences: A growing number of disabled visitors require accessible facilities and experiences. Planning and implementing alterations to buildings, improving trails, and providing accessible trail experiences are a priority.

Effectively Reaching Visitors: There is no single gateway to the park where a contact station or visitor center could be located to reach the majority of park visitors. There is a growing need to increase outreach to current and future visitors. Development and implementation of a dedicated interpretation program that includes improving the park website and the development of media and virtual resources coupled with reaching visitors in the field traveling with commercial transport (CUAs) is a priority.

Sanitation: Restroom facilities are not available at most of these highly visited locations.

Trails: Existing social trails have grown over time and require extensive work to maintain and manage for future use. Multiple new user groups contribute to the increase in use including a large number of disabled visitors who need accessible facilities and trails. A trail management plan and extensive trail improvements are required to protect the resources and to serve all types of visitors.

Providing for Visitors and Protecting Cultural Resources at the Richard L. Proenneke National Historic Site: A site management plan is required to protect this valuable cultural resource and to provide for a quality visitor experience. The existing primitive campground at this site is the park's most popular campsite. It can no longer support the number of visitors it receives and is experiencing unauthorized expansion.

Operations:
The majority of park facilities are located in Port Alsworth. This reflects historical visitor trends but also helps the park ensure positive relationships with park connected communities in the Bristol Bay region. The concentration of facilities and operational support on one side of the park creates challenges in conducting operations on the park's Cook Inlet coast. The condition of the facilities requires significant improvement to meet current visitor needs.

Getting staff and supplies into remote Alaska is costly and requires extensive travel by small aircraft. The National Park Service Aviation Program, regulated by the Office of Aviation Services (OAS), is an expensive program with increasing fees for operating park owned aircraft. Due to the most recent OAS restrictions, we now have limited use of vendors to transport park staff to the west side of the park and no authorized vendors to access the Cook Inlet coastline. This has greatly increased the park aircraft workload and operational expenses. The remote nature of the park and the current travel requirements create an extensive travel administration workload. Additional support is needed to ensure that travel program regulations are followed and the administrative travel workload is completed.

Most of the current facilities in Port Alsworth were purchased from local homeowners and have been renovated to facilitate operational use. Many of these facilities were poorly constructed with limited resources. The buildings are expensive to heat; heating fuel is flown into Port Alsworth and is double the cost of fuel in Anchorage. Additionally, many facilities cannot be winterized. Virtually all facilities require alterations to meet accessibility requirements.

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

There is limited to no housing available for purchase or for rent in Port Alsworth and NPS housing is occupied by existing staff and local hire staff who were not able to find housing. This situation affects the recruitment and retention of permanent, seasonal, volunteer, and intern positions.

Climate Change:
Information existing in the scientific literature makes it reasonable to project that:

- Impacts to bivalve populations due to ocean acidification may reduce a significant food source for coastal wildlife likely resulting in population declines of coastal wildlife (including the park's high concentrations of brown bears). In addition to a significant resource impact, this could also have significant impacts for bear-dependent tourism on the coast and the majority of the park's commercial operators and visitors.
- Unknown impacts to salmon populations due to changes in the Pacific Ocean may impact the primary nutrient flow to the forest ecosystem and the primary subsistence resource for subsistence dependent communities including all of Lake Clark's resident zone communities. Some of these communities are dependent on healthy salmon runs for their food security.
- The reduction in the number and duration of frozen lakes and rivers will impact subsistence wood cutting. This will limit the ability of users to disperse wood harvest causing greater impact in areas local to homes and communities such as Port Alsworth.
- Changing climate may result in increasing wildfire frequency and severity.

Addressing the issues listed above in the context of ANILCA Title 8 subsistence rights will create complex management challenges.

Existing data on climate changes is limited, making it difficult to measure the scope of these changes and their impact on park resources.

- Recent studies suggest that the severity of the recent outbreaks of spruce bark beetle (*Dendroctonus rufipennis*) may be unprecedented. Recent spruce bark beetle (*Dendroctonus rufipennis*) activity in southcentral and southwest Alaska has resulted in widespread die-off of mature white spruce.
- Significant decreases in glacier extent are documented.

The natural resource program is engaged in long-term monitoring of Lake Clark salmon returns and Cook Inlet coastal bear populations. Social science studies have documented the food security dependence and species preference of Nondalton and Newhalen Villages. The NPS is collaborating with other federal agencies on forest health monitoring. In 2014 a study of glacial extent in the park took place.

Development on Park Boundaries:
Proposed development projects on multiple park boundaries may impact natural or cultural resources including regional wild salmon fisheries, clean waters, abundant wildlife, and clear air. The subsistence culture, Bristol Bay fishing industry, and tourism heavily rely on these world renowned natural resources.

References

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:

Alaska Department of Natural Resources – Division of Agriculture – Invasive Plants and Agricultural Pest Management: Waterweed (Elodea). Alaska Department of Natural Resources. Available at: http://plants.alaska.gov/invasives/elodea.htm

Alaska Natural Heritage Program: Alaska Exotic Plants Information Clearinghouse (AKEPIC). Alaska Natural Heritage Program. Available at: http://accs.uaa.alaska.edu/invasive-species/non-native-plants/

Balluta, A. 2008. Shtutda'ina Da'a Sheł Qudeł: My Forefathers are Still Walking with Me, Verbal Essays on Qizhjeh and Tsaynen Dena'ina Traditions. Ed. by James Kari. Lake Clark National Park and Preserve.

Bartz K. 2014. Water quality. National Park Service, Southwest Alaska Network (SWAN).

Bartz, K., and D. Young. 2014. Salmon. National Park Service, Southwest Alaska Network (SWAN).

Bartz, K., J. Shearer, and D. Young. 2014. Resident lake fish. National Park Service, Southwest Alaska Network (SWAN).

Bieniek, P. A., J. E. Walsh, R. L. Thoman, and U. S. Bhatt. 2014. Using climate divisions to analyze variations and trends in Alaska temperature and precipitation. Journal of Climate. 27(8): 2800–2818. Journal Article-2229077.

Blodgett, R. B., C. P. Hults, L. Stromquest, V. L. Santucci, and J. S. Tweet. 2015. An inventory of Middle Jurassic fossils and their stratigraphic setting at Fossil Point, Tuxedni Bay, Lake Clark National Park & Preserve, Alaska. Natural Resource Report. NPS/LACL/NRR—2015/932. National Park Service. Fort Collins, Colorado.

Bohnert, A. 2012. Museum Management Plan, Lake Clark National Park and Preserve. Lake Clark National Park and Preserve, Anchorage, Alaska.

Boisvert, L. N., and J. C. Stroeve. 2015. The Arctic is becoming warmer and wetter as revealed by the Atmospheric Infrared Sounder. Geophysical Research Letters. 42(11):4439–4446. Journal Article-2229078.

Brabets, T. P. 2002. Water quality of the Tlikakila River and Five Major Tributaries to Lake Clark, Lake Clark National Park and Preserve, Alaska, 1999–2001. Water-Resources Investigations Report. 02—4127. United States Geological Survey. Anchorage, Alaska.

Branson, J. B. 2007. The Canneries, Cabins and Caches of Bristol Bay, Alaska. Research/Resources Management Report, NPS Alaska Region. 2007–63.

Branson, J. B. 2009. The Canneries, Cabins and Caches of Bristol Bay, Alaska. Lake Clark National Park and Preserve, Anchorage, Alaska. Available at: http://www.nps.gov/lacl/learn/historyculture/canneries-cabins-caches.htm

Branson, J. B. 2014. A 20th-century portrait of Lake Clark, Alaska, 1900–2000. National Park Service. Anchorage, Alaska.

Chapin, F. S., III, S. F. Trainor, P. Cochran, H. Huntington, C. Markon, M. McCammon, A. D. McGuire, and M. Serreze. 2014. Ch. 22: Alaska. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T. C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program.514–536. Published Report-2215236.

Duriscoe, D. M. 2013. Measuring anthropogenic sky glow using a natural sky brightness model. Publications of the Astronomical Society of the Pacific. 125(933):1370–1382.

Duriscoe, D. M., C. B. Luginbuhl, and C. Moore. 2007. Measuring night-sky brightness with a wide-field CCD camera. Publications of the Astronomical Society of the Pacific. 119:192–213.

Eagles-Smith, C. A., J. J. Willacker, and C. M. Flanagan Pritz. 2014. Mercury in Fishes from 21 National Parks in the Western United States—Inter- and Intra-Park Variation in Concentrations and Ecological Risk. USGS Open-File Report. 2014—1051.

Ellanna, L J. and A. Balluta. 1992. Nuvendaltin Ouht'ana: The People of Nondalton. Smithsonian Institution Press. Washington, DC.

Evanoff, K. E. (ed). 2010. Dena'ina Ełnena, A Celebration: Voices of the Dena'ina. Lake Clark National Park and Preserve, Anchorage, Alaska. Available at: http://www.nps.gov/lacl/historyculture/denaina-elnena.htm

Fagan, B. 2008. Where we found a whale, a history of Lake Clark National Park and Preserve. National Park Service. Anchorage, Alaska. Available at: http://www.nps.gov/lacl/historyculture/we-found-a-whale.htm

Fall, J. A., D. Holen, T. M. Krieg, R. La Vine, K. Stickman, M. Ravenmoon, J. Hay, and J. Stariwat. 2010. The Kvichak watershed subsistence salmon fishery: an ethnographic study. ADF&G Division of Subsistence, Technical Paper No. 352.

Federal Aviation Administration. 2010. FAA Aerospace Forecast Fiscal Years 2010–2030. U.S. Department of Transportation Federal Aviation Policy and Plans, Washington DC.

Flanagan Pritz, C. M., J. E. Schrlau, S. L. Massey Simonich, and T. F. Blett. 2014. Contaminants of Emerging Concern in Fish from Western U.S. and Alaskan National Parks – Spatial Distribution and Health Thresholds. Journal of the American Water Resources Association (JAWRA). 50(2):309–323.

Gaul, K. K. 2007. Nanutset ch'u Q'udi Gu: Before our time and now – An ethnohistory of Lake Clark National Park & Preserve. National Park Service, Department of the Interior.

Interagency Monitoring of Protected Visual Environments (IMPROVE), National Website, Fort Collins, Colorado. Available at: http://vista.cira.colostate.edu/improve/

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate change 2007: The physical science basis. University Cambridge Press. Available at: http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg1_report_the_physical_science_basis.htm

Intergovernmental Panel on Climate Change (IPCC). 2013. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T. F., D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P. M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

Jones, B. M., and C. D. Arp. 2014. Thermal response of western Alaska lakes to past, present, and future changes in climate: Western Alaska Landscape Conservation Cooperative Final Report. Anchorage, Alaska.

Jones, M., T. Sands, C. Brazil, G. Buck, F. West, P. Salomone, S. Morstad, and T. Krieg. 2014. 2013 Bristol Bay Area Annual Management Report. Alaska Department of Fish and Game, Fishery Management Report. 14—23. Alaska Department of Fish and Game. Anchorage, Alaska.

Lake Clark National Park and Preserve. 2009. Foundation Statement. National Park Service, Anchorage, Alaska.

Lake Clark National Park and Preserve. 2014. Collections Management Report. National Park Service, Anchorage, Alaska.

Larsen, J. N., O. A. Anisimov, A. Constable, A. B. Hollowed, N. Maynard, P. Prestrud, T. D. Prowse, and J. M. R. Stone.2014: Polar regions. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V. R., C. B. Field, D. J. Dokken, M. D. Mastrandrea, K. J. Mach, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea, and L. L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1567–1612. Book Chapter-2229099.

Lindsay, C. 2013. Climate. National Park Service, Southwest Alaska Network (SWAN).

Lindsay, C. 2014. Climate monitoring in the Southwest Alaska Network: Annual report for the 2013 hydrologic year. Natural Resource Technical Report. NPS/SWAN/NRTR—2014/857. National Park Service. Fort Collins, Colorado.

Lindsay, C., and G. Adema. 2013. Glacier Extent: Glacier changes since 1950s documented for Katmai, Kenai Fjords, and Lake Clark. Southwest Alaska Network Southwest Alaska Network SWAN Inventory & Monitoring Program Resource Brief. National Park Service, Southwest Alaska Network (SWAN).

Lindsay, C., and M. Shephard. 2014. Weather and Climate: Lake Clark – Fall 2014 Weather Summary. National Park Service, Southwest Alaska Network (SWAN), Anchorage, Alaska. Available at: http://science.nature.nps.gov/im/units/swan/assets/docs/reports/resourcebriefs/LACL_2014_FallClimateBrief_20141208.pdf

Loso, M., A. Arendt, C. Larsen, J. Rich, and N. Murphy. 2014. Alaskan national park glaciers – status and trends: Final report. Natural Resource Technical Report. NPS/AKRO/NRTR—2014/922. National Park Service. Fort Collins, Colorado. Published Report—2217472.

Lynch, A. J., and A. Worthington. 1990. National Register of Historic Places Inventory Nomination form for Kijik Archeological District. Lake Clark National Park and Preserve, Anchorage, Alaska.

Mangipane, B., and T. Wilson. 2011. Brown Bear. National Park Service, Southwest Alaska Network (SWAN).

Mangipane, B., and T. Wilson. 2011. Moose. National Park Service, Southwest Alaska Network (SWAN).

Mantua, N. J., and S. R. Hare. 2002. The Pacific Decadal Oscillation. Journal of Oceanography. 58 (1): 35–44. Available at: https://www.terrapub.co.jp/journals/JO/pdf/5801/58010035.pdf

Markon, C. J., S. F. Trainor, and F. S. Chapin (eds.). 2012. The United States National Climate Assessment— Alaska Technical Regional Report: U.S. Geological Survey Circular 1379, 148 p. Published Report-2229100.

Mennitt, D., K. Sherrill, and K. Fristrup. 2014. A geospatial model of ambient sound pressure levels in the contiguous United States. The Journal of the Acoustical Society of America 135(5): 2746–2764.

Miller, A. 2013. Forest Insects and Disease. National Park Service, Southwest Alaska Network (SWAN).

Monahan, W. B., and N. A. Fisichelli. 2014. Climate exposure of US National Parks in a new era of change. Plos One. 9(7):1. Journal Article-2211579.

Moore, C. M., J. M. White, and F. Turina. Recommended Indicators of Night Sky Quality for NPS State of the Parks Reports. National Park Service, Fort Collins, Colorado. Available at: https://irma.nps.gov/App/Reference/DownloadDigitalFile?code=468796&file=Recommended_Indicators_of_Night_Sky_Quality.pdf

Namias, J. 1953. Thirty-day forecasting: a review of a ten-year experiment. Meteorology. Monographs. American Meteorological Society, (6):2. Journal Article-2229189.

Namias, J. 1959. Recent seasonal interactions between North Pacific waters and the overlying atmospheric circulation. Journal of Geophysical. Research. 64(6): 631–646. Journal Article-2229191

National Park Service, Air Resources Division. Air Quality Conditions & Trends by NPS Units: Lake Clark National Park & Preserve, 2012 End Year. National Park Service. Denver, Colorado. Accessed March 30, 2015. Available at: http://www.nature.nps.gov/air/data/products/parks/index.cfm.

National Park Service, Alaska Park Historic Structures and Cultural Landscapes Program. 2014. Cultural Landscape Inventory Database. National Park Service, Anchorage, Alaska. Accessed December 10, 2014.

National Park Service Geologic Resources Inventory Program. 2010. Digital Surficial Map of Lake Clark National Park and Preserve and Vicinity, Alaska (NPS, GRD, GRI, Lake Clark NP&P, LSUR digital map). NPS Geologic Resources Inventory Program. Lakewood, Colorado.

National Park Service, Natural Sounds and Night Sky Division. 2014. National Park Service. Night Sky Website, National Park Service, Washington, DC. Available at: http://www.nature.nps.gov/night/

National Park Service, Natural Sounds and Night Sky Division. 2014. National Park Service. Natural Sounds Website. National Park Service, Washington, DC. Available at: http://www.nature.nps.gov/sound/

National Park Service, Park Facility Management Division. 2015. Park Facility Maintenance—Explanation of Some Terminology and Concepts. National Park Service, Washington, DC. Available at: http://www.nps.gov/stateoftheparks/assets/docs/Park_Facility_Management_Terminology_and_Concepts.pdf

[NCA] U.S. Global Change Research Program. 2014. Climate change impacts in the United States: the third national climate assessment. U.S. Global Change Research Program. Washington, DC. Published Report-2215236.

NOAA National Centers for Environmental Information, State of the Climate: National Overview for Annual 2015, published online January 2016, retrieved on February 12, 2016 from http://www.ncdc.noaa.gov/sotc/national/201513.

Papineau, J. M. 2001. Wintertime temperature anomalies in Alaska correlated with ENSO and PDO. International Journal of Climatology. 21(13): 1577–1592. Journal Article-2229103.

Root, H. T., B. McCune, and S. Jovan. 2014. Lichen Communities and Species Indicate Climate Thresholds in Southeast and South-Central Alaska, USA. The Bryologist 117(3):241–252.

Scenarios Network for Alaska and Arctic Planning, University of Alaska (SNAP). 2016. Retrieved Mar.17, 2016 from: https://www.snap.uaf.edu/sites/all/modules/snap_community_charts/charts.php

Shephard, M. 2014. Visitor Use-Lake Clark National Park and Preserve. National Park Service. Southwest Alaska Network (SWAN), Anchorage, Alaska. Available here: http://science.nature.nps.gov/im/units/swan/assets/docs/reports/resourcebriefs/LACL_VisitorUse_RB_201403.pdf

Sherriff, R., and E. Berg. 2011. Reconstruction of historic insect outbreaks in Lake Clark and Katmai National Parks and Preserves: Final Report. Natural Resource Technical Report. NPS/SWAN/NRTR—2011/482. National Park Service, Natural Resource Stewardship and Science. Fort Collins, Colorado.

Smith, T. M., R. W. Reynolds, T. C. Peterson, and J. Lawrimore. 2008. Improvements to NOAAs Historical Merged Land–Ocean Temp Analysis (1880–2006). Journal of Climate. 21: 2283–2296. Journal Article-2229194.

Stanek, R., J. Fall, and D. Holen. 2006. West Cook Inlet Ethnographic Overview and Assessment for Lake Clark National Park and Preserve. Alaska Department of Fish and Game and Lake Clark National Park, Anchorage, Alaska. Available at: http://www.nps.gov/lacl/learn/historyculture/west-cook-inlet.htm

Stickman, K., A. Balluta, M. McBurney, and D. Young. 2003. K'ezghlegh, Nondalton Traditional Ecological Knowledge of Freshwater Fish. Fisheries Project 01-075. US Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program. Anchorage, Alaska.

Sullivan, T. J., G. T. McPherson, T. C. McDonnell, S. D. Mackey, and D. Moore. 2011a. Evaluation of the Sensitivity of Inventory and Monitoring National Parks to Acidification Effects from Atmospheric Sulfur and Nitrogen Deposition: Main Report. Natural Resource Report NPS/NRPC/ARD/NRR—2011/349. National Park Service, Denver, Colorado.

Sullivan, T. J., T. C. McDonnell, G. T. McPherson, S. D. Mackey, and D. Moore. 2011b. Evaluation of the Sensitivity of Inventory and Monitoring National Parks to Nutrient Enrichment Effects from Atmospheric Nitrogen Deposition: Main Report. Natural Resource Report NPS/NRPC/ARD/NRR—2011/313. National Park Service, Denver, Colorado.

Southwest Alaska Network (SWAN), Lake Ice Map. National Park Service, Southwest Alaska Network (SWAN), Anchorage, Alaska. Available at: http://science.nature.nps.gov/im/units/swan/monitor/lake_ice_map.cfm

Southwest Alaska Network (SWAN), Marine Nearshore Monitoring. National Park Service, Southwest Alaska Network (SWAN), Anchorage, Alaska. Available at: http://science.nature.nps.gov/im/units/swan/monitor/nearshore.cfm?tab=3

Stewart, B. C., K. E. Kunkel, L. E. Stevens, L. Sun, and J. E. Walsh. 2013. Regional Climate Trends and Scenarios for the U.S. National Climate Assessment. Part 7. Climate of Alaska. NOAA Technical Report NESDIS 142-7. National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service. Washington, DC. Published Report-2198289.

Tennessen, D. 2012a. Draft nomination for Chilikadrotna Headwaters Archeological District. Lake Clark National Park and Preserve, Anchorage, Alaska.

Tennessen, D. 2012b. Draft Nomination for the Snipe Lake Archeological District. Lake Clark National Park and Preserve, Anchorage, Alaska.

Tennessen, D. 2013. Draft Nomination for the Two Lakes Archeological District. Lake Clark National Park and Preserve, Anchorage, Alaska.

Tennessen, D. 2014. K'etniyi Settlement Patterns and Prehistory in Lake Clark National Park and Preserve: An Archeological Overview and Assessment. Lake Clark National Park and Preserve, Alaska.

Tobey, J. 2003. Cabins of Lake Clark National Park and Preserve Volume I: Cabins Eligible for the National Register of Historic Places, with Special Section: Fire Management Cabin Database and Volume II: Cabins Not Eligible for the National Register of Historic Places, with Special Section: Tresspass Cabins. Lake Clark National Park and Preserve, Anchorage, Alaska.

Trenberth, K. E., and J. W. Hurrell. 1994. Decadal atmosphere-ocean variations in the Pacific. Climate Dynamics. 9(6): 303–319. Journal Article-2229195.

Unrau, H. D. 1994. Lake Clark National Park and Preserve, Alaska: Historic Resource Study, edited by Frank Norris. National Park Service, Anchorage, Alaska.

U.S. Census Bureau. 2010. 2010 Census Urban and Rural Classification. Retrieved June 28, 2013 from http://www2.census.gov/geo/tiger/TIGER2010/UA/2010.

U.S. Census Bureau. 2011. Urban Area Criteria for the 2010 Census. Federal Register. 76(164):53029–53043.

U.S. Federal Highway Administration. 2013. Traffic Volume Trends: May 2013 (p. 10). Retrieved from http://www.fhwa.dot.gov/policyinformation/travel_monitoring/13maytvt/13maytvt.pdf.

Wells A., M. Macander, T. Jorgenson, T. Christopherson, B. Baird, and E. Trainor. 2013. Ecological Land Survey and Soil Landscapes Map for Lake Clark National Park and Preserve, Alaska, 2011. Natural Resource Technical Report. NPS/Lake Clark NP&P/NRTR—2013/693. National Park Service. Fort Collins, Colorado.

Western Alaska Landscape Conservation Cooperative. Western Alaska Landscape Conservation Cooperative. Available at: https://westernalaskalcc.org/SitePages/Western%20Alaska%20LCC.aspx

Wilson, T. 2013. Bald Eagles. National Park Service, Southwest Alaska Network (SWAN), Anchorage, Alaska.

Witter, L. A., and B. M. Mangipane. 2011. Bald Eagle Nest Survey Lake Clark National Park and Preserve, Alaska. Natural Resource Data Series. NPS/Lake Clark NP&P/NRDS—2011/313. National Park Service, Natural Resource Stewardship and Science. Fort Collins, Colorado.

Wrona, F. J., T. D. Prowse, and J. D. Reist. 2005. Freshwater ecosystems and fisheries. Pages 353–452 in Arctic Climate Impact Assessment. Cambridge University Press, New York City, New York.

Young, D. 2014. Lake Clark Sockeye Salmon Escapement and Population Monitoring, 2008–2011. Lake Clark National Park and Preserve, Anchorage, Alaska.

See Also:

Collection of Natural Resource-Related References

Collection of Cultural Resource-Related References

Collection of Subsistence-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:

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.
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 (CLR) 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 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.
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.
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.
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.
Southwest Alaska Network (SWAN)	One of 32 I&M networks established as part of the NPS Inventory and Monitoring Program. The Southwest Alaska Network provides scientific data and expertise for natural resources in five parks located in Alaska.
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.
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 (VIP) 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.