



State of the Park Report

Cape Krusenstern National Monument

Alaska



2017

On the cover: View looking north from radio hill in Cape Krusenstern National Monument. NPS Photo.

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.

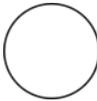
The purpose of this State of the Park report is to:

- 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.

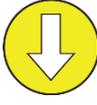
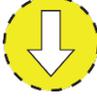
Cape Krusenstern National Monument (CAKR) is managed as a unit within the Western Arctic Parklands. The purpose of CAKR (“the park”) is to preserve, study, and interpret a sequential archeological record of human migration and adaptation, and to protect arctic ecosystems and subsistence resources.

The summary table, below, and the supporting information that follows, provide an overall assessment of the condition of priority resources and values at Cape Krusenstern National Monument based on scientific and scholarly studies and expert opinion. The internet version of this report, available at <http://www.nps.gov/stateoftheparks/cakr/>, 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 goals for managing park resources, and may alter how the park measures the trend in condition of resources. Thus, reference conditions, regulatory standards, and/or best judgment about resource status or trend may evolve as the rate of climate change accelerates and the park responds to novel conditions. In this context, the status and trends documented here provide a useful point-in-time baseline to inform understanding of emerging change, as well as a synthesis to share as the park builds 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 ▶		
Air Quality		<p>Air quality at CAKR is generally good. Locally, dust from the Red Dog Mine haul road that crosses the park has impacted air quality intermittently, and has dispersed zinc, lead, and cadmium dust onto the surrounding tundra since 1989. Mine pollution controls have reduced these impacts. Other airborne organic pollutants including those related to mercury deposition are a moderate concern in the Arctic region.</p>
Geological Resources		<p>Located on the coast, active geologic erosion is heavily influenced by sea ice. Rates of coastline erosion have been increasing, and heavy erosion caused by storm surges has created visible damage. Most of CAKR is underlain by frozen soil called permafrost. Permafrost average temperatures have warmed since 1950, and the thickness of the seasonally-thawed upper (or “active”) layer has increased as a result of climate warming since 1950. While the extent of permafrost has changed little so far, continued warming is expected to impact the permafrost and tundra ecosystem. In addition to the Red Dog Mine currently in operation, there is mineral exploration and other small-scale mining near outside the park boundary.</p>
Paleontological Resources		<p>CAKR contains fossils in two contexts: 1) Paleozoic (250–540 million years ago) marine invertebrate fossils in the uplands; and 2) Pleistocene and Holocene (2.6 million years ago to present) vertebrate fossils within unconsolidated deposits along the beaches and in the lagoons. Non-permitted collecting in the Western Arctic Parklands has been observed, but has not been officially documented. Fossils in sea bluff exposures and river cut banks are at high risk of being eroded.</p>
Water Resources		<p>Increased drainage due to warming permafrost has decreased the surface area of lakes in the park. Sampling for water quality of lakes and streams is infrequent, but indicates that water quality is good. Timing of peak stream flows has changed in recent decades in response to climate warming, with the timing of peak discharge occurring over 4 days per decade earlier since 1984; however, the timing of river freeze-up during autumn has not changed significantly during this same period.</p>
Terrestrial Vegetation		<p>Terrestrial lichen cover is fairly low in CAKR because of the dominance of dwarf birch tussock shrub tundra, which is naturally low in lichen cover. Lichen diversity is relatively high in Cape Krusenstern due to a diversity of habitats from lowland to alpine. CAKR has relatively high vascular plant diversity. Vascular plant cover has been increasing across the Arctic in recent decades, as shrubs and other plants increase in height and density. The cover, density, and height of shrubs have increased in tundra areas of CAKR, as has occurred elsewhere in the Arctic. This shrub increase is expected to continue with climate warming. While shrub increase will benefit certain species—such as moose and willow ptarmigan—it will alter the iconic open arctic tundra landscape and harm some of the species that depend on it.</p>

Priority Resource or Value	Condition Status/Trend	Rationale
<p>Birds</p>		<p>CAKR falls into nationally and internationally recognized bird conservation regions; however, population status information for landbird species in the park is incomplete. Information about the population status of breeding shorebirds in CAKR is lacking. Loss of wetlands—particularly migratory stopover areas outside of Alaska that are important to those species breeding in Alaska—represents the greatest threat to shorebird populations worldwide.</p>
<p>Terrestrial Mammals</p>		<p>Terrestrial mammals in the park include, but are not limited to, moose, brown bear, caribou, muskox, wolves, and wolverines.</p> <p>The most recent population estimate for moose in the lower Noatak River drainage was in 2013. Sport hunting is prohibited in CAKR, but subsistence harvest and predation remain significant sources of moose mortality.</p> <p>An aerial survey conducted in the lower Noatak drainage and CAKR in 2008 estimated the bear densities for independent bears and total bears to be 1 bear/57 km² and 1 bears/36 km², respectively.</p> <p>The Western Arctic Caribou Herd is currently at the low end of its population cycle. In general, the health and success of the various herds in this region is stable with some natural fluctuation.</p> <p>Muskoxen were extirpated from Alaska in the late 1800s. Seventy muskoxen were reintroduced at Cape Thompson between 1970 and 1977. The Cape Thompson population that now inhabits CAKR and adjacent lands are descendants of these animals. The population appears to be expanding beyond its core area.</p> <p>The few historical estimates of the wolf population size in northwest Alaska are varied and unreliable, but the concern of wolf influence upon the Western Arctic Caribou Herd spurred predator control as early as the 1940s. The wolf population in CAKR has not been estimated in recent years, but many local residents report an increase in observations and a concern for the caribou and public safety.</p> <p>Wolverine naturally occur at low population densities and have low reproductive rates. Little wolverine data are available, and currently there is an effort underway to quantify wolverine populations to the north and east of CAKR.</p>
<p>Fish</p>		<p>Fish species in CAKR include sheefish (Inconnu), other whitefish, Dolly Varden, and arctic char. Fish are an important subsistence resource. Five species of anadromous whitefish (not including sheefish) inhabit the waters of the Western Arctic Parklands. As a group, they represent the most accessible subsistence resource in the area, and are available from late spring through early winter. Generally, fish diversity and populations are presumed to be good based on their remote location and low levels of anthropogenic impact; however, there exists a lack of rigorous fish data. Anecdotal evidence indicates some species may be declining.</p>

Priority Resource or Value	Condition Status/Trend	Rationale
Unique Communities and Features (Lagoon Complexes)		<p>The coastline of CAKR includes about 78 km of open and closed lagoon complexes. These unique landscapes consist of sand or gravel beaches backed by grass-covered beach berms or dune ridges, behind which there can be more ridges covered with dwarf shrub-lichen vegetation, small freshwater lakes and ponds, and salt marshes. The lagoons host a tremendous diversity of wildlife including waterfowl, muskoxen, brown bears, and caribou.</p> <p>Valuable cultural sites, some thousands of years old, are scattered along the coastline, and the barrier spits and lagoons remain the most frequently visited part of the park. Impacts to the barrier spits and lagoons include litter and marine debris, OHV use, and an increase in recent years in erosion rates and storm overwash events associated with the loss of sea ice. These impacts are expected to continue and increase in the future as sea ice declines, sea level rises, and permafrost thaws. Increased shipping activity in the region also brings with it the possibility of a serious oil or other type of industrial spill.</p>
Landscape and Ecosystem Processes		<p>Due to the coastal influence of weather at Cape Krusenstern, fire is fairly infrequent with an average of 0.06 fires occurring per year in Cape Krusenstern. No fires have occurred in the park unit between 2010 and 2015. Changes in greenness from vegetation cover shifts are expected to have diverse impacts to the tundra ecosystem.</p>
Marine Nearshore		<p>Through 2015, the September Arctic sea ice extent has decreased by 13.4% per decade, relative to the 1981 to 2010 average. The nine lowest September sea ice extents have occurred in the last nine years. Important marine nearshore animals include ringed and bearded seals, beluga whales, and polar bears. Reliable population estimates for ringed and bearded seals are not available. Beluga whales are present in waters off the park's coast, and distributed throughout seasonally ice-covered water. Polar bears are a threatened species, whose populations are also heavily influenced by sea-ice conditions. The polar bear population trend specific to CAKR is unknown; population trends vary throughout the Arctic.</p> <p>Marine incidents are relatively common in the Chukchi Sea and Kotzebue Basin Area. With significant increases in Arctic marine traffic operations through the Bering Strait, associated Arctic marine incident risks are also increasing. Marine debris including microplastics and other pollutants are a growing concern, especially in areas where rural communities are dependent on marine mammal harvest for subsistence.</p>
Dark Night Sky		<p>The NPS Night Sky Program characterizes a park's dark sky environment by measuring both man-made and natural light. While no ground based or modeled data are available for Cape Krusenstern National Monument, 2012 visible infrared imaging radiometer (VIIRS) satellite data, which uses a broadband imaging detector with high sensitivity, indicates that there is minimal visible upward radiance within the park boundary, and small amounts of upward radiance within a 200-km radius surrounding the park. The largest sources of upward radiance emanate from the Red Dog Mine, about 30 km from the park's northeast boundary, and from the town Kotzebue, AK about 20 km from the park's southern boundary. Night sky quality at CAKR is in good condition.</p>
Acoustic Environment		<p>Sound and acoustic impact levels at CAKR are very low in this remote place. Local and intermittent impacts to soundscape in the northern section of CAKR occur due to the operations of the Red Dog Mine including ore truck transits, other vehicular traffic, blasting, shipping, and port operations.</p>

Priority Resource or Value	Condition Status/Trend	Rationale
Cultural Resources web ▶		
Archeological Resources		<p>The major themes/historic contexts for CAKR are well developed, particularly for the late-Holocene cultures, but many questions remain about the origins of coastal adaptations, trans-Bering strait connections, and the role of Beringia in the peopling of the Americas. Incremental progress is being made as modern methods and theories guide new research and refine previous interpretations. The beach ridge sequence at Cape Krusenstern preserves a record of human adaptation that spans 5,000 years. The artifacts preserved at the sites in this sequence are often used as type specimens that define the archeological traditions across northern Alaska. The percentage of area surveyed in CAKR is high along the beach ridge complex but low for inland areas. Documentation including National Register materials, GIS data, and site condition assessments is incomplete.</p>
Cultural Anthropology		<p>Although anthropological research has been conducted in the region by scholars, local residents, and federal/state agencies, the park lacks formal baseline documentation to assess condition and adequately protect unknown or undocumented ethnographic resources. Each passing year marks the loss of knowledge bearers and elders who can contribute to the documentation process.</p>
Cultural Landscapes		<p>Three cultural landscapes have been identified in the park, but none have been formally documented, inventoried, or evaluated using the park's established historical contexts.</p>
Historic Structures		<p>Several historic structures have been identified in CAKR. These structures lack formal documentation including National Register evaluation. GIS data and documentation of structure condition are lacking. The harsh arctic environment continues to erode the structures.</p>
History		<p>CAKR lacks a Historic Resource Study and an Administrative History. Only 4 (1.2%) of the recorded sites in CAKR have been determined eligible for the National Register. No other resources have been evaluated.</p>
Museum Collections		<p>The park currently has an adequate amount of research and reports to demonstrate the significance and context of the items in the museum collection; however, the park has the potential for both continued and expanded archeological, ethnological, historical, and natural history studies that would expand understanding. CAKR benefits from substantial support of the National Park Service's Alaska Regional Curatorial Center, located in Anchorage, AK.</p>
Visitor Experience web ▶		
Number of Visitors		<p>The 10-year annual average of visitors for 2003–2012 was 4,872. CAKR is remote and has no public roads, entrance station, or facilities. Non-local and recreational visitors rely on outside providers to get to the park in aircraft. Visitation numbers are estimates by staff who conduct field work in the park. Counts include outside visitors plus local area residents who travel through the park.</p>

Priority Resource or Value	Condition Status/Trend	Rationale
Visitor Satisfaction		Park staff does not conduct visitor satisfaction surveys because the park is remote and there is no ability to gather survey data. However, contact with visitors in the Northwest Arctic Heritage Center, community feedback, and social media suggest that people have significant appreciation for wilderness solitude and the effort it takes for a once in a lifetime trip in the park.
Interpretive and Education Programs – Talks, Tours, and Special Events		A small but robust interpretive team conducts many interpretive programs for community children and adults, as well as virtual visitors. The curriculum-based school program recently received the Freeman Tilden Award. Many local people attend the special events and listen to the weekly radio show. Increasing the numbers of general walk-in visitors is an ongoing effort—banners and a new Facebook page are planned solutions.
Interpretive Media – Brochures, Exhibits, Signs, and Website		Interpretive media exists only in the Northwest Arctic Heritage Center (NAHC), as there are no facilities in the park. Repairs to the aging exhibits are in progress. New audiovisual presentations are being created regularly. Maintaining the website is a challenge due to internet connectivity issues, but interpreters are spending an increasing amount of time to troubleshoot and create new content.
Accessibility		When the Northwest Arctic Heritage Center opened to the public in 2010, few accessibility features were put in place. Basic accommodations currently exist for mobility, visual, and auditory accommodations.
Safety		The safety of visitors and employees is a priority for the park. No visitor injuries have been reported in the Northwest Arctic Heritage Center and the number of accidents in the park is very low. A suite of safety courses are offered to permanent and temporary staff every year.
Partnerships		Volunteer efforts are critical to operation of CAKR. Many long-term community partnerships exist to enhance interpretive efforts for the public. Volunteers need to be skilled in specific disciplines in order to do projects in this remote area, so the numbers of individual volunteers are not high.
Recreational Opportunities		Wilderness covers a wide area of the park, so there are many opportunities for solitude, floating, and hiking. Planes can be chartered from several companies for flightseeing, hiking, and floating. No signs or improved trails exist, so visitors have to navigate on their own and possess wilderness survival skills.
Scenic Resources		CAKR is notable both for natural character and human use. There are five major impairments to the scenic resource quality of the park: (1) marine debris, (2) the Red Dog mine haul road and Port Site, (3) lead and zinc dust, (4) refuse on allotments, and (5) a WWII bulldozed mountaintop with radio repeaters and climate stations.

Priority Resource or Value	Condition Status/Trend	Rationale
Wilderness Character and Stewardship web ▶		
Overall Wilderness Character		The natural and undeveloped qualities of wilderness character warrant moderate concern due to the effects of climate change, structures and installations, and use of motorized vehicles. On the other hand, CAKR has some of the most intact areas in existence, in the sense that they have remained largely free from the influence of modern human control and manipulation. Away from the infrastructure associated with the Red Dog Mine and reclaimed sites such as Radio Hill, opportunities for solitude abound. Archeological resources add an important element to the character of CAKR wilderness. Wilderness character monitoring would greatly bolster the confidence with which this assessment is made.
Wilderness Stewardship		CAKR management utilizes the Wilderness Minimum Requirements Analysis (MRA) when considering actions and operations that would affect wilderness values. The park lacks important baseline documentation.
Subsistence web ▶		
Overall Condition, Opportunity and Continuity for Subsistence Activities		CAKR has three primary communities that are affiliated with the park and are heavily dependent on subsistence resources from the park: Kotzebue, Noatak, and Kivalina. Sharing of subsistence foods with relatives and friends is an important cultural practice that extends beyond the region. Opportunity to pursue key subsistence activities is decreasing. Key wildlife species of primary importance for subsistence use in the region are caribou, moose, and muskoxen. Caribou are declining. This is leading to a compounding situation where there is a decrease in availability of important wildlife resources and an increase in number of subsistence users. Deteriorating ice conditions reduces hunting access to marine mammals.

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

- NPS's Arctic Network Inventory and Monitoring Program conducted monitoring in CAKR on vital signs including: muskoxen, brown bears, moose, terrestrial vegetation (including lichen), terrestrial landscape patterns, permafrost, caribou, Yellow-billed loon, large lakes, shallow lakes, streams, fire, snowpack, air quality, and weather and climate.
- CAKR completed Shorezone mapping and videography of its entire coastline (including interiors of lagoons and estuaries). The resulting oil spill physical and biological risk maps and logistical aid maps are posted on Shorezone.org. This large project is part of a statewide effort including partnerships with the National Oceanographic and Atmospheric Administration, the Landscape Conservation Cooperative Programs, and the State of Alaska.
- CAKR and Noatak National Preserve partnered with Alaska Department of Fish and Game to complete an expanded survey of the Cape Thompson muskox population. This interagency survey has the largest spatial extent of any survey in the state.
- An aerial brown bear survey was conducted in the lower Noatak River within CAKR and Noatak in 2016; this was the first reliable population estimate for the area in over 20 years.
- CAKR obtained major funding to develop scientific and logistical preparedness for an oil spill.
- NPS partnered with the U.S. Forest Service to produce a model of the effects of climate change on the habitat of over 200 species of birds and mammals.

Cultural Resources

- CAKR’s archival processing has been brought up-to-date. 205 linear feet of archives with a finding aid were produced for all northwest Arctic parks including Bering Land Bridge, Cape Krusenstern, Kobuk Valley, and Noatak.
- In the summer of 2015, the National Park Service collaborated with Alaska Geographic, Bering Straits Native Corporation, Kawerak Incorporated, Carrie McClain Museum, and UAF Northwest Campus to host Nome Archaeology Camp, an opportunity for Alaskan teens to learn more about the heritage of the Bering Straits region through archeological methods, oral history, and museum studies.
- Since 2012, NPS has administered a vulnerability assessment program to identify the most significant and at-risk cultural and paleontological resources on the coast of Bering Land Bridge National Preserve and CAKR. These sites are in danger of being washed away by storm surges that are more and more frequent as the climate changes in arctic waters.
- The NPS financially supported several place name documentation projects in the region during the 1970s and 1990s. For a number of years, NPS staff has been working to identify existing Iñupiaq place names data sets that may be suited for digitization into a Geographic Information System (GIS). Although issues of cultural sensitivities may limit the degree to which the data is distributed and shared, Native communities who created the data will certainly benefit from the consolidation of this type of information into a GIS format.

Visitor Experience

- Artists-in-Residence Susan Watkins, Dean Cully, and Bob Winfree have each contributed a painting or photograph to represent the muskoxen and landscape of the park. All three pieces are on permanent display in the Northwest Arctic Heritage Center.
- High quality video of a muskox sparring match led to the development of a new video that educates the public on muskox behavior. Please enjoy the video at the [park website](#).
- SCA interns created a video that celebrates the Find Your Park campaign and features a life-sized woolly mammoth in Cape Krusenstern National Monument. 68,055 visitors got an unforgettable view of the park resources and the local Alaska Native community.
- NPS ethnographers recently completed the publication of journals from beloved local elder Bob Uhl. Rangers are highlighting Bob’s 10 years of daily wisdom about Iñupiaq culture and the land through quotes from the journals on the CAKR Twitter feed every week. One great example: On this day in 1995, Bob wrote “Had a crane in the soup pot tonight... It was quite fat and quite good.” Follow the park on Twitter @CKrusensternNPS.

Wilderness

- CAKR completed the mapping of current wilderness boundaries and calculation of current wilderness acreage.
- Western Arctic Parklands compiled the legislative history of Wilderness in Noatak National Preserve, Kobuk Valley National Park, and Cape Krusenstern.

Subsistence

- NPS continues to work within a regulatory framework to balance subsistence uses with conservation of wildlife populations. The NPS manages one muskox hunt in CAKR and coordinates with the State of Alaska.
- The NPS holds Subsistence Resource Commission (SRC) meetings for CAKR. The most recent SRC meetings were held in fall 2015, spring 2016, and fall 2016. The next meeting is planned for spring 2017.
- NPS released new regulation changes allowing customary and traditional uses of horns, antlers, and plant materials collected from parklands (Federal Register 2017).

Key Issues and Challenges for Consideration in Management Planning

Many of the major management challenges facing CAKR are common to all Arctic parks, including: adapting to landscape and ecosystem change driven by climate change, managing for subsistence and wildlife populations, mitigating current and potential impacts from development outside park boundaries, addressing logistical challenges unique to remote parks, and adapting to the increase in shipping in the Arctic. While recognizing that preventing many of these changes is beyond park control, the NPS may consider a suite of adaptations.

Climate-driven Challenges

The Arctic has been warming at twice the rate of the temperate latitudes, which has led to several observed physical and ecological changes with many more anticipated. Models predict that the Western Arctic Parklands are expected to experience warming of up to 10 °F mean annual temperature over the next 60 years. Sea ice has retreated to historic lows in both extent and thickness, and researchers predict an ice-free summer Arctic Ocean by 2035. With a changing climate comes a host of current and potential issues requiring adaptation in terrestrial, coastal and marine, and aquatic environments.

Terrestrial

The most dramatic of changes predicted to occur in terrestrial ecosystems in CAKR in the coming decades include: tall shrub increase and the movement of forest into open dwarf and low shrub tundra; loss of ungulate lichen winter range and open tundra currently hosting abundant lichen cover types; permafrost thaw and degradation of ice wedge polygons; increased fire frequency leading to more of the landscape being in an early successional state with fewer lichens; increases in winter icing events leading to wildlife winter forage difficulties; changes in the composition of wildlife and bird communities with declines in tundra-adapted species and increases in boreal species; habitat decline for the Western Arctic Caribou Herd; reduction in the availability of and access to key wildlife species hunted for subsistence by local residents, including caribou and moose; and mismatch of migration, forage, and pollination timing because of earlier green-up and longer snow-free season.

Aquatic

As temperatures warm, shallow lakes and ponds have shown a modest decrease in number and size, a trend expected to intensify, reducing aquatic habitat. Rivers will warm and become more filled with sediment seasonally, presenting challenges to Arctic fisheries important to subsistence (including chum salmon, sheefish, and several other species of whitefish). As peat decomposes, it is expected to release nitrogen and mercury into surface waters.

Coastal and Marine

The rapid retreat of Arctic Ocean summer sea ice has brought significant changes to the shipping industry (over 200% increase from 2009 with project increases of up to 500%). Increased shipping traffic increases the risk of spills and vessel incidents.

Rates of coastline erosion in CAKR have increased from 0.2 m/yr to 0.7 m/yr over the past decade with sand bars adjacent to the closed lagoon systems and upland bluffs eroding most rapidly. The later onset of shorefast ice in the fall has exposed the coastline to powerful fall storm surges. Landscape erosion along coastal beaches, bluffs, and riverbanks may accelerate with storm surge events, high spring floods, thawing permafrost, and dune deflation. The village of Kivalina is threatened by coastal erosion, as are nearshore ecosystems, and fragile archeological sites.

Subsistence Opportunity

CAKR was established in part to provide for subsistence opportunity. A large part of subsistence harvest in the Kotzebue Sound region involves marine mammals, most notably seals. Local hunters report that conditions on the sea ice are much more dangerous than in past years due to a thinned ice pack, and that the windows of hunting opportunity are far less than in the past. The release of sediment and organic carbon caused by coastal erosion as a result of climate change has the potential to alter coastal subsistence fisheries including whitefish. Local fishermen have observed the loss of “countless numbers” of whitefish in some areas of Kotzebue Sound, emphasizing the need to understand factors driving such perceived declines. No rigorous fish data exists.

On land, subsistence opportunity for caribou is likely to face increasing hardship because the Western Arctic Caribou Herd has declined over 50% since 2003 and changes in vegetation due to climate change may alter habitat suitability.

Wildlife-related Challenges

ANILCA mandates protection of habitat for and populations of fish and wildlife, resources related to subsistence needs, and subsistence use by local residents in CAKR. As per ANILCA, wildlife management in the parks as it relates to subsistence includes involvement of local residents and Native Alaskans through Regional Advisory Councils and Subsistence Resource Commissions.

Wildlife Management Challenges

Challenges to wildlife management in CAKR include the park's lack of data on wildlife populations that are critical to meeting ANILCA's mandates of protecting habitat for and populations of fish and wildlife, providing for subsistence, protecting resources related to subsistence needs, and providing for non-consumptive uses. This lack of data leaves CAKR unable to appropriately respond to regulatory proposals that affect park wildlife resources, including the management of predators. The NPS lacks critical wildlife data primarily because of the lack of funding for wildlife studies.

Additional challenges stem from divergent park uses including: subsistence hunting and gathering, recreational boating, and wildlife watching. Some of these uses can be at odds with others, which presents the management challenges of mitigating the effects of these activities on park resources as well as mitigating impacts to other user groups' activities. It is an ongoing challenge to provide appropriate staffing to manage logistics of permitting and enforcing wildlife regulations over the extensive area that comprises CAKR.

Some Key Species-specific Challenges

For brown bears and wolves, CAKR lacks population estimates, movement, demographic, and habitat use data for the last 20 years. Meanwhile, wildlife proposals are routinely submitted to State and Federal bodies to increase harvest of brown bears and wolves.

Although western science and traditional knowledge concur that caribou naturally cycle in abundance, the Western Arctic Caribou Herd is currently at the low end of its population cycle and has declined over 50% since 2003.

Muskoxen were once common in Alaska, but were heavily hunted and extirpated from Alaska by the mid- to late-1800s, and reintroduced in 1935. Biologists are monitoring whether the population in CAKR may be declining or may be shifting its range eastward. The NPS manages two muskoxen hunts in CAKR and Noatak National Preserve and relies on data from cooperative surveys with Alaska Department of Fish and Game to inform harvest management; providing opportunities for subsistence hunting while conserving the population is a significant challenge.

Moose calf recruitment and population numbers are low in CAKR. The NPS relies on data from cooperative surveys with Alaska Department of Fish and Game to inform population and harvest management.

Wildlife Conflicts

In addition to being important resources for subsistence, wildlife can be the source of conflicts with local residents. For example: some muskoxen tip over grave markers and stomp on graves, some people feel intimidated by muskoxen near berry-picking locations, and some bears break into cabins or take fish from fish racks or nets. Addressing wildlife conflicts in a non-lethal way is a management challenge for all Western Arctic Parklands.

External Challenges

A number of current impacts and future threats to CAKR's natural resources come from external sources including mining, air pollution, marine debris, introduction of invasive species, and illegal activity. Red Dog Mine has a congressionally-granted 18-mile road easement through CAKR for the transport of lead and zinc concentrates. This activity has resulted in the release of heavy metal-containing fugitive dusts into the environment over many years resulting in killing and reduction of lichens adjacent to and within 2 km of the road. Although Red Dog has invested in dust control measures and subsequent measurements have shown improvement, the NPS continues to monitor the situation. There have been a significant number of spills along the haul road. Although these have been successfully cleaned up, scars from cleanup excavations remain and are in various states of recovery.

Other emerging threats include proposed mining, likely increase in regional pollution, increased shipping and traffic through the Bering Strait, increase in marine debris, increased potential for invasive species, and ongoing illegal activity including looting of archeological and paleontological resources, poaching, and wanton waste.

Logistical Challenges

Working in the Arctic presents unique logistical challenges. Fieldwork in these remote, roadless parks requires access by boat or plane and is hampered by high costs of supplies, poor weather, and lack of infrastructure. The Western Arctic Parklands are understaffed and struggle with high staff turnover, difficulty hiring local residents (due to low federal wages compared to the high cost of living in Kotzebue), lack of housing, and slow telecommunications.

Chapter 1. Introduction

Cape Krusenstern National Monument (CAKR) is managed as a unit within the Western Arctic Parklands in northwestern Alaska. The purpose of this State of the Park report for CAKR (“the park”) 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:

1. 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.
2. Summarizes and communicates complex scientific, scholarly, and park operations factual information and expert opinion using non-technical language and a visual format.
3. Highlights park stewardship activities and accomplishments to maintain or improve the state of the park.
4. 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.

Most of the national park units in Alaska, including CAKR, were established or expanded under the Alaska National Interest Lands Conservation Act (ANILCA), adopted on December 2, 1980. ANILCA’s passage culminated more than 20 years of deliberation on federal land claims after Alaska statehood.

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. CAKR 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.

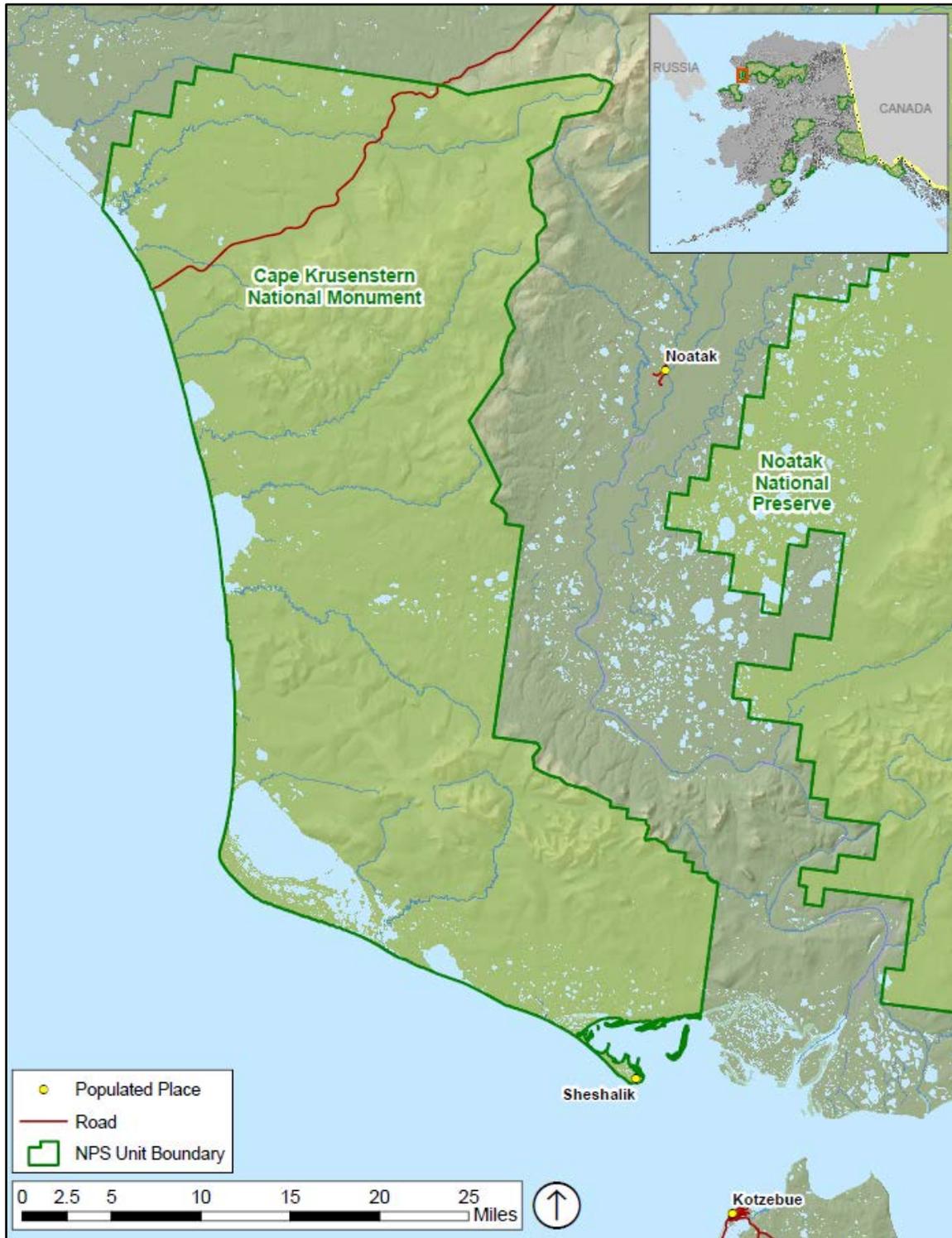
Guided by legislation and the knowledge acquired through management, research, and civic engagement; statements of significance define what is most important about the park’s natural and cultural resources and values. The significance statements are used to guide planning and management decisions to ensure that priority resources and values are preserved. Significance statements for CAKR are:

1. In cooperation with the Iñupiaq people, Cape Krusenstern National Monument preserves, studies, and interprets evidence of human migration from Asia and thousands of years of cultural adaptation in arctic Alaska.
2. Cape Krusenstern National Monument preserves a landscape supporting dynamic processes of coastal erosion, accretion, and aggradation in an arctic environment as exemplified by the formation of over 100 beach ridges containing a 5,000 year record of sequential human use.
3. Cape Krusenstern National Monument protects habitat for and populations of birds, fish, and other wildlife in an ecologically diverse coastal and upland ecosystem.
4. Cape Krusenstern National Monument protects natural resources that provide the opportunity for local rural Alaska residents to engage in customary and traditional subsistence uses.

North of Kotzebue and above the Arctic Circle, the park is comprised of more than 650,000 acres of land and water. Located on a coastal plain dotted with sizeable lagoons and gently rolling limestone hills, the area is not connected to the state road system. Access to the area is available by commercial jet flights to Kotzebue, the largest community in the region. Access to monument lands is by small charter aircraft, and in winter by snow machine, ATV, and dogsled. Extremely variable weather and fluctuating sea-ice presence can make travel in the park a challenge.

Cape Krusenstern’s bluffs and its series of 114 beach ridges show the changing shorelines of the Chukchi Sea and contain a chronological record of an estimated 5,000 years of prehistoric and historic uses of northwest Alaska’s coastline. Some of the archeological resources in the park are older than ancient Greek civilization.

Along the shoreline, shifting sea ice, ocean currents, and waves have formed spits and barrier islands. These constantly shifting islands are important for their scientific, cultural, and scenic values. The broad plain between the hills of the cape and the hills in the northern portion of the park is tundra, with features shaped by a glacier 250,000 years ago, and a former channel of the Noatak River.



Map of the Monument

Chapter 2. State of the Park

The State of the Park is summarized below for five categories—Natural Resources, Cultural Resources, Visitor Experience, Wilderness Character, and Subsistence Use—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 provides 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). Note that climate change adaptation requires park managers to continue to learn from the past, but attempting to manage for conditions based on an understanding of the historical “natural” range of variation will be increasingly futile in many locations. Thus, these reference conditions, and/or judgment about resource condition or trend may evolve as the rate of climate change accelerates and park managers respond to novel conditions. Management must be even more “forward looking,” to anticipate plausible but unprecedented conditions, also recognizing there will be surprises. In this context, the NPS strives to incorporate climate considerations in decision-making processes and management planning and consider adaptation options that may deviate from traditional practices.

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 and average winter temperature by 6 °F ([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 temperature trends and other climatic indicators is complicated. Climate in Alaska is dynamic and nonlinear, with strong linkages to atmospheric and oceanic processes, such as the position of the polar jet stream or the frequency of El Niño events (Papineau 2001). An important climate pattern, evident in the relatively few long-term climate stations located in parks, is the Pacific Decadal Oscillation (PDO). Much of the warming that has occurred since the middle of the 20th century occurred in 1976 as a stepwise shift, attributed to a climatic transition from a cool to a warm phase in the PDO ([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 the previous decades ([Bieniek et al. 2014](#)). The most recent years have seen yet another shift back to a warm phase that may or may not persist, but has resulted in 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. Nonlinear responses and regional variations are expected to continue to occur as the planet adjusts to global scale change ([IPCC 2013](#), [Larsen et al. 2014](#)). Recent studies suggest that warming Arctic temperatures weaken the temperature gradient between the poles and lower latitudes leading to a wavier jet stream, which results in more persistent weather patterns and extreme conditions such as cold spells, heat waves, droughts, and flooding ([Francis and Vavrus 2015](#)). The data and information gathered from national parks provide an important piece of the puzzle in understanding both the drivers and effects of climate change.

2.1. Natural Resources

Air Quality  web ▶			
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Ozone	Ozone Annual 4th-Highest 8-Hour Concentration		No condition data are available for ozone. However, given the paucity of ozone sources, it is likely that concentrations fall well below advisory thresholds.
Deposition	Nitrogen and Sulfur Wet Deposition		<p>Data from the Bettles, AK National Atmospheric Deposition Program (NADP) monitoring station (320 miles distant) and adjacent areas suggest that wet nitrogen deposition (ammonium, nitrates) is likely to be in the range of 0.2–0.5 kg/ha/yr level (NADP Monitor ID: AK06; NPS-ARD 2015, Brumbaugh et al. 2016). National and Arctic nitrogen critical loads assessments (Pardo et al. 2011, Linder et al. 2013) rated arctic tundra as extremely sensitive with a critical load of 1 kg/ha/yr of nitrogen deposition. While nitrogen levels in park rivers are currently low (O'Donnell et al. 2015), permafrost thaw may eventually contribute nitrogen to surface waters (Ewing et al. 2015, Sullivan et al. 2011d, Sullivan et al. 2011b).</p> <p>Ecosystems in CAKR were rated as having high sensitivity to nitrogen and sulfur acidification effects relative to other parks (Sullivan et al. 2011b) and moderate sensitivity to nutrient nitrogen effects (Sullivan et al. 2011c). Ecosystems and vegetation types such as the park's remote lakes, tundra lichen communities, and herbaceous communities are sensitive to the effects of both nitrogen nutrient enrichment and acidification. Acidification effects can include changes in water and soil chemistry that impact ecosystem health, lichens, fish, invertebrates, and phytoplankton (Sullivan et al. 2011a, Sullivan et al. 2011c).</p> <p>The degree of confidence in the nitrogen and sulfur deposition status is low because of the large distance to the monitoring sites. No trend data is available due to insufficient monitoring timespan.</p> <p>Regional pollution is likely to increase due to increased shipping traffic through the Chukchi Sea and oil development in the National Petroleum Reserve – Alaska.</p>

Air Quality (continued)

[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Deposition (continued)	Dry Deposition		<p>The Red Dog Mine haul road links the Red Dog Mine—one of the world’s largest zinc and lead mines—with a shipping port on the Chukchi Sea. Twenty miles of the road traverses CAKR. Fugitive dust from ore transport and mining operations has dispersed zinc, lead, and cadmium dust onto the surrounding tundra since 1989. Concentrations of zinc, lead, and cadmium in moss tissue close to the road were 10–100 times the baseline levels found in the southern portion of the park (Hasselbach et al. 2005, Neitlich et al. 2017a). Heavy metal contaminants have resulted in declines in (or elimination of) lichen cover and species diversity out to 2 km from the road (Exponent 2007a, b; Neitlich et al. 2017b). The area closest to the road is now mostly devoid of lichens. Red Dog Mine invested heavily in pollution control technology, and unpublished data shows that 2006 contaminant levels for study units close to the road were up to 50% lower than 2001 levels (Neitlich et al. 2017a).</p>
Contaminants	Mercury and Persistent Organic Pollutants		<p>Mercury deposition warrants moderate concern, based on estimated wet mercury deposition and predicted levels of methylmercury in surface waters in other Arctic parks, Gates of the Arctic and Noatak. The 2011–2013 average wet mercury deposition is very low at the adjacent monitoring station in Bettles at 2.1 micrograms per square meter (NADP MDN Monitor ID: AK06) and predicted methylmercury concentrations in surface waters are very low, estimated to be 0.02 nanogram per liter (USGS 2015). While much lower than NPS Air Resource Division benchmarks, there is concern because mercury concentrations in some fish in Gates of the Arctic and Noatak exceeded thresholds for both subsistence users and wildlife health (Landers et al. 2008, NPS-ARD 2015).</p> <p>Persistent organic pollutants are low in water, air, snow, lake sediment, and vegetation of Noatak, about 200 miles distant. However, concentrations of historically-used pesticides were generally mid-range along the spectrum of western U.S. National Parks. The banned pesticide Dieldrin in long-lived fish such as lake trout exceeded the health advisory threshold for subsistence users while Chlordanes approached the advisory threshold for fish-eating birds (Landers et al. 2008).</p>

Air Quality (continued)

[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Visibility	Haze Index		<p>Data from the Bettles monitoring site indicates that visibility is in good condition. This status is based on NPS Air Resource Division benchmarks and the 2009–2013 estimated visibility on mid-range days of 1.8 deciviews (dv) above estimated natural conditions of 4.1 dv. The degree of confidence is low due to the distance between the park and the visibility monitor. No trend information is available because the monitor has an insufficient number of years of data (IMPROVE Site ID: GAAR1, AK; NPS-ARD 2015). While haze is generally low, the park has also experienced intermittent periods of high particulate haze from local or regional summer fires.</p>

Resource Brief: Historical and Projected Changes in Climate for Cape Krusenstern

Climate, by determining the temperature and precipitation regimes for any ecosystem, is widely recognized as one of the most fundamental drivers of ecological condition. The climate patterns of Alaska are primarily influenced by latitude, continentality, and elevation. The high latitude drives the seasonal pendulum of available solar radiation; areas farther north have limited incoming solar warmth in the winter and an abundance of available light in the summer. Major mountain ranges act as barriers to the moisture from surrounding ocean waters. Large scale atmospheric and oceanic circulation patterns influence seasonal and annual weather patterns in the parks, like the repositioning of the polar jet stream and the Aleutian low-pressure system or the frequency of La Niñas and El Niño's (Papineau 2001). Each of these can affect the regional patterns of storm tracks, prevailing winds, snowfall amounts, and the extent of sea ice (ACIA 2004).

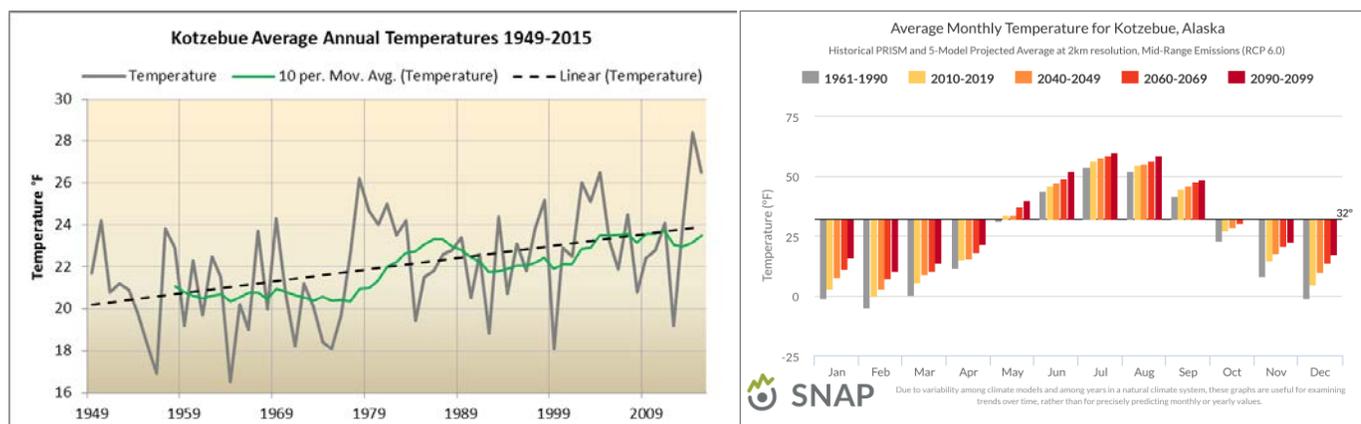
Cape Krusenstern National Monument is within the West Coast climate division as defined by Bieniek et al. (2012). The long-term climate station at Kotzebue, just south of the monument, provides the climate context for the monument. Average seasonal and annual temperatures from the site are shown in the graphs below. For consistency among other park units in the state, observations are from 1949, the time period for which the most reliable meteorological data are available. Temperature and precipitation projections over the next century have been calculated on a monthly time scale for Kotzebue. The projections are based on the PRISM model historical baseline projected at a 2 km resolution using the mid-range emissions scenario (representative concentration pathway RCP 6.0). These graphs are useful in looking at overall trends in temperature increases versus specific values due to the uncertainty in models and natural climate variability ([SNAP 2016](#)).

Historical trends and future projection for temperature

The observed temperature trend is non-linear, with multi-decadal variations (graph below left). The increase in the mean annual temperature is significant with temperatures warming ≈ 3.8 °F at Kotzebue. Considering just a linear trend masks important variability in the time series; the record spans the phase shift of the Pacific Decadal Oscillation (PDO) in 1976 where annual temperatures at this location, and at most locations around the state, abruptly shifted up by ≈ 2.5 °F in a single year and then persisted in a warmer phase for the next several decades. The trend in annual temperatures since 1977 has been relatively stable. However, over the past several years the PDO index has had the highest, most persistent positive values since the 1980s, coinciding with a strong El Niño pattern, resulting in two of the warmest years on record for the state of Alaska in 2014 and 2015.

Seasonally winter temperatures show the most significant increase. Summer temperatures have also increased significantly over the period of record. Temperatures are projected to increase for all seasons by mid-century, with the greatest increases likely in winter (graph below right). There is general agreement among individual climate models in the direction and magnitude of warming over the coming decades.

Persistent warm periods and temperatures that reach above freezing in winter can pose problems to an ecosystem that is dominated by snowcover for a good portion of the year: snow turns to rain, which leads to icing, which makes foraging difficult; plants are subject to desiccation because of low or no snow cover; and snowpack-dwelling fauna are left unprotected.



Left: Average annual temperature Kotzebue. The green lines show the 10-year moving averages. The dotted lines show a simple linear regression trend; Right: The Scenarios Network for Alaska and Arctic Planning (SNAP) monthly temperature projections for the next century are shown for Kotzebue ([SNAP 2016](#)).

Extremes in spring temperatures, especially in late spring can have repercussions related to the timing of many phenological events that are triggered by the return of warmer temperatures in May. An increase in summer temperatures can lead to many scenarios that fall out of the "normal" range of expectations including impacts to the fire season, insect outbreaks, wildlife migrations, aquatic

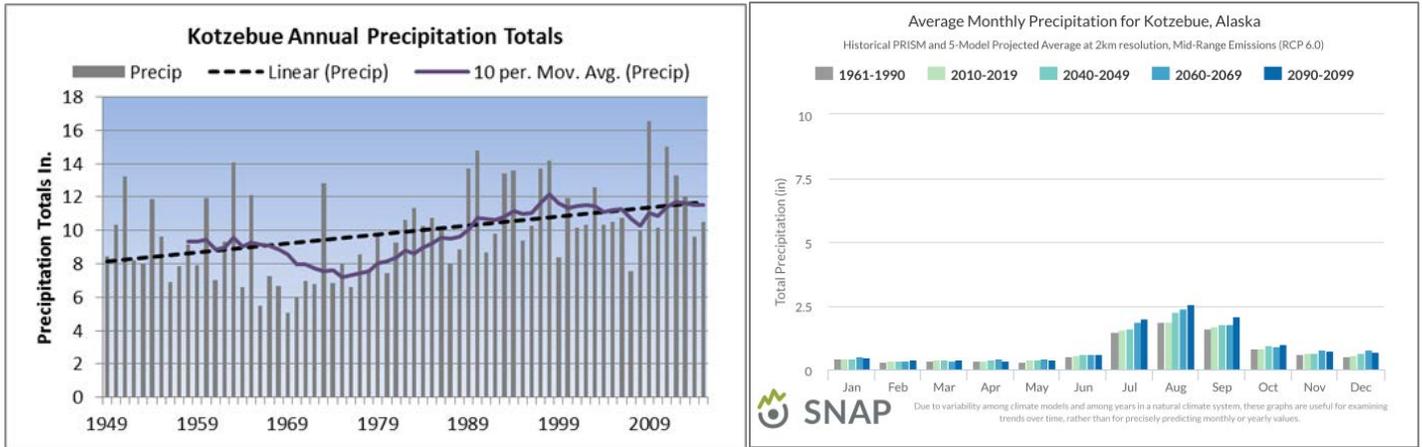
Resource Brief: Historical and Projected Changes in Climate for Cape Krusenstern (continued)

ecosystems, active layer thawing, etc. Changes in early fall season temperatures can once again impact the timing of many phenological events that are triggered by cooler temperatures and decreasing daylight.

Historical trends and future projection for precipitation

Observed annual precipitation totals have increased significantly at Kotzebue, with most of the increase apparent in the winter and spring seasons. Snowfall records show a significant increasing trend for annual and winter snowfall totals at both locations. Total annual precipitation is projected to increase throughout the next century, particularly in the summer season (graph below right) (SNAP 2016). Precipitation variability is likely to remain large over the coming decades (larger uncertainty in precipitation than in temperature projections) (Stewart et al. 2013).

Seasonal trends show the extreme variability in precipitation between seasons and among seasons, and can also be used to highlight extreme events that have large ecological implications for humans (i.e., floods, droughts) and wildlife (i.e., high or low snowfall). Increasing winter temperatures can lead to an increase in the number or intensity of rain-on-snow events that could potentially disrupt the path to the food supply for wildlife. The precipitation projections indicate that late spring may see an increase in precipitation amounts. Late spring snowfall events can interfere with the timing of bird migrations, wildlife health, green-up, and other ecological processes that begin once the snow has melted. The precipitation projections show that precipitation will increase the most during the summer months in Kotzebue; more rain and more intense rain events can lead to flooding, erosion, and permafrost instability.



Left: Total annual precipitation at Kotzebue. The purple lines show the 10-year moving average. The dotted lines show a simple linear regression trend; **Right:** The Scenarios Network for Alaska and Arctic Planning (SNAP) monthly precipitation projections for the next century are shown for Kotzebue (SNAP 2016).

Other projections

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

Geological Resources



[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Coastal Formations</p>	<p>Coastline Stability</p>		<p>Rates of coastline erosion in CAKR averaged 0.7 m/yr for the period 2003 to 2014, compared to the long-term average erosion rate of 0.2 m/yr. Sand bars adjacent to the closed lagoon systems and upland bluffs are eroding rapidly, at an average rate of 0.7 m/yr and 0.8 m/yr, respectively. Rates of change are slowest along the Sheshalik Spit (average rate of erosion 0.5 m/yr), and the beach ridges of Krusenstern Lagoon (average rate of erosion 0.3 m/yr, Farquharson 2016). The village of Kivalina is threatened by coastal erosion and their landfill is routinely overwashed, contributing marine debris to the southern Chukchi Sea. Coastal erosion and high storm surges (made worse by the lack of shorefast ice in the fall during the stormy season) has also eaten into private land allotments and claimed structures that people use to pursue subsistence hunting.</p>
<p>External Development</p>	<p>Condition of Red Dog Mine Haul Road (Number of spills, restoration needs, lichen effects)</p>		<p>There are several issues in Cape Krusenstern related to the Red Dog Mine Haul Road:</p> <ol style="list-style-type: none"> 1) Toxic effects of zinc and lead dusts on lichens (Exponent 2007a, b; Neitlich et al. 2017a); 2) Zinc, lead, and diesel spills along the haul road that have resulted in excavation requiring vegetation recovery; 3) Delay of caribou migration timing (July 2014); 4) Effects of road dust on small mammals adjacent the haul road (Exponent 2007a, b); 5) Noise from vehicle traffic; and 6) Changes in the viewshed from the presence of the haul road and the development of a major shipping port. <p>Fugitive dust from mining operations have decreased or eliminated lichen cover out to 2 km on either side of the haul road along its entire length (32 km) in the park NPS maintains a database of spills documenting 48 spills of lead concentrate, zinc concentrate, diesel fuel, ethylene glycol and other substances within the park since 1991.</p>

Geological Resources (continued)

[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
External Development (continued)	Other External Development Threats		In addition to the Red Dog Mine currently in operation and its haul road that passes through CAKR, there have been several proposed and/or implemented external developments over the past decade. First, Red Dog Mine expanded into the new Aqqaluk deposit starting in 2010, which allowed the mine 20 more years of operation in the main pit. Second, the village of Noatak has sought a right-of-way through CAKR for testing of a vehicle to haul fuel from the Red Dog port to the village in winter. Third, the village of Kivalina has been developing a proposal for a right-of-way for an electric transmission line from the Red Dog port to the village. A gravel mine has been in operation since 2010 in the Mulik Hills on the lower Noatak River, less than 500m from the Noatak National Preserve boundary. A geodatabase has been developed to allow managers to track current and proposed development activity in and around CAKR.
	Abandoned Mine Lands		CAKR has only one known Abandoned Mine Land site. The prospect, reported to the park in the 1980s, contained exploratory trenches. Although the site's exact location and condition are unknown, and it has not been surveyed by NPS, it is unlikely to pose a threat to resources.
Permafrost	Extent, Temperature, Thickness of Active Layer		Most of CAKR is underlain by permafrost. Modeling by University of Alaska scientists and ground temperature observations by NPS show that permafrost has warmed and the thickness of the seasonally-thawed upper (or "active") layer has increased as a result of climate warming since 1950, but the extent of permafrost has changed little so far (Panda et al. 2016, Swanson 2016a). Recent warming has increased permafrost temperatures above -3 °C across much of CAKR. This has reduced the margin of safety protecting permafrost from thaw in the future, and widespread thaw of permafrost is expected in these areas in the latter half of the current century if warming continues.
	Stability of Permafrost Terrain		Climatic warming since 1950 has locally caused ground ice near the surface to melt. Some degradation of ice wedges has been documented in southern Kobuk Valley National Park (to the east) and far western Noatak National Preserve (Swanson 2016b) and it has probably also occurred in CAKR. The loss of lake area in recent decades in CAKR is likely linked to increased breaching of lake shores due to permafrost thaw (Jones et al. 2011, Swanson 2013). Unusual weather in 2004 produced a large number of small landslides due to permafrost thaw (Swanson 2014 , Balsler 2015), a few of which occurred in CAKR. Most of these landslides have since stabilized and revegetated, though a few have continued to grow. No new major thaw-landslide events have occurred since 2004.

Resource Brief: Red Dog Mine

The Red Dog Mine is one of the world’s largest zinc and lead mines. The mine is operated by the Canadian mining firm Teck, Incorporated and is situated on lands owned by the Northwest Alaska Native Association (NANA). The mine received Congressional authorization for a haul road easement through Cape Krusenstern National Monument in 1985 and has been operating since 1989. The mine is the economic engine for northwest Alaska. Most communities have a large number of residents who work at the mine, and NANA and its shareholders receive a significant amount of royalties from the annual mining profits that can range from millions to billions of dollars. The influx of cash into local communities has been essential for helping with the high cost of living (including fuel that can reach \$12/gallon).

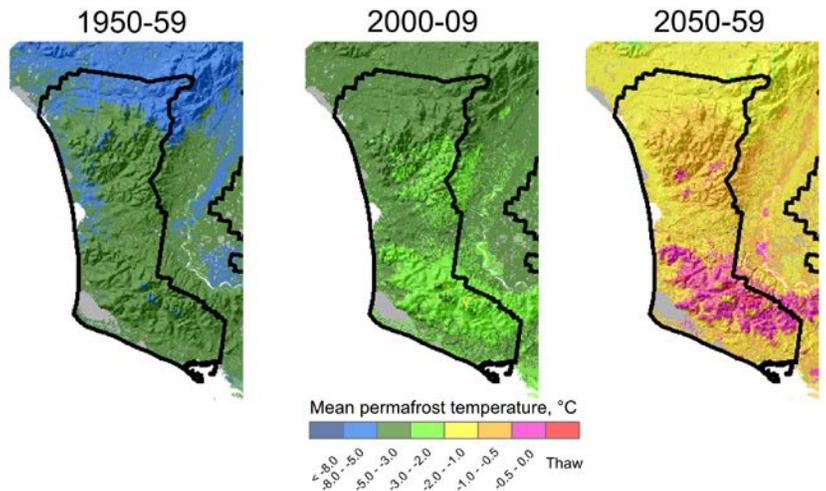
The Red Dog haul road runs approximately 46 miles from the mine site to the shipping port on the Chukchi Sea, crossing 18 miles of NPS land. Eighty-ton haul trucks and other traffic have dispersed fugitive dusts bearing moderate levels of zinc, lead, and cadmium onto CAKR lands since the mine opened. Beginning in 2001, the mine began to invest in dust control technologies and this has reduced the amount of heavy metals dispersion. A 2007 ecological risk assessment approved by the State of Alaska showed no harm to wildlife or people other than to small mammals living right alongside the haul road (from Boron) and willow ptarmigan browsing at the mine site. According to the study, the dust caused a decline in lichens out to 1.2 miles from each side of the haul road, and mortality in these sensitive organisms close to the road. NPS research has shown that the road has also delayed the migration of caribou crossing the road by several weeks. Since 2001, NPS has worked with the mine to continue to study and reduce pollution onto NPS lands, monitor the restoration of diesel and concentrate spill sites, and coordinate monitoring of natural and subsistence resources. Resource monitoring along the road is planned for 2017.



The Red Dog port site on the Chukchi Sea. The mine ships millions of tons of zinc and lead concentrates each year, which are stored in the two large buildings prior to shipping. NPS Photo.

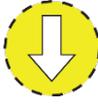
Resource Brief: Permafrost Temperature

Permafrost underlies most of CAKR and affects nearly everything in the ecosystem, from soils and vegetation to water and wildlife. Permafrost is ground that does not thaw in the summer due to a cold climate. Permafrost perches water near the surface, making soils wet. Permafrost thaw in a warming climate could have far-reaching effects on arctic ecosystems. Ground temperature measurements and computer modeling by University of Alaska scientists and NPS show that warming since the 1950s has caused the permafrost in CAKR to warm, but most is still safely frozen and has temperatures below -2 °C. With the continued warming expected in the future, permafrost in CAKR is expected to warm so that by the year 2050 most will be near the thaw point and vulnerable to major changes with warming after 2050.



Mean permafrost temperature. Maps courtesy of Santosh Panda, University of Alaska Fairbanks.

Paleontological Resources [web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Paleontological Resources	Inventory and Understanding		<p>Fossils are non-renewable resources that are irreplaceable windows into the past. Once a fossil is gone, it is gone forever. Very few paleontological surveys have been completed in the preserve. A cursory paleontological inventory was completed by Elder et al. (2009). A database of the few known paleontological resources is under development and expected to be completed in 2017.</p> <p>CAKR contains fossils in two contexts: 1) Paleozoic (250–540 million years ago) marine invertebrate fossils in the uplands; and 2) Pleistocene and Holocene (2.6 million years ago to present) vertebrate fossils within unconsolidated deposits along the beaches and in the lagoons.</p>
	Percentage of Known Sites in Good Condition		A paleontological resources inventory and field-based site assessment to establish baseline resource monitoring needs has not been done. Non-permitted collecting in the Western Arctic Parklands has been observed, but has not been officially documented. Fossils in sea bluff exposures and river cut banks are at high risk of being eroded.

Water Resources [web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Lake Communities and Ecosystems	Surface Area and Number of Lakes		Analyses of lake area change by remote sensing (Swanson 2013) indicate that in recent decades the area of lakes and ponds has been stable or decreasing in CAKR. The decreases have been due to decadal-scale climate variations that could persist into the future. Areas with the most substantial declines in lake area in recent decades are the lowlands of northern CAKR, due mainly to lake drainage in permafrost areas. The declines of 10% to 20% in recent decades have likely reduced habitat for aquatic wildlife; if this continues, it could be cause for significant concern in the future.
	Water Quality (chemistry, temperature, concentration of organics, turbidity)		Lake chemistry in the Arctic is sensitive to the effects of climate change and disturbance (e.g., permafrost thaw and erosion; Vonk et al. 2015). However, there are very few lakes in CAKR, and these lakes have not been sampled. Other lakes in other Arctic park units are in good condition with respect to water chemistry and physical limnology (O'Donnell et al. 2015).

Water Resources (continued)

[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Lagoon Communities and Ecosystems	Water Quality (dissolved oxygen, salinity, conductivity, pH, surface area)		<p>Sampling for water quality is infrequent. All water quality parameters measured within the lagoons are within state standards. Water quality changes relatively rapidly with significant causes being freshwater inflows, oceanic connectivity, and wind driven mixing throughout the shallow (< 2m) lagoons leading to a lack of vertical stratification in water quality parameters (Reynolds and Clough 2010).</p> <p>Individual localized lagoon histories drive water quality and caution should be taken when evaluating water quality results, as exemplified by three lagoons: Krusenstern, Aukalak, and Kotlik. Krusenstern lagoon is a large freshwater dominated lagoon. Mean conductivity values between 2009 and 2015 point towards an increasingly freshwater lagoon. Aukalak, a smaller lagoon with seasonal oceanic connectivity demonstrated widely varied conductivity in this time period, while Kotlik Lagoon has shown an altogether different pattern with conductivities rising.</p>
Stream Communities and Ecosystems	Water Quality (chemistry, temperature)		<p>Arctic stream chemistry is sensitive to the effects of climate change and disturbance (e.g., permafrost thaw; Vonk et al. 2015). A 2014 survey of 8 streams in CAKR indicates that water quality is presently in good condition with respect to nutrient concentrations (O'Donnell et al. 2015). Nitrate concentrations were low, ranging from 13 to 96 µg/L, whereas ammonium and phosphate concentrations were at or near the analytical detection limit. Dissolved organic carbon concentrations were also low, ranging from 1.4 to 4.7 mg/l. No long-term records exist for stream chemistry in CAKR at this time. At the nearby Asik Creek, a significant long-term decline in stream nitrate concentration has been observed (Stottlemyer 2013). This observation is opposite of the increasing trend in stream nitrate documented in the Kuparuk River (McClelland et al. 2007).</p>

Water Resources (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Stream Communities and Ecosystems (continued)	Flow (magnitude and timing)		<p>The USGS actively monitors discharge on the Wulik River near Kivalina, which drains a portion of northern CAKR. The seasonality of streamflow has changed in recent decades in response to climate warming, with the timing of peak discharge occurring over 4 days per decade earlier since 1984 (Tape et al. 2016a). However, the timing of river freeze-up during autumn has not changed significantly during this same period (USGS National Water Information System (NWIS); http://waterdata.usgs.gov/nwis). While annual discharge has increased in many Arctic rivers in recent decades (e.g., Peterson et al. 2002), there is not a significant trend in annual discharge in the Wulik River between 1984 and the present (O'Donnell, unpublished data).</p> <p>Earlier peak stream flow reflects earlier snowmelt from the terrestrial ecosystem, and may have cascading consequences for aquatic habitat and organisms. However, these mechanisms are complex and poorly understood.</p>

Terrestrial Vegetation



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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Native Plants	Terrestrial Lichen Cover/Caribou Lichen Winter Range		<p>Terrestrial lichen cover is fairly low in CAKR because of the dominance of dwarf birch tussock shrub tundra, which is naturally low in lichen cover. Lichen cover was 4% in the communities richest in lichens (Holt and Neitlich 2010). Terrestrial lichen cover is likely to have declined slightly due to shrub increase in tundra habitats (Swanson 2015), and this trend is expected to continue. Lichen cover has been reduced or eliminated by fugitive dusts within 2 km of the Red Dog Mine Haul Road (Exponent 2007a, b; Neitlich et al. 2017a). Lichen cover may increase with the decline of the Western Arctic Caribou Herd (Joly et al. 2010). Increasing forest cover in the future is likely to promote higher cover by epiphytic lichens (i.e., lichens growing on trees). If CAKR experiences increases in fire frequency and area burned due to the continued warming and the increase in lightning strikes, this will impact late successional lichen cover. Landscape units burned in the past 60 years had only one quarter of the lichen abundance of unburned units in the Western Arctic Caribou Herd's historic winter range (Joly et al. 2010). A greater presence of fire on the landscape is likely to place more of the landscape into earlier successional states with less lichen abundance (Joly et al. 2009, Racine et al. 2006).</p>

Terrestrial Vegetation (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Native Plants (continued)	Lichen Species Diversity		Lichen diversity is relatively high in Cape Krusenstern due to a diversity of habitats from lowland to alpine (Holt and Neitlich 2010). 171 macrolichen species have been documented with a mean of 30 species per acre. Diversity is likely to increase with climate change due an influx of forest-associated lichen species as forests colonize this landscape. CAKR currently has no trend data on lichen diversity but has no basis to suspect changes.
	Vascular Plant Diversity		CAKR has a relatively high vascular plant diversity, with 401 species identified to date, of which 13 are classified as rare or imperiled (S1, S2, or S3) at the State of Alaska level by the Alaska Natural Heritage Program (AKNHP 2016 , Parker 2006). At present, these plants are naturally rare and are not threatened with extinction by human actions. Climate change and associated changes in ecological disturbance regimes such as fire and flooding are expected to alter the abundance of many plant species, but significant changes in overall diversity of vascular plants are not expected to occur in the next few decades.

Resource Brief: Lichen

Lichens are a conspicuous and abundant component of the flora in Arctic parklands. Lichens are fragile, slow-growing, and sensitive to air pollutants. Forage lichens—i.e., the dominant lichens of the low shrub and alpine tundras—form the bulk of the winter diet for caribou and domesticated reindeer, and are also consumed by muskox. Over the past decade, NPS studies have documented 491 species of macrolichens in the Arctic parklands ([Holt and Neitlich 2010](#)). Scientists have estimated the presence of a similarly large number of crustose lichens. NPS cooperators recently described 3 new lichen species of *Hypogymnia* (or Tube Lichens) from Beringia, based in part on specimens gathered on the Seward Peninsula ([McCune 2008](#)).

One expected impact of climate change is increased shrub dominance and spread of forest into tundra habitats (Swanson 2015). In the long term, this may turn lichen-rich dwarf and low shrub tundra into denser shrub thickets and woodlands. These communities tend to smother terrestrial lichens with litter fall and therefore have lower biomass of the forage lichens needed to sustain large ungulate herds ([Joly et al. 2010](#)). Such a pattern has been demonstrated on the Seward Peninsula, with black spruce encroachment (Lloyd et al. 2003). The future state of northern Alaska lichen communities may more closely resemble the lower lichen biomass mixed forest-alpine communities of southern or interior Alaska. These climate-driven changes, in combination with a decreased fire-return interval, may result in substantial declines in lichen biomass. NPS has constructed grazing exclosures (which keep ungulates out) in Bering Land Bridge National Preserve to study the effects of ungulate grazing and climate change on lichen biomass. The results are likely to apply to all of the Arctic parks. While lichen biomass may eventually decline, lichen diversity may actually increase with greater tree and shrub cover.



Reindeer lichens can frequently form a co-dominant land cover in the Arctic parks and are preferred caribou winter forage. NPS Photo by Peter Neitlich.

Terrestrial Vegetation (continued)

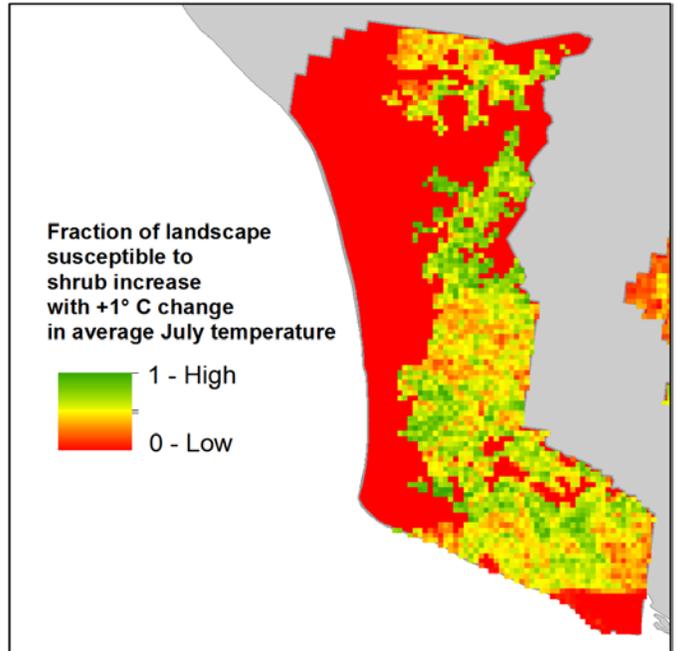
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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Native Plants (continued)</p>	<p>Area of Open Tundra</p>		<p>Vascular plant cover has been increasing across the Arctic in recent decades, as shrubs and other plants increase in height and density, and this trend is expected to continue in the future (Tape et al. 2006, Verbyla 2008). Local declines in plant cover due to fires are short-lived, as vascular vegetation cover is quickly re-established.</p> <p>The cover, density, and height of shrubs have increased in tundra areas of CAKR, as has occurred elsewhere in the Arctic. Comparison of aerial photographs from 1980 and 2010 across 5 NPS units in northern Alaska showed that about 14% of the area of tall shrub thickets in 2010 was new since 1980, but shrub thickets still cover only about 6% of the total area (Swanson 2013). Most of the increase in shrubs is occurring in the relatively warm and well-vegetated portions of the tundra lowlands or near current treeline. This shrub increase is expected to continue with climate warming. While shrub increase will benefit certain species such as moose and willow ptarmigan, it will alter the iconic open arctic tundra landscape and harm some of the species that depend on it (Marcot et al. 2015).</p> <p>Expansion of trees onto arctic tundra has also been documented in the <i>National Parks of Northern Alaska</i> (Suarez et al. 1999, Swanson 2013). Tree expansion has been slower and less widespread than shrub expansion. In coming decades it is likely that white spruce (<i>Picea glauca</i>) will expand out very gradually from the few existing stands in the southeast corner of CAKR.</p>
<p>Invasive Plants</p>	<p>Presence/Absence</p>		<p>There are no known occurrences of non-native plant species in the park. Terrestrial invasive plant species have been recorded at airports in Nome, Quartz Creek, Kotzebue, Dahl Creek, and Bettles. These airports are frequently used to access the park, and CAKR's greatest concern is that plants could be inadvertently transported from these locations into the park. Future monitoring of the floatplane landing areas for aquatic invasive species is warranted. The main aquatic plant of concern is <i>Elodea</i>, a freshwater aquatic plant that has become established in southern and interior Alaska.</p>

Resource Brief: Shrub Extent and Expansion into the Tundra

Shrubs have grown taller and expanded into new areas of arctic tundra in recent decades (Tape et al. 2006). This shrub expansion is due mainly to climate warming, and it has far-reaching consequences. Shrubs provide forage for browsing species (moose, hares, and ptarmigan); they also can: reduce erosion by vegetating bare areas along streams, increase snow depth by capturing windblown snow, and shade out plants of lower stature (such as lichens). Shrubs react quickly to climate warming because they are relatively fast-growing and already present across the arctic tundra and adjacent boreal forests—though often stunted by wind and cold.

Shrub expansion can be detected by comparing aerial photographs from the 1950s or 1980s with more recent photos or satellite images. These comparisons have shown that, while shrub expansion is clearly visible, it has covered modest total areas as yet and has occurred mainly in the tundra areas with the warmest summers. July average temperatures above 10 °C (50 °F). Multiple tall shrub species can grow on well-drained soils with neutral pH, while only a few tolerate the cold-wet, acid soils common in the Arctic. Thus in the future shrub expansion is expected to be most apparent on well-drained soils in places with tundra vegetation where, as a result of warming, the July average temperatures have risen above 10 °C. The uplands of southeastern CAKR contain the land in the park that is most susceptible to future shrub expansion with climate warming.

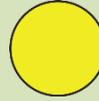


Landscape susceptible to shrub increase. Map from Swanson (2015).



Alder (*Alnus viridis*) and willow (*Salix sp.*) tall shrubs with a small grove of poplar (*Populus balsamifera*) trees in a swale on the uplands of southern CAKR. NPS Photo taken 26 August 2009.

Birds



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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Landbirds</p>	<p>Species Presence and Populations</p>		<p>CAKR falls into nationally and internationally recognized bird conservation regions (Conservation Region 2, BPIF 1999 and the Arctic Avifaunal Biome, Rich et al. 2004); however, the preserve lacks current population status information for all landbird species. 53 species of montane-nesting birds were detected during a 2001–2003 inventory of Arctic parklands.</p> <p>The following are species of high conservation concern because most, if not all, of their Western Hemisphere populations breed in Alaska: short-eared owl, McKay’s bunting, Smith’s longspur, snowy owl, snow bunting, hoary redpoll, and Lapland longspur. Species associated with shrub habitat may be vulnerable to climate-induced expansion of woody vegetation into open landscapes. For example, in a study of passerine assemblages in Denali National Park from 1995–2013, Mizel et al. (2016) documented pervasive upslope shifts in the distributions of shrub-associated passerine species. In particular, species associated with high elevation, open shrub habitats, including Arctic warbler, savannah sparrow, and golden-crowned sparrow, showed relatively large upward shifts in their optimum elevation.</p>
<p>Shorebirds</p>	<p>Species Presence and Populations</p>		<p>Information about the population status of breeding shorebirds in CAKR is lacking. Loss of wetlands, particularly migratory stopover areas outside of Alaska that are important to those species breeding in Alaska, represents the greatest threat to shorebird populations worldwide. Wetland habitats are threatened by climate change through rising sea level, drying interior wetlands, and increased storm frequency and intensity (Thorne et al. 2015). Priority species of high conservation concern that are experiencing population declines and thought to breed or migrate through the park include: American golden-plover, whimbrel, Hudsonian godwit, bar-tailed godwit, marbled godwit, black turnstone, surfbird, western sandpiper, dunlin, red knot, pectoral sandpiper, red-necked and red phalaropes (ASG 2008, Andres et al. 2012).</p> <p>Ground surveys documented approximately 10,300 post-breeding shorebirds at Sisualik Spit from 23 July–9 August, 2014. Western sandpiper, semi-palmated sandpiper, dunlin, and red-necked phalarope were the most abundant species each with at least 500 observations made over three weeks. Least sandpiper, pectoral sandpiper, and long-billed dowitcher were the most common and even the stilt sandpiper, an uncommon migrant along the Chukchi Sea coast, was sighted.</p>

Birds (continued)

[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Yellow-Billed Loons	Population		<p>Yellow-billed loons in Alaska were recently considered for listing under the Endangered Species Act, and although they were not listed, the species is still considered an international species of concern. More years of data are needed to assess the status of the population trend, so no condition arrow has been assigned.</p> <p>Preliminary results of contaminants analyses in yellow-billed loon eggs and prey fish from Bering Land Bridge National Preserve and CAKR are still being analyzed but suggest that mercury may be approaching levels that could impede reproduction in the species (Schmidt et al.2014).</p>
	Distribution		<p>Aerial surveys for yellow-billed loons in Bering Land Bridge National Preserve and CAKR were conducted in 2005, 2007 (Mallek et al. 2006, Bollinger et al. 2008), 2009, 2011 and 2013 (Flamme unpublished data, Schmidt et al. 2014). About 5% of yellow-billed loon observations occurred in CAKR. Most yellow-billed loons were spotted on large, arctic tundra lakes (> 7ha).</p> <p>Yellow-billed loons have very specific habitat requirements for nesting (Earnst et al. 2006) that are strongly associated with fish distribution. Current studies of fish distributions and environmental DNA seek better understanding of habitat requirements for loons selecting nesting lakes.</p>
Threatened & Endangered Birds	Population of Spectacled Eider		<p>The NPS is not currently monitoring Spectacled Eider in CAKR. Global populations of the Spectacled Eider are declining, but population trends in the park are unclear. In 1993, the Spectacled Eider was listed as threatened under the Endangered Species Act and critical habitat was later designated throughout the species' North American range in Alaska.</p> <p>During the winter, the world population of spectacled eiders gather at a single site south of St. Lawrence Island in the northern Bering Sea. During the summer, the species is divided into three breeding populations: western Alaska, northern Alaska and northern Russia. A majority (> 90%) of adults nest in Russia. Between the 1970s and 1990s, a 96% population decline was observed on the Y-K Delta in western Alaska, from 48,000 pairs to about 2,500 pairs in 1992 (Stehn et al. 1993). The breeding population in Alaska appear to have stabilized in recent years (Stehn et al. 1993, Fischer et al. 2012). Threats to eiders at breeding areas include ingestion of contaminants, particularly lead through expended shot, and predators.</p>

Resource Brief: Yellow-billed Loon

The yellow-billed loon (*Gavia adamsii*) is an international species of concern with the global population estimated at 16,650–21,000. The species was considered for listing under the Endangered Species Act in 2014, but was not listed. These birds occur in a circumpolar distribution and breed on arctic tundra habitats, including areas of Cape Krusenstern National Monument. Little is known about the species' status outside of the U.S. and Canada. The loons winter from Russia and Alaska along the coastlines of the Bering Sea and Aleutian Islands to the Yellow Sea in China. Approximately 20–25% of the global population occurs seasonally in Alaska, where the total summer breeding population is estimated at 3,700–4,900 birds. The species is considered one of the 10 rarest birds that regularly breed on the mainland U.S. In Alaska, yellow-billed loons are restricted to tundra landscapes on the Arctic Coastal Plain and northwestern Alaska with large, deep, clear, freshwater, fish-bearing lakes.



Yellow-billed Loons are being monitored in 2 Arctic parks: Bering Land Bridge National Preserve and Cape Krusenstern National Monument.

Based on aerial surveys conducted in June of 2011 and 2013 in Bering Land Bridge National Preserve and CAKR, the population of yellow-billed loons occurring in northwestern Alaska is about 2.5 times larger than indicated by earlier estimates of 418 birds and 85 nests. This larger estimate may indicate that habitats on the northwestern Seward Peninsula and Cape Krusenstern National Monument may be more important for overall yellow-billed loon conservation in Alaska than previously realized. Yellow-billed loons used 207 of 1,291 lakes in the study area and nested at an additional 205 lakes. Between 2011 and 2013, the probability of reuse of an individual lake by a yellow-billed loon was greater than 70%, suggesting the birds were attracted to these lakes by either high site fidelity or high lake suitability.

Preliminary results of genetic data of yellow-billed and Pacific loons from the North Slope of Alaska and Canada suggest that population genetic diversity was low, particularly for yellow-billed loons (Talbot et al. 2014). Assessments of genetic variability in species can provide insight into how well a species may adapt to or recover from environmental change or impacts. NPS Management Policies direct parks to assess genetic variation of wildlife populations and “*strive to protect the full range of genotypes of native plant and animal populations in the parks...The need to maintain appropriate levels of genetic diversity will guide decisions on what actions to take to manage isolated populations*” (NPS 2006). The genetic comparisons between the North Slope and Canada populations suggest this low level of genetic diversity is not restricted to just these populations but may be inherent in yellow-billed loons. More research is needed, but unpublished data suggest that these populations also may be demonstrating tendencies for nest site fidelity, annually returning to the same breeding sites. Further analyses are necessary to determine the likely cause of comparatively lower levels of genetic diversity in yellow-billed loons.

Terrestrial Mammals



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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Moose</p>	<p>Distribution</p>		<p>Moose in the Arctic are limited by winter range, defined by access to shrubs in excess of 1 meter in height (Tape et al. 2016b). Available habitat has changed over time concurrently with climate and fire regimes that favor the succession of woody browse over lichens (Joly et al. 2012). Moose have been found in the archeological record in arctic Alaska, but were absent from this region prior to recolonization in the 20th century (Westing 2012). Moose inhabited CAKR by the 1960s (LeResche 1974, Tape et al. 2016b) and primarily utilize habitat in the Mulgrave Hills and among conifers and riparian areas adjacent to the Noatak River, which flows parallel to CAKR’s eastern boundary.</p>
	<p>Abundance</p>		<p>The most recent (2013) population estimate for moose in the lower Noatak River drainage was 1,478 animals at a density of 0.23 moose per square mile. The population meets the management goal defined by the Alaska Department of Fish and Game: a ratio of 40 bulls per 100 cows. The moose survey area includes only a small portion of CAKR. Recent observations by biologists confirm low moose densities. In addition, the Alaska Department of Fish and Game is currently not recommending reauthorization of an antlerless moose (i.e., cow moose) harvest in Game Management Unit 23, of which CAKR is a part (B. Saito, personal communication).</p> <p>Sport hunting is prohibited in CAKR, but subsistence harvest and predation are sources of moose mortality.</p>
<p>Caribou</p>	<p>Migration</p>		<p>Climate change is anticipated to affect mammals in myriad ways, including the timing of migration. Caribou in northwest Alaska have crossed the Kobuk River for thousands of years. There does not appear to be a change in the average timing of this fall crossing, though there is some indication that the first collared caribou has been coming later and later (Joly and Cameron 2015).</p>
	<p>Population Trend</p>		<p>The Western Arctic Caribou Herd is currently at the low end of its population cycle. In 2016, the population was estimated at 201,000, down from 490,000 in 2003 (Parrett 2016). In general, the health and success of the various herds in this region is stable, with some natural fluctuation.</p>

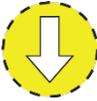
Terrestrial Mammals (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Brown Bears	Abundance and Harvest		<p>A study conducted between 1986 and 1988 found brown bear densities in a 1,862 km² area just northeast of CAKR (around the Kelly River, Wrench Creek, and Wulik River) to be 1 bear per 66 km² for independent bears (i.e., bears without cubs) and 1 bear per 51 km² for total bears (Ballard et al. 1990). Estimated annual harvest rates in this area range between 8% and 16% (Ballard et al. 1990), which exceed maximum allowable harvest and the conservative exploitation rates of 2–4% recommended for northern latitudes (Reynolds 1976, Sidorowicz and Gilbert 1981). The observed harvest rate also exceeds the suggested maximum sustainable annual hunting mortality of 5.7% (Miller 1990).</p> <p>Aerial survey techniques are used to estimate the bear population in CAKR. An aerial survey conducted in the lower Noatak drainage and CAKR in 2008 estimated the bear densities for independent bears and total bears to be 1 bear per 57 km² and 1 bear per 36 km², respectively.</p> <p>A trend is not assigned to this measure because recent survey estimates are not directly comparable with estimates from the 1980s, due to the different study areas. In addition, the 2008 survey methods had some design flaws; the method has since been improved to generate more accurate estimates and a survey employing the improved method was conducted in lower Noatak and Cape Krusenstern in May 2016. Results are forthcoming.</p> <p>Local residents believe that there are numerous bears in Game Management Unit 23 (of which CAKR is a part). Local residents have reported bear-related damage to cabins and nets, taking of fish from fish drying racks, and a general concern for human safety.</p>
	Distribution		<p>In the last 20 years, bear distribution has changed in response to changes in habitat prompted by climate, human commerce, and the impacts of development. More salmon reach spawning areas far inland due to decreased commercial fishing locally, while berry shrubs have proliferated. Meanwhile, impacts from Red Dog Mine have caused den abandonment and mortality (Ayres 1991). Variability in marine mammal carcass availability may have shifted bear distribution.</p>

Terrestrial Mammals (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Muskoxen	Abundance		NPS and the Alaska Department of Fish and Game (ADF&G) collaborate on muskox population estimation and composition surveys of the Cape Thompson (CT) muskox population. Since 1988, population estimates and composition surveys have been conducted on the CT population in what is called the “core area” in and adjacent to Cape Krusenstern. Since 2004, the CT population has declined in the core area and/or is shifting eastward into what has been called the “expanded area” in Noatak (Schmidt and Westing 2011 , J. Lawler, pers. comm., J. Dau, pers. comm.). The 2016 point estimate for whole population in the expanded area was 556.
	Distribution		The Cape Thompson population has expanded beyond its core area. Muskoxen currently occur in CAKR, Noatak National Preserve, and north of the Brooks Range.

Resource Brief: Muskoxen

The muskox is an iconic species of the Arctic and is native to Alaska. Once common in Alaska, muskoxen were heavily hunted and extirpated from Alaska by the mid- to late-1800s ([Lent 1988](#), Allen 1912). Muskoxen were reintroduced to Alaska in 1935; 34 animals were captured in eastern Greenland and translocated to Nunivak Island (Gunn and Forchhammer 2008, [ADF&G 2016b](#)). The population on Nunivak Island thrived and in 1970 and 1977, 70 muskoxen were reintroduced from Nunivak Island to Cape Thompson (Gunn and Forchhammer 2008, [ADF&G 2016b](#)).



Muskoxen in snow. NPS Photo.

NPS and the Alaska Department of Fish and Game (ADF&G) collaborate on muskox population estimation and composition surveys of the Cape Thompson (CT) muskox population. Since 1988, population estimates and composition surveys have been conducted on the CT population in what is called the “core area” in and adjacent to Cape Krusenstern. The core area consists of an area within 30 km of the shore from the mouth of the Noatak River northwest to Cape Lisburne. Since 2004, the CT population has declined in the core area and/or is shifting eastward into what has been called the “expanded area” in Noatak National Preserve ([Schmidt and Westing 2011](#), J. Lawler, pers. comm., J. Dau, pers. comm.).

In 2011, the suspected shift in the population’s distribution prompted the NPS and ADF&G to survey and generate a population estimate for the CT population in both the core and expanded areas. The results showed that at least half of the CT population resided in the expanded area. There is increased interest to expand subsistence hunting of the CT population. Recent concern about the overharvest of adult bulls and subsequent declines in muskox populations ([Schmidt and Gorn 2013](#)) has led to the need for more frequent and precise estimates of sex and age composition and abundance of the population. To this end, in March 2016 the NPS and ADF&G again collaborated on population and composition surveys of the CT population in both the core and expanded areas.

The 2016 point estimate for the whole population in the expanded area was 556, which was not significantly different from the 2011 estimate of 576. However, when looking at the data from 1988 to present, the core area subset of the population declined from a high of about 370 animals in 2005 to around 220–230 animals in 2011, and has stabilized at the 2011 level. The bull: cow ratio in the expanded area was 42:100, which is reasonable for muskox; however, it is concerning that the bull: cow ratio in the core area declined from 37:100 in 2015 to 34:100 in 2016. Once populations exhibit a bull: cow ratio of 20:100, harvest is not recommended ([Schmidt and Gorn 2013](#)). This gives managers pause to think about the impact of the harvest of bulls, especially those bulls that are closer to and more accessible from communities.

Terrestrial Mammals (continued)

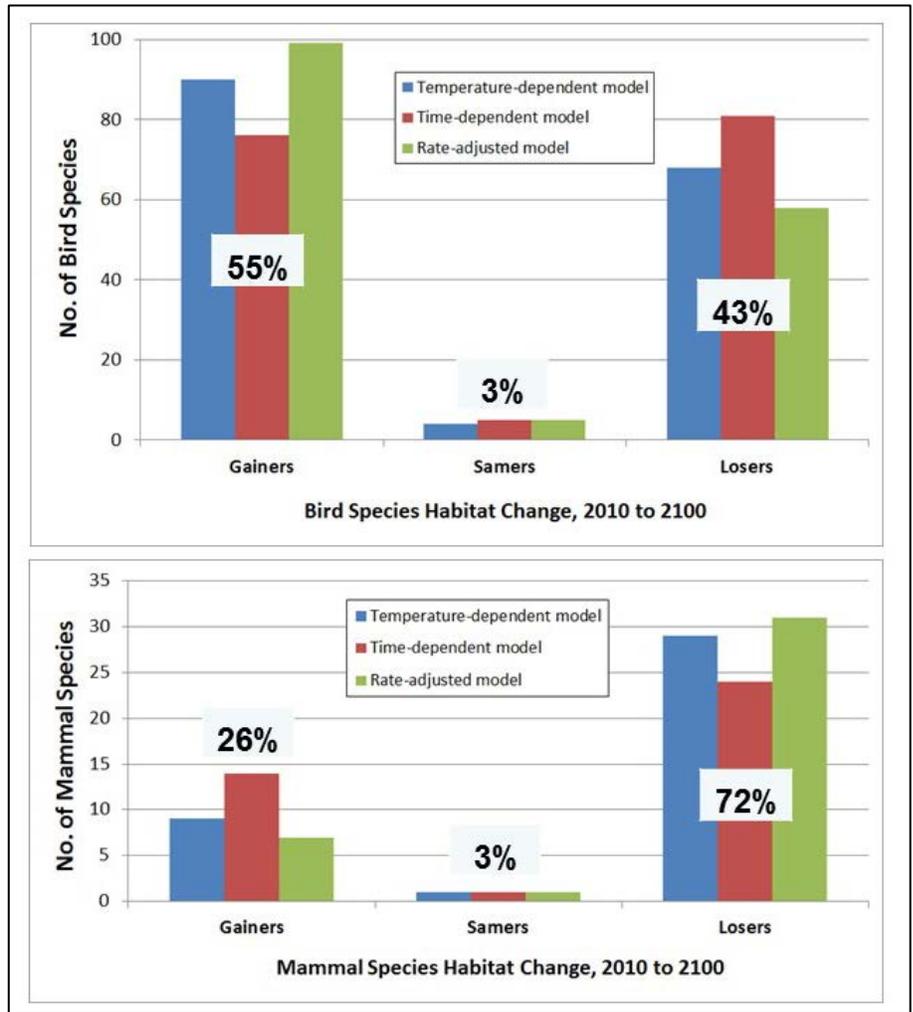
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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Wolverines</p>	<p>Abundance and Distribution</p>		<p>Wolverines are distributed throughout northwestern Alaska. In general, most of what is known about both wolverine distribution and abundance is based on anecdotal observation from local hunters and trappers as well as trapping records. Currently, there is an effort underway to quantify wolverine populations to the north and east of the park using a systematic survey of wolverine tracks in the snow and an occupancy modeling approach (Wildlife Conservation Society 2015). Within Game Management Unit 23, which includes CAKR, the Alaska Department of Fish and Game reports that wolverine populations were thought to be low during the period of last reporting (Westing 2013).</p> <p>Wolverines naturally occur at low population densities and have low reproductive rates. Wolverine populations have been shown to be very sensitive to harvest. An investigation of radio-collared wolverines (including 2 in Alaska) concluded that populations in these areas would decrease without immigration from untrapped populations (Krebs et al. 2004).</p> <p>In CAKR, wolverine are available for harvest under hunting regulation from 1 September–31 March. Trapping season goes from 1 November–15 April. Although local hunters intensively pursue wolverine for their fur, the cost of gasoline in recent years may have reduced local effort to take wolverine (Westing 2013). Although it does not capture all of the harvest, sealing (hunting) records from 1988–2011 (Unit 23) indicate an average wolverine take of 24 per year. More than half of sealed wolverines were taken in the Kobuk drainage, and the Noatak drainage accounted for 31% of the sealed wolverines. Community harvest surveys from 2011–2012 indicate that villages in Game Management Unit 23 harvested 46 wolverines per year.</p>
<p>Wolves</p>	<p>Abundance and Distribution</p>		<p>The few historical estimates of the wolf population size in northwest Alaska are varied and unreliable, but the concern of their influence upon the Western Arctic Caribou Herd spurred predator control by means of poison and aerial shooting as early as the 1940s (Kelly 1954) and liberal harvest quotas since. From 1987–1992, wolves were radio-collared to study their demographics and predation rates; it was determined that hunting, trapping, and rabies were the most significant sources of mortality (Ballard and Krausman 1997). The wolf population in CAKR has not been estimated in recent years, but many local residents report an increase in observations and a concern for the caribou and public safety.</p>

Resource Brief: *Wildcast*

The NPS Wildcast project modeled the likely effects of climate warming in northwest Alaska on the extent of 60 habitat types for 162 bird and 39 mammal species known (or expected to occur regularly) in the region. The project was a partnership with cooperators including U.S. Forest Service, U.S. Fish and Wildlife Service, and several universities. The project developed three models based on studies of historic changes in vegetation, mean annual air temperature, and influences of 23 biophysical drivers (such as permafrost melt and tundra fire). Researchers project that shrub, woodland, and forest habitats of 53% of the 201 wildlife species will increase, habitats of 3% will have no change, and lowland shrub, meadow, grassland tundra and other habitats of 44% will decrease (Marcot et al. 2015). In addition, habitat for 86 species of birds (43% of total bird species) and 28 species of mammals (72% of total mammal species) is likely to decline (Marcot et al. 2015). Changes in wildlife habitats will likely affect the composition and function of the ecosystem; of particular significance are the predicted declines in habitats of most small mammals, as these form the prey base for mid-sized carnivores and raptors and serve ecosystem engineering functions of burrowing and soil and nutrient turnover. Habitat is also likely to decline for 25 of the 50 bird and mammal species harvested for subsistence (including greater white-fronted goose, tundra swan, rock and willow ptarmigan, caribou, muskoxen, Arctic fox, muskrat, American beaver, and northern river otter), with habitat increases for grouse, some waterfowl, cranes, moose, black bear, and American marten.

The Wildcast project will help NPS managers design better adaptation strategies by projecting the future composition of the ecosystem. Tomorrow’s ecosystem will more closely resemble that of the subarctic coast and the boreal forest, with tundra restricted to the alpine. Caribou, in particular, are expected to lose a significant portion of their lichen winter range to shrub and forest communities. This will have profound influences on the ecosystem and subsistence hunting opportunity.



Winners and losers with changing habitat. Adapted from Marcot et al. 2015.

Biggest Habitat Losers

Birds

- Golden Eagle
- Gyr Falcon
- Peregrine Falcon
- Snowy Owl ❖
- Northern Harrier
- Rough-Legged Hawk
- Greater White-Fronted Goose ❖
- Tundra Swan ❖
- Rock and ⋯
- Willow Ptarmigan ❖
- Long-Tailed Jaeger
- Eastern Yellow Wagtail
- Savannah Sparrow
- Upland Sandpiper
- Bristle-Thighed Curlew
- Bar-Tailed Godwit

Mammals

- Caribou ❖
- Muskoxen ❖
- Arctic Fox ❖
- American Mink ❖
- Muskrat ❖
- American Beaver ❖
- Northern River Otter ❖
- Northern Bog Lemming
- Collared Lemming
- Arctic Ground Squirrel
- Tundra Shrew
- Cinereus Shrew
- Dusky Shrew
- Barren-Ground Shrew
- Singing Vole
- Meadow Vole
- Northern Red-Backed Vole
- Tundra Vole

Habitats:

- Low shrub, dwarf shrub
- Herbaceous, grassland
- Freshwater

❖ subsistence species

Projected Habitat Losers. Adapted from Marcot et al. 2015.

Fish  web 			
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Sheefish	Abundance/Spawning Estimates		<p>Inconnu (sheefish) are an important subsistence resource in the region (Georgette and Loon 1990, Whiting 2006). Inconnu are in the salmon family. They spawn in the upper Kobuk River and overwinter in the Hotham Strait/Kotzebue Sound area. Unlike salmon, inconnu reproduce approximately every 2–3 years and can live more than 20 years. High reproductive success may be intermittent. The subsistence harvest dwarfs the small commercial and sport harvests (Menard et al. 2015).</p> <p>Populations of sheefish are found in Krusenstern and Sisualik Lagoons in smaller numbers than on the Kobuk River (Scanlon 2015), but exact population estimates are unknown.</p>
Whitefish	Abundance		<p>Five species of anadromous whitefish (not including sheefish) inhabit the waters of the Western Arctic Parklands. As a group, they represent the most accessible subsistence resource in the area, and are available from late spring through early winter. Traditionally, whitefish were harvested to feed both people and sled dogs. As dog teams are used less, the demand for dog food has decreased substantially. Both eggs (roe) and meat are still prized by people (Georgette and Shiedt 2005).</p> <p>Whitefish movements between nearshore marine waters, brackish waters, and the rivers, streams and lakes of the region are very complex (Georgette and Shiedt 2005). Whitefish move in and out of the coastal lagoon system of CAKR and often are trapped when lagoon entrances close naturally. A rather unique subsistence fishery has developed, particularly at <i>Anigaaq</i>, although modern seines and gill nets are often used. <i>Tukruk</i> (Situkuyok River) is an important whitefish habitat in CAKR.</p> <p>Robust abundance and escapement data for whitefish in CAKR do not exist. In a traditional ecological knowledge survey in Kotzebue and nearby villages, elders generally agreed whitefish were abundant and could not recall a time they were not (Georgette and Shiedt 2005). Importantly, whitefish availability for subsistence seems to be tied to the opening and closing of Krusenstern Lagoon, which is weather dependent.</p>

Fish (continued)

[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Dolly Varden	Abundance		Dolly Varden (known locally as “trout”) are members of the salmon family that feed in the ocean and spawn in rivers and streams (Scanlon 2015). They inhabit most coastal streams and large rivers in the Kotzebue Sound area. Dolly Varden are important subsistence fish in many villages after chum, sheefish, and other whitefish (Whiting 2006), though in some villages they outrank other fish (Menard et al. 2015). Known for their large size in the area, Dolly Varden are also targeted by sport fishermen, though subsistence harvests are much greater. The Wulik River, north of the park, is known for spawning aggregations in excess of 100,000 fish (Scanlon 2015). However, very few data are available on escapement, spawning, or abundance (Scanlon 2015).
Lagoon Fish Assemblages	Species Diversity and Abundance		<p>Coastal lagoons are a dominant landscape feature of the Arctic coastline. Fish communities of Aukulak, Kotlik, and Krusenstern were sampled as part of a study to inventory and develop vital sign monitoring protocols for coastal lagoons (Haynes et al. <i>in prep</i>). Additional studies have sampled Ipiavik, Port, Imik, and Sisualik Lagoons (Raymond et al. 1984, Blaylock and Houghten 1983, Reynolds 2012, Reynolds and Clough 2010 and Robards 2014; see Haynes et al. <i>in prep</i> for a summary). Thirty-three fish species were identified across all lagoons, which ranged from 0 (Imik Lagoon) to 20 (Krusenstern Lagoon).</p> <p>Large numbers of larval fish in Aukulak Lagoon suggest these ecosystems play an important nursery role. Seasonal changes in lagoon openings to the sea, freshwater input, salinity, temperature, pH and dissolved oxygen likely play a strong role in determining the type of fish in each lagoon. Catches of migratory species (e.g., sheefish, humpback whitefish) generally decreased towards the end of the season as fish left the lagoons, likely in response to the potential loss of connectivity to overwintering habitat as freeze-up approached. Preliminary observations of fish diets suggest that mysid shrimp, midges, and ninespine stickleback are the primary source of food in the lagoons and likely play a critical role in the lagoon food web (Haynes et al., <i>in prep</i>). These data are preliminary and insufficient to establish a trend.</p>

Unique Communities and Features (Lagoon Complexes)



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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Lagoon and Barrier Island Complexes</p>	<p>Condition of Unique Community</p>		<p>The coastline of CAKR includes about 78 km of open and closed lagoon and barrier complexes. These unique landscapes consist of sand or gravel beaches backed by grass-covered beach berms or dune ridges, behind which there can be more ridges covered with dwarf shrub-lichen vegetation, small freshwater lakes and ponds, and salt marshes. Barrier islands and spits protect lagoons and estuaries from the open ocean. Some barriers are breached permanently by narrow tidal channels, and intermittently by overwash events during storms.</p> <p>The lagoon and barrier complexes host a tremendous diversity of wildlife including waterfowl, muskoxen, brown bears, and caribou.</p> <p>Valuable cultural sites, some thousands of years old, are scattered along the coastline, and the barrier complexes remain the most frequently visited part of the park.</p> <p>The main impacts to the lagoon and barrier complexes include litter and marine debris, OHV use (which is mostly confined to the beach itself), and an increase in recent years in erosion rates and storm overwash events associated with the loss of sea ice. Coastal erosion may ultimately affect subsistence users through loss of allotments and structures. These impacts are expected to continue and increase in the future as sea ice declines, sea level rises, and permafrost thaws. Increased shipping activity in the region also brings with it the possibility of a serious oil or other type of industrial spill.</p>

Landscape and Ecosystem Processes


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Fire	Frequency		Due to the coastal influence of weather at Cape Krusenstern, fire is fairly infrequent with an average of 0.06 fires occurring per year in Cape Krusenstern. No fires have occurred in the park unit between 2010 and 2015. There is no significant change in the trend of number of fires over that past 60 years.
	Total Area Burned		An average of 70 park acres burn per year. There has been no change in the trend of area burned for CAKR.
Landcover	Match of Seasons to Historic Norms (snow-free season, green-up, peak greenness, senescence)		Overall greenness of lowland tundra landscapes as measured by satellite has increased since records began in the 1980s. This is probably due to climate warming that occurred in the late 1900s, which involved both longer and warmer summers. More detailed satellite records since 2000 provide specific information on the timing of snow cover loss, spring green-up, and fall. This shorter time period is dominated by year-to-year fluctuations. Higher greenness indicates higher shrub cover, which implies a decrease in caribou winter range lichen habitat; the earlier dates of snow melt has the potential to bring mismatches in the timing of wildlife migration and foraging.

Marine Nearshore


[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Sea Ice	Extent		With climate change progressing steadily in the Arctic, sea ice has retreated by an average of 1.3% per year since the 1950s (NSIDC 2015 , Perovich 2015). Through 2015, the September Arctic sea ice extent has decreased by 13.4% per decade, relative to the 1981 to 2010 average. The nine lowest September sea ice extents have occurred in the last nine years. In the summer months, the Arctic ice pack is now sufficiently far north to allow for passage of vessels via both the Northern Sea Route (above Siberia) and the Northwest Passage (through the Canadian Archipelago to Greenland). As a result, this park unit is now more vulnerable to marine incidents (e.g., oil spills) and coastal erosion. While in past decades the formation of shorefast ice in early fall protected the coastline from erosion during powerful fall storms, the current onset of shorefast ice in late fall has removed this protection.

Marine Nearshore (continued)

[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Sea Ice (continued)	Age and Thickness		<p>The oldest sea ice (> 4 years old) continues to make up a small fraction of the Arctic ice pack in March at its typical annual maximum. Sea ice age is a reliable proxy for ice thickness because older ice is generally thicker (Tschudi et al. 2016). In 1985, old ice made up 20% of the ice pack, but in March 2015 old ice only constituted 3% of the ice pack. First-year ice now dominates the ice cover, comprising ≈ 70% of the March 2015 ice pack, compared to about half that in the 1980s (Perovich 2015).</p> <p>Sea ice in the Beaufort and Chukchi Seas is more seasonal in nature and is a mix of multiyear (≈ 25%) and first-year ice (≈ 75%). The inter-annual variability of ice thickness over the last seven years has been more variable with mean and modal ice thickness around 2.1 m and 1.8 m, respectively (Richter-Menge and Farrell 2013).</p> <p>The thinning sea ice has made subsistence hunting for marine mammals much more dangerous and has limited hunting opportunity drastically (Arctic Council 2009b). Traditional knowledge has indicated that sea ice is much thinner, more mobile, more broken, and hazardous than in past generations (NOAA 2012).</p>
Ice Seals	Abundance and Distribution		<p>Ice seals are occasionally sighted in the region's lagoons and estuaries. In December 2012, the U.S. National Marine Fisheries Service determined two of the four ice seal species found in the preserve warranted listing as threatened species (bearded and ringed seals). The bearded seal listing was vacated by a court in 2014 and the ringed seal determination was vacated in 2016. Population estimates of seals are difficult because of logistical challenges in conducting population studies. The average age of harvest for ringed seals is decreasing, suggesting either the population age as a whole or the age at reproductive maturity is decreasing, thereby leading to a younger population age profile, and raising concern over the population as a whole (Quakenbush 2011a). Ringed and bearded seal gut analysis indicates that there has been a shift in food preferences towards fishes and away from invertebrates. In the last 50 years, growth studies indicate that bearded and ringed seals are growing at a faster rate (Quakenbush 2011a, b). Ice seals are dependent on ice for birthing and rearing their young. The reduction of sea ice is anticipated to have a negative impact on ice seal populations worldwide.</p>

Marine Nearshore (continued)

[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Polar Bears	Abundance and Distribution		<p>Polar bear were listed as a globally-threatened species under the U.S. Endangered Species Act in 2008. This listing was based on the threat to future populations in light of rapidly declining sea ice habitat (Atwood et al. 2015). Polar bear populations in the north are divided into 19 subpopulations. The subpopulations that reside in winter along the coast of CAKR are the Chukchi and Bering Seas subpopulations. The US Fish and Wildlife Service established critical habitat for polar bear along CAKR’s entire Chukchi coast.</p> <p>Polar bears in the Chukchi and Bering Sea have large body size, good body condition, and high survival rates in comparison to other subpopulations.</p>
Beluga Whales	Abundance and Distribution		<p>Two stocks of Beluga use the coastal and marine areas of Bering Land Bridge National Preserve and CAKR: (1) the Beaufort Sea stock and (2) the Eastern Chukchi Sea stock. Both winter in the Bering and southern Chukchi Seas and have stock-specific migrations to the north and northeast in the spring and summer. During the return migration in September and October, beluga from stocks overlap in the western Beaufort Sea (Hauser et al. 2014).</p> <p>The most recent population estimate for the Beaufort Sea stock is 32,453 whales. Trend data indicate the stock is at least stable or increasing (Allen and Angliss 2015). Subsistence users, however, report beluga are decreasing and not found in areas they used to hunt them such as near Buckland (W. Goodwin, personal communication). The most recent stock estimate for the eastern Chukchi beluga stock is 3,710 (Allen and Angliss 2015). The current population trend for the eastern Chukchi sea Beluga stock is unknown.</p>

Marine Nearshore (continued)

[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Marine Invasive Species	Presence/Absence		<p>Attempts have been made to monitor for invasive tunicates; however, results of that monitoring are not yet available. To date, no marine invasive species have been identified in the Southern Chukchi; however, very little monitoring is being conducted in the region by any Government agency or private entity.</p> <p>Marine invasive species have the potential to seriously impact coastal biological and subsistence resources in CAKR (Larsen 2014). Increased vessel traffic associated with reduced sea ice extent and duration (Azzara et al. 2015), including the advent of Arctic marine tourism in the area, is elevating the risk of marine invasions. The risks of invasion may also be exacerbated by the environmental stress of increased water temperatures on existing fauna and increased marine debris (Ruiz and Hewitt 2009). Models of the ecological parameters of marine invasives of the Pacific coast of North America indicate high latitude environmental conditions suitable for survival under current climate predictions in the 21st century (de Rivera et al. 2011).</p>
Marine Incident Preparedness	Level of Preparation (data availability, logistical readiness)		<p>Marine incidents are relatively common in the Chukchi Sea and Kotzebue Basin Area, with historical incident rates (1995–2012) as high as 0.556 incidents/year (Reich et al. 2014). With significant increases in Arctic marine operations through the Bering Strait, associated Arctic marine incident risks are also increasing (NOAA 2012). Marine incidents in this remote region are extremely difficult to mitigate, even with effective response operations, and recommendations from an ecological risk assessment of the Northwest Arctic (Aurand and Essex 2012) include assessing the geographic response strategies. Geographic Response Strategies (GRSs) in the area were developed primarily from site overflights, satellite imagery, and/or aerial imagery. However, most of the GRSs have not been assessed and updated with onsite information to verify their validity. Bathymetric and flow velocity measurements are being conducted at existing GRS locations within CAKR.</p> <p>Potential challenges to the GRSs include shallow lagoon bottoms and boat routes (< 1ft or < 0.3m) for many proposed tactics, and high water flow areas that may compromise oil boom success. Several of the strategies require updating, and ongoing assessments are being conducted to understand seasonality of the depth and currents at GRS locations. There are currently 7 draft GRS locations within CAKR. Training has occurred in Kotzebue and Nome, with test deployments. Ongoing training by the U.S. Coast Guard is occurring.</p>

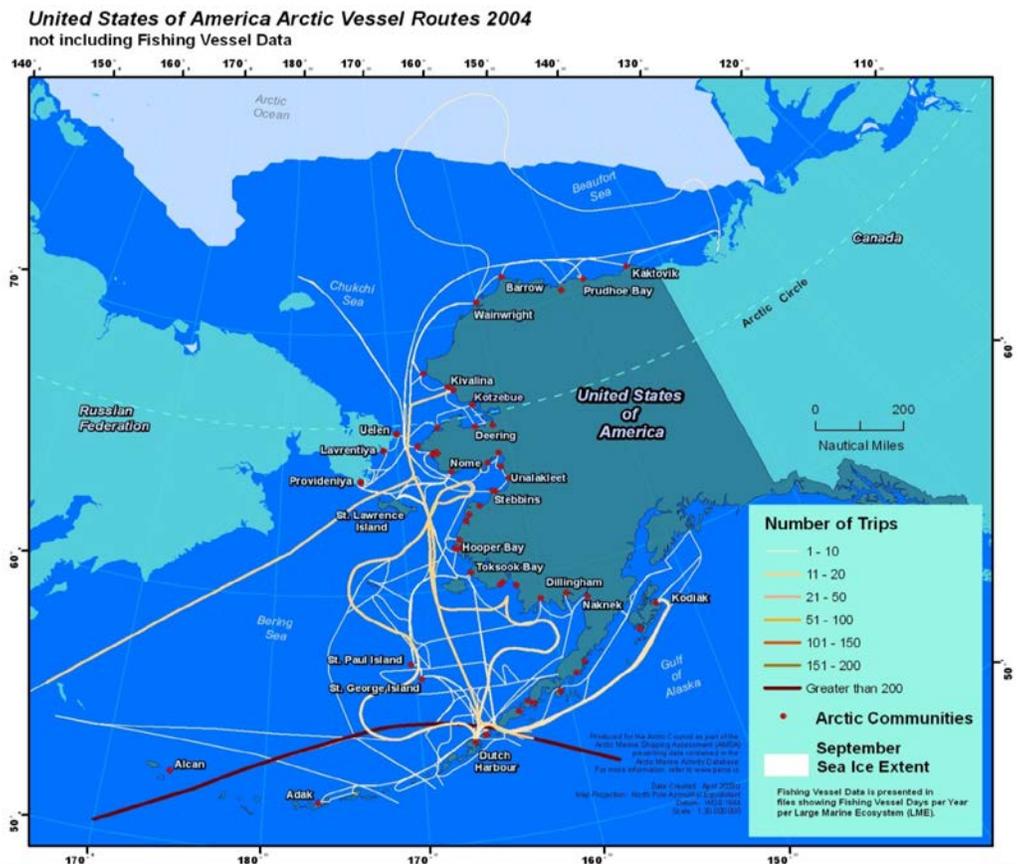
Resource Brief: Ship Traffic in Arctic Waters

With climate change progressing steadily in the Arctic, sea ice has retreated by an average of 1.3% per year since the 1950s (NSIDC 2015). Through 2015, the September Arctic sea ice extent has decreased by 13.4% per decade, relative to the 1981 to 2010 average. The nine lowest September sea ice extents have occurred in the last nine years. In the summer months, the Arctic ice pack is now sufficiently far north to allow for passage of vessels via both the Northern Sea Route (above Siberia) and the Northwest Passage (through the Canadian Archipelago to Greenland). As a result, vessel traffic has increased dramatically through the Bering Strait (Arctic Council 2009a).

The Bering Strait is poised to become a crucial and highly used waterway for commercial traffic. Connecting the Bering Sea to the Chukchi Sea, the Bering Strait is the only connection from the Pacific Ocean into Arctic waters; all Pacific marine traffic to or from the Arctic Ocean must pass through the Bering Strait. The Northern Sea Route shipping lanes to Europe and North America from Asia are now in use by cargo ships and fuel tankers, and there is projected to be as much as a 500% increase in traffic by 2025, from 2015 transit estimates (Azzara et al. 2015). Arctic shipping transits through the Bering Strait are immediately adjacent to the Western Arctic Parklands of Bering Land Bridge National Preserve and Cape Krusenstern National Monument. Arctic large cruise ship tourism is also emerging as a new enterprise, and a 1,100-passenger ship completed its voyage through the Northwest Passage in 2016. The popular, month-long trip had a 1,000-passenger waiting list.

As shipping traffic increases, so does the risk of spills and vessel incidents. For example, fuel is being transported via fuel barges that navigate and anchor in the shallow waters near shore, occasionally in close proximity to Arctic parklands. Given the rise in demand for infrastructure to support burgeoning demand, the Army Corps of Engineers has been conducting site assessments for a new deep-water port in Nome to support trans-Arctic vessel traffic. Given the proximity of emerging shipping to these formerly remote conservation units, preparing for a coastal incident has become one of the top management priorities for Bering Land Bridge National Preserve and Cape Krusenstern National Monument. These two units have an ambitious coastal data gathering plan including: 1) collection of baseline data on coastal and marine resources; 2) ground-truthing of incident response plans; 3) arranging for community incident preparedness trainings; and 4) modeling of future vessel traffic routes and densities.

Other key issues associated with shipping traffic increase include: dumping and vessel-related pollution in the Chukchi and Bering Seas, collisions with marine mammals, disturbance of communication and migration routes for marine mammals and fish due to undersea vessel noise pollution, potential decrease in subsistence marine mammal resources, collisions with other vessels, and increased demand for search and rescue.



Vessel traffic routes through the Bering Strait.
Map from the Arctic Marine Shipping Assessment, 2009.

Marine Nearshore (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Marine Debris</p>	<p>Marine Debris Abatement (beach cleanliness)</p>		<p>In 2015, a small group of volunteers removed approximately 675 kg of marine debris from Cape Krusenstern in 16 hours (Polasek et al. 2017). Debris consisted of plastic, tires, ropes and nets, foam and other trash. Debris was heavier in proximity to private allotments but averaged 30 kg/km in the small zone sampled. New debris appears each year from local and international sources.</p> <p>Sampling in the Chukchi Sea confirms levels of microplastics (from degraded plastic debris and other sources) higher than those of the Great Garbage Patch in the North Pacific Gyre (Obbard et al. 2014, Lusher et al. 2015). Microplastic particles have accumulated persistent organic pollutants and have entered the food web in the Pacific Ocean (Rochman et al. 2013). For rural communities dependent on marine mammal harvest for subsistence, the bioaccumulation of toxic substances (small, yet increasing with the increase of microplastics) is a concern.</p>

Resource Brief: Marine Debris, an Ongoing Challenge

The remote coastlines of northwest Alaska have increasing accumulations of marine debris. Marine debris includes fishing gear, trash, plastic materials, buoys, tarps, rope, drums, building materials, and any other non-natural, solid material that washes ashore. Debris can affect marine mammals and birds directly through entanglement, drowning, strangulation, and digestive blockage (Derraik 2002, EPA 2011, Ryan et al. 2009). Marine debris can transport invasive marine organisms, which have the potential to cause ecological and economic impacts. Over time, plastics break down into microplastic particles. Research has shown that bioaccumulative toxic substances borne by microplastics have entered the food web in the Pacific Ocean (Rochman et al. 2013); for rural Alaskan communities dependent on marine mammal subsistence harvest, the potential for bioaccumulation of toxic substances is a health concern. Of equal concern, it has recently been discovered that Arctic Sea ice from remote locations contains concentrations of microplastics several orders of magnitude higher than those previously reported in high concentration zones such as those of the North Pacific Gyre (Obbard et al. 2014).

In the Arctic parklands, debris sources include: 1) local garbage from poorly contained landfills, camps, and communities; 2) pan-Asian garbage from Russia, Korea, Japan and elsewhere; and 3) fishing and shipping vessels. In 2015, Bering Land Bridge National Preserve and Cape Krusenstern National Monument partnered with other Alaska coastal parks for a marine debris cleanup and quantification study in 5 parks that removed a total of 11 tons of debris. NPS will continue to engage with communities to present school programs on marine debris, sponsor community cleanups, and facilitate dialog on ways to reduce trash escapement.



Beach trash in Cape Krusenstern National Monument, close to summer camps.
NPS Photo by Peter Neitlich.

Dark Night Sky



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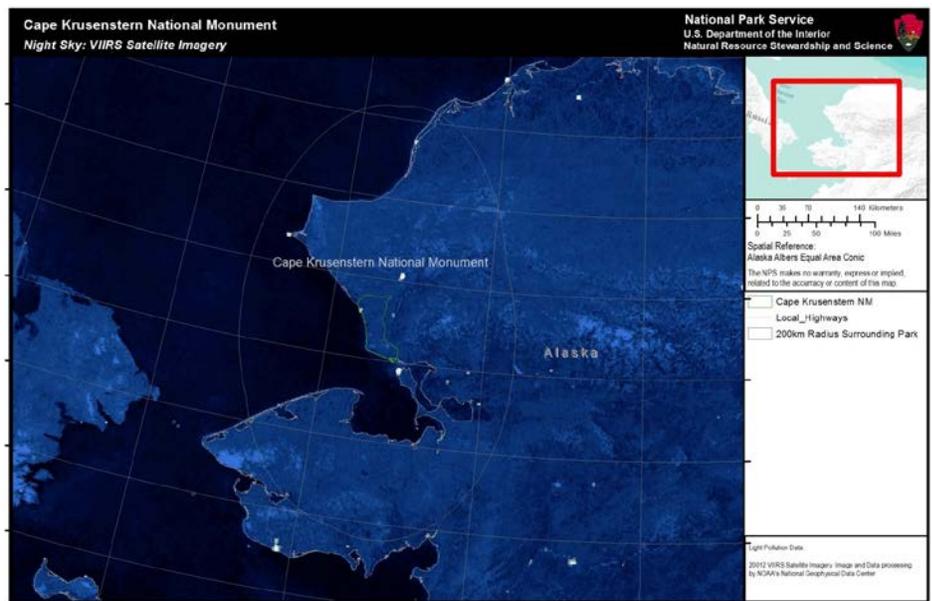
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Anthropogenic Light</p>	<p>Anthropogenic Light Ratio (ALR) — Average Anthropogenic Sky Glow: Average Natural Sky Luminance</p>		<p>A photic environment is described as the physical amount and character of light at a particular location, irrespective of human perception. The NPS Night Sky Program characterizes a park’s photic environment by measuring both anthropogenic and natural light. While no ground based or modeled data are available for Cape Krusenstern National Monument, 2012 visible infrared imaging radiometer (VIIRS) satellite data, which uses a broadband imaging detector with high sensitivity, indicates that there is minimal visible upward radiance within the park boundary, and small amounts of upward radiance within a 200-km radius surrounding the park. The largest sources of upward radiance emanate from the Red Dog Mine, about 30 km from the park’s northeast boundary, and from Kotzebue, about 20 km from the park’s southern boundary. A small amount of upward radiance is visible from the western edge of the park emanating from Kivalina, AK.</p>

Resource Brief: Night Sky Resources at Cape Krusenstern

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 evidenced 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 are both a natural and a cultural resource and are critical aspects of scenery, visitor enjoyment, and wilderness character.

Condition and Functional Consequences

Night sky quality at CAKR is in good condition. 2012 visible infrared imaging radiometer (VIIRS) satellite data, which uses a broadband imaging detector with high sensitivity, suitable for detecting anthropogenic sources of light on the earth’s surface, reveals no upward light within the park. Further, very little anthropogenic light is detected in an area within a 200-km radius surrounding the park except for a small amount of upward radiance from the Red Dog Mine, adjacent to the park’s northwest boundary, and from the town of Kotzebue, AK just over 20 km from the park’s southwest boundary. Given the absence of anthropogenic light originating within the park boundaries, and low to moderate upward radiance within 200 km of the park, the photic environment of CAKR is subject to the natural regime of dark/light patterns allowing visitors to the park to experience pristine night sky resources. At these light levels, most observers feel they are in a natural environment. The Milky Way is visible from horizon to horizon and may show great detail, with fine details such as the Prancing Horse. Zodiacal light (or “false dawn” which is faint glow at the horizon just before dawn or just after dusk) can be seen under favorable conditions, and there is negligible impact to dark adaptation looking in any direction.



Regional view of anthropogenic light near CAKR. White represents more environmental influence from artificial lights while blues and black represent natural conditions.

Acoustic Environment



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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Acoustic Impact Level</p>	<p>Mean Acoustic Impact Level</p>		<p>The mean acoustic impact level (L_{50} dBA) in CAKR, calculated as the difference between nationwide models of existing and natural ambient, is 0.0 dBA. This indicates that the acoustic environment is in good condition. State-wide increases in development and steady tourism pressure throughout the state of Alaska (McDowell 2014) also indicate a downward trend in acoustic conditions.</p> <p>Local impacts to soundscape in the northern section of CAKR occur due to the operations of the Red Dog Mine including: ore truck transits, other vehicular traffic, blasting, shipping, and port operations.</p>

Resource Brief: Acoustic Environment

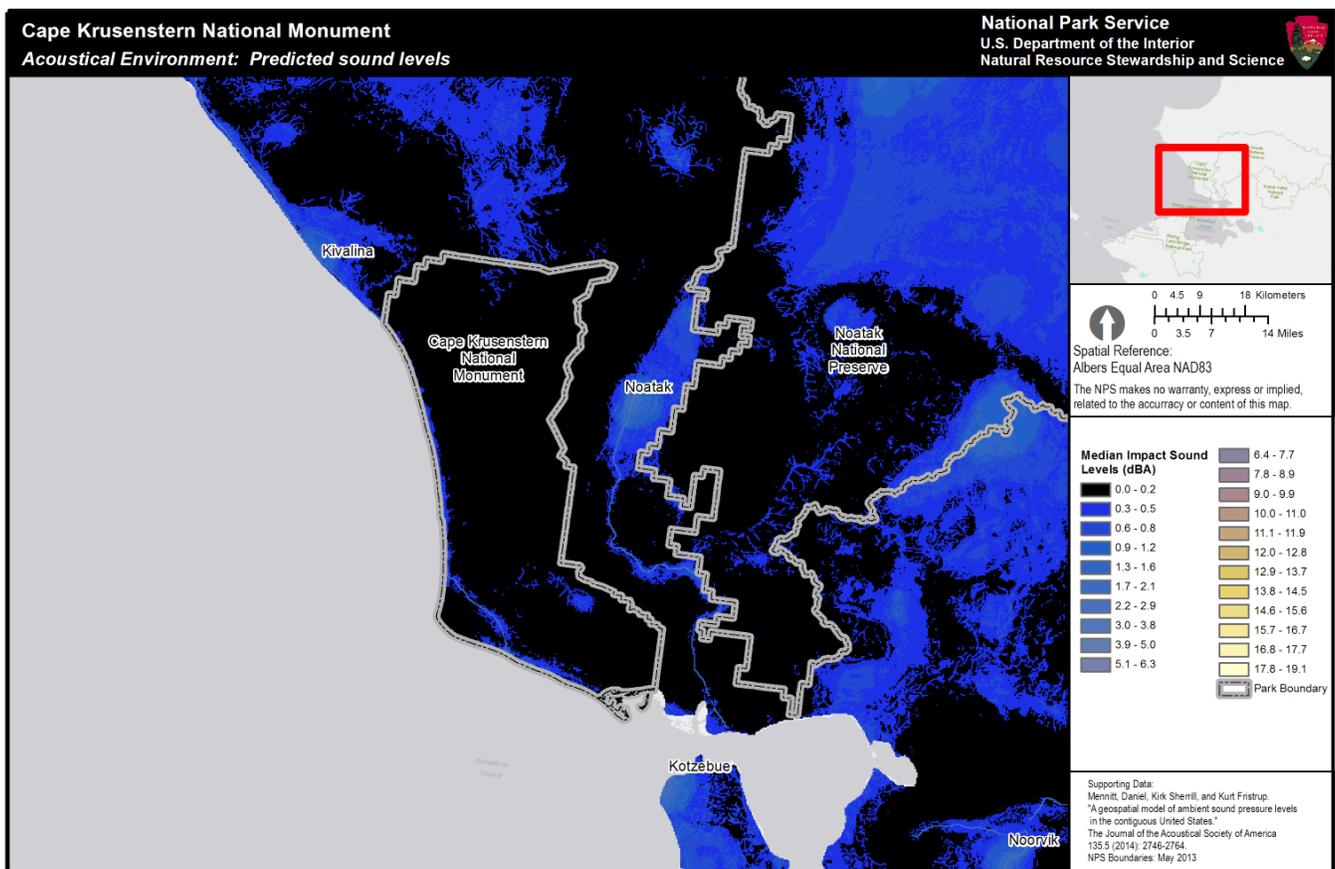
To characterize the acoustic environment, the NPS has developed a national model of noise pollution (Mennitt et al. 2014). This model predicts the increase in sound level due to human activity on an average summer day. The model is based on measured sound levels from hundreds of national park sites and approximately 100 additional variables such as location, climate, vegetation, hydrology, wind speed, and proximity to noise sources such as roads, railroads, and airports. The model reveals how much quieter parks would be in the absence of human activities. The quality of the acoustic environment affects visitor experience and ecological health. Acoustic resource condition, both natural and cultural, should be evaluated in relation to visitor enjoyment, wilderness character, ecosystem health, and wildlife interactions. Learn more at the NPS Natural Sounds & Night Skies Division website (<http://www.nature.nps.gov/sound/>).

Indicator	Threshold (dBA)
Acoustic Impact Level A modeled measure of the noise (in dBA) contributed to the acoustic environment by man-made sources.	Threshold ≤ 1.5 <i>Listening area reduced by $\leq 30\%$</i>
	$1.5 < \text{Threshold} \leq 3.0$ <i>Listening area reduced by 30 – 50%</i>
	$3.0 < \text{Threshold}$ <i>Listening area reduced by $> 50\%$</i>

Condition thresholds for the acoustic environment in non-urban parks

Criteria for Condition Status/Trend

Parks outside designated urban areas typically possess lower sound levels, and exhibit less divergence between existing sound levels and predicted natural sound levels. These quiet areas are susceptible to even subtle noise intrusions, so care should be taken to maintain low impact conditions in these places. Park units inside urban areas typically experience more interference from noise sources. Based on these assumptions, all Alaska parks are assessed using the non-urban criteria.



Map of predicted acoustic impact levels in the park for an average summer day. The color scale indicates how much man-made noise increases the sound level (in A-weighted decibels, or dBA), with 250 meter resolution. Black or dark blue colors indicate low impacts while yellow or white colors indicate greater impacts. Note that this graphic may not reflect recent localized changes such as new access roads or development.

2.2. Cultural Resources

Archeological Resources  web ▶			
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research is conducted to understand the relationship of the park's archeological resources to the historic contexts for the park.		CAKR was established to preserve, study, and interpret a sequential archeological record of human migration and adaptation in arctic Alaska. The major themes/historic contexts for CAKR are well developed, particularly for the late-Holocene cultures, but many questions remain about the origins of coastal adaptations, trans-Bering strait connections, and the role of Beringia in the peopling of the Americas. Enough research has been conducted to know that CAKR archeological sites have high research potential for answering important questions about human migration and adaptation in the Arctic. Incremental progress is being made as modern methods and theories guide new research and refine previous interpretations.
	Archeological resources are identified and evaluated using appropriate anthropological and historical contexts.		The beach ridge sequence at Cape Krusenstern preserves a record of human adaptation that spans 5,000 years. The artifacts preserved at the sites in this sequence are often used as type specimens that define the archeological traditions across northern Alaska. All new discoveries are evaluated against these historical and prehistoric contexts. Ethnographic and ethnohistoric data from local native tribes are often used as source materials for the interpretation of artifacts and sites. However, many areas within the park have not been surveyed and many of the sites that have been found have not been investigated well enough to determine cultural affinity or timeframe of the occupation.
	Number of archeological context statements.		386 sites have been reported in CAKR and many more subsites are known. Two primary documents produced in the 1980s and 1990s provide a solid (albeit dated) overview of the general context that most resources fall under; most notable is Giddings and Anderson (1986) <i>Beach Ridge Archaeology of Cape Krusenstern</i> , which is a de facto context statement. It is a bit dated, but remains an excellent guide to research. An Archeological Overview and Assessment was produced in 1993 but is in need of updating. Most recently, Anderson and Freeburg (2014) have updated the inventory, mapping, and chronology of the CAKR beach ridge sequence, but updated context statements for the rest of the park are needed.

Archeological Resources (continued)

[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge (continued)	Scope of archeological resources 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 archeological resources in CAKR is very well understood and the determination was made at the park's inception that archeological resources are a fundamental resource. No other park unit in Alaska has such a strong emphasis on archeological resources in its enabling legislation. The scope of archeological sites on the beach ridge complex is well known (from Giddings and Anderson's work, as well as recent work by University of Washington). More inventory, mapping, and assessment are still needed, but the broad strokes are well-established and many site-specific details are known. Inland sites at CAKR are comparatively less well known and are the biggest current gap in knowledge.
	Percentage of archeology baseline documents with current and complete information.		An Archeological Overview & Assessment (McClenahan 1993) was completed 24 years ago. The Giddings and Anderson (1986) report coupled with Anderson and Freeburg's (2014) recent work at Cape Krusenstern Beach Ridges provided a fairly complete and current documentation of resources for this portion of the park.
	The mechanisms affecting site stability and taphonomic influences are understood.		The basic processes threatening site stability such as coastal erosion and permafrost degradation are well understood, but site-specific impacts are not well documented.
	Percentage of sites/archeological landscapes that are tied to information regarding influences from the physical and social environment.		All of the sites have general environmental information reported, allowing the park to generally assess environmental influences. 51.1% of CAKR sites (167 out of 327) have been specifically assessed for threats and disturbances from human or natural sources. Sites located on the coast and along the rivers where locals and visitors spend most of their time are certainly more at risk to impacts from human actions. More work is needed to assess which sites are most vulnerable to environmental and social influences.
	Percentage of sites with known date ranges associated with a research theme.		Most documented CAKR sites are from the beach ridge complex and each beach ridge has at least a rough chronological interval assigned to it, so nearly every beach ridge site has a known (if rough) date range. Recent work dramatically expanded the number of radiocarbon dated sites and helped to refine the relative beach ridge chronology (Anderson and Freeburg 2014).

Archeological Resources (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Inventory	Percentage of park intensively surveyed.		The percentage of area surveyed in CAKR is high along the beach ridge complex. The percentage of inland areas of CAKR that have been intensively surveyed is low and probably slightly lower than average for parks in the Arctic. Recent work has expanded the survey coverage of the beach ridges. More precise data on areas inventoried is being produced each year as GPS technology and data are updated.
	Percentage of survey data included in the Geographic Information System (GIS).		For the beach ridge complex, recent GIS data is excellent; however, most of the park's GIS data does not meet current Cultural Resource GIS data standards.
	Percentage of archeological resources with complete, accurate, and reliable data in the Archeological Sites Management Information System (ASMIS).		182 sites out of 327 (55.7%) have all required data in ASMIS. Relative to other park units, this percentage is good.
Documentation	Percentage of known sites with adequate National Register documentation.		There are 327 sites recorded in CAKR in ASMIS. 174 of 327 (53.2%) sites have not been evaluated for the National Register. 4 (1.2%) have been determined eligible, 0 have been determined ineligible, 144 (44.0%) have been listed/documented.
	Percentage of archeological materials cleaned, conserved, studied, cataloged, and properly stored.		<p>According to the 2015 Collections Management Report, 100% of CAKR's archeological materials are cleaned, conserved, studied, cataloged, and properly stored; however, this figure is probably closer to 95%. One particular large multi-year project produced materials that came from in-holdings as well as parkland. The in-holdings need to be separated out before the material can be cataloged.</p> <p>Approximately 95% of the park's collections are in need of rehousing. They have never been properly processed for storage.</p>

Archeological Resources (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Documentation (continued)	Park base maps are prepared showing the location and distribution of archeological resources, the nature and extent of archeological identification activities, and the types and degree of threats and damages.		The park has a set of 1:63,360 quadrangle maps annotated with known sites and survey lines as of roughly 2004. Survey lines have not been digitized. Site locations are available in a GIS layer, although not all locations reflect the most current, accurate information. Locational and spatial data methods are improving every year and are expected to continue into the near future. Efforts to relocate known sites and update position data are ongoing. Detailed survey and mapping of known and newly identified sites and features has been conducted in coastal areas since 2006.
	Percentage or number of sites without assessed and defined threats and damages.		160 (48.9%) of CAKR sites remain unassessed for threats and disturbances. 72 (22%) have been disturbed by humans or natural forces.
	Percentage of archeological reports and publications entered in the Integrated Resource Management Applications (IRMA) database with appropriate restrictions for access to sensitive information.		There are 37 documents related to CAKR archeology in IRMA. It appears that appropriate restrictions have been applied to the documents. The number of outstanding documents is unknown. Recent efforts to populate IRMA have increased the number of entries. Reports are also archived in the park museum collection.
Certified Condition	Percentage of archeological resources certified as complete, accurate, and reliable in the Archeological Sites Management Information System (ASMIS) in good condition.		10 (3%) of the archeological sites in CAKR are listed in good condition. 182 of 327 (55.7%) sites have all required data.

Cultural Anthropology



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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research is conducted to understand the relationship of the park’s ethnographic resources to the historic context(s) for the park.		Although anthropological research has been conducted in the region by scholars, local residents, and federal/state agencies, the park lacks baseline documentation to assess condition and/or adequate protection of unknown or undocumented ethnographic resources. Completion of a comprehensive Ethnographic Overview and Assessment, with collaboration from other Arctic parks, is a top park anthropology research priority. Ethnographic studies would enhance and inform ongoing archeological field research and traditional ecological studies.
	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 park lacks sufficient baseline documentation of ethnographic resources. Of particular concern is knowledge of sites and resources in areas vulnerable to erosion and other natural and human threats, particularly along coastal areas. Ethnographic studies would enhance and inform ongoing archeological field research.
	Percentage of cultural anthropology baseline documents with current and complete information.		CAKR currently lacks an Ethnographic Overview and Assessment and relies on disparate existing sources as required. The existing traditional use study (Uhl & Uhl 1977) is out of date.
Inventory	Appropriate studies and consultations document resources and uses, traditionally associated people, and other affected groups, and cultural affiliations.		The park should explore Traditional Use/Cultural Affiliation Studies with associated tribes in order to document resources and uses and ensure their consideration in park planning and protection. Efforts should be made to develop collaborative Traditional Environmental Knowledge (TEK) studies with affiliated communities to document traditional knowledge of the environment and natural resources, particularly those related to subsistence lifeways. Each passing year marks the loss of knowledge bearers and elders who can contribute to the documentation process.
	Traditionally associated groups, and the legislative, regulatory, or policy basis for relationships with them, are identified.		Traditionally associated groups have been identified through years of engagement with local communities and organizations and are regularly consulted under Section 106, NAGPRA, and other laws and regulations.

Cultural Anthropology (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Inventory (continued)	Resources eligible for the National Register of Historic Places as traditional cultural properties (TCPs) are identified.		CAKR has not yet identified any TCPs.
Documentation	Planning documents contain current information on traditional resource users and uses, the status of ethnographic data, and the legislative, regulatory, policy, or other bases.		General ethnographic information is included in park planning documents. These documents include discussions of subsistence use, allotments, and other ethnographic information.
	Research results are disseminated to park managers, planners, interpreters, and other NPS specialists and incorporated into appropriate park planning documents.		Limited anthropological research has been conducted by NPS, but those data along with results of independent and pre-park research are shared with management, interpretation, and other NPS specialists. Regional and park-based anthropologists provide expertise in review and development of park planning documents.

Resource Brief: Miniature Whaling Harpoon Head – Pendant or Toy?



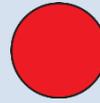
Miniature harpoon head pendant recovered from Agiagruat. This pendant of antler with a brass inset blade demonstrates the rich resources of both land and sea around Cape Krusenstern. Cape Krusenstern National Monument, CAKR 8725. NPS Photo.

from opposite sides and has diameters of 2.3 and 2.6 mm. The blade is at least 1.6 cm long, 2 cm wide, and 0.3 mm thick. It has a sharp point, rounded sides, and is covered by a greenish oxidation. The high level of craftsmanship, the incorporation of a raw material of some economic value, and a lustrous appearance on the surface of the object that may have rested against the body of the individual to whom this object belonged suggests that this miniature is a pendant and not a child's toy (Young 2000).

More than 100 beach ridges along 70 miles of shoreline on the Chukchi Sea provide evidence of 5,000 years of human use, which continues today. Human occupation of Cape Krusenstern spans numerous cultural traditions and changes in subsistence, settlement, and socio-economic organization that occurred throughout the region. The offshore marine environment provided marine mammals including whales and seals in addition to the resources of the arctic terrain. Radiocarbon results place the occupation of the particular house where this artifact was recovered around 1400 A.D., which is believed to be a transitional period in the Kotzebue Sound. Around this time, larger settlements that had focused on whaling began to be replaced by smaller settlements focused on sealing and fishing (Giddings and Anderson 1986).

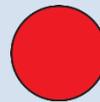
This very small object in the shape of a whaling harpoon head is unique. It has a delicately carved antler head with an inset blade made of a flattened diamond-shaped piece of brass. The entire piece is 3.3 cm long. The closed socketed harpoon head is 1.8 cm long, 0.9 cm wide, and 0.6 cm thick. The object could be strung through the line hole that was drilled through the sides in the same plane as the blade. The hole was drilled

Cultural Landscapes


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research exists to understand the relationship of the park's cultural landscapes to the historic context(s) for the park.		There are no completed Cultural Landscape Inventories (CLIs) for CAKR. The Cape Krusenstern Archeological District CLI is projected to be completed by 2020. Two other identified landscapes with no projected completion date are Cape Krusenstern National Monument (Parent Landscape) and Reindeer Herding Sites (NOA-108; NOA-110).
	Cultural landscapes are identified and evaluated using appropriate historical contexts.		Three cultural landscapes have been identified and none have been evaluated using the park's established historical contexts, regardless of the completeness of the study of each landscape.
	Scope of cultural landscapes in the park is understood and a determination has been made whether or not they are a fundamental or other important resource.		The three identified cultural landscapes in the park remain incompletely scoped and there has not been a determination whether they are fundamental resources or other important resources. Nevertheless, NPS managers, recognizing the special relationship of the landscapes to local people, consult with the I.R.A. Councils, Elders Councils, the City Councils, and the Native Corporations of the villages on a regular basis concerning management issues within the park.
Inventory	Percentage of landscapes eligible for the National Register in the Cultural Landscapes Inventory (CLI) with certified complete, accurate, and reliable data.		There are currently no completed CLIs for CAKR.

Historic Structures


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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.		Shelter Cabin Number 1 and Shelter Cabin Number 2—which are associated with the Mail Carriers/Alaska Road Commission—have been listed on the List of Classified Structures, but lack proper National Register evaluation.

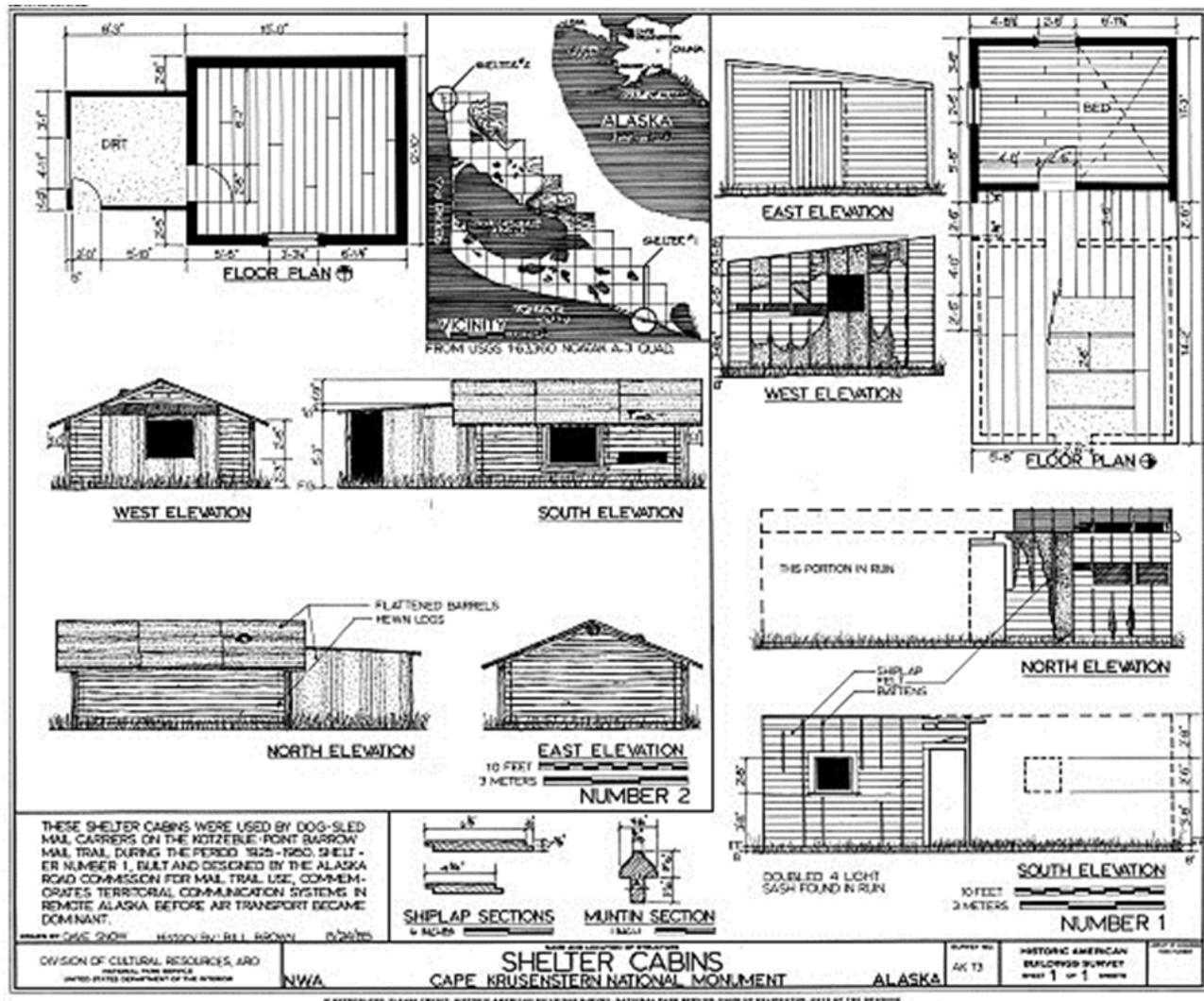
Historic Structures (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge (continued)	Historic structures are identified and evaluated using historical contexts.		Most historic structures have been identified, but not all have been evaluated using historical contexts.
	Scope of historic structures 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 historic structures in the park is not understood and no determination has been made whether or not they are a fundamental or other important resource. The shelter cabins throughout the park need to be evaluated. No Historic Structure Reports exist for CAKR; however, both shelter cabins have Historic Architecture Building Survey (HABS) documentation (HABS AK, 11-Noatak National Preserve).
	Adequate research exists to document and preserve the historic structures' physical attributes that contribute to historical significance.		Adequate research does not exist to document and preserve the historic structures' physical attributes that contribute to historical significance.
Inventory	Percentage of historic structures eligible for the National Register in the List of Classified Structures (LCS) with accurate, complete, and reliable data.		None of the historic structures eligible for the National Register in the List of Classified Structures (LCS) have accurate, complete, and reliable data. Shelter Cabin Number 1 and Shelter Cabin Number 2, which are associated with the Alaska Road Commission, should be evaluated for the National Register.
	Percentage of List of Classified Structures (LCS) data included in the Geographic Information System (GIS) meeting current cultural resource standards.		The structures on the LCS have been documented in GIS, but do not meet current cultural resource GIS standards.
Certified Condition	Percentage of historic structures certified as complete, accurate, and reliable in the List of Classified Structures (LCS) in good condition.		None of the historic structures certified as complete, accurate, and reliable in the List of Classified Structures (LCS) are listed in good condition. Both Shelter Cabins are no longer certified as complete, accurate, and reliable; they are currently listed in poor condition.

Resource Brief: Shelter Cabins

Starting in the early 1900s, the Alaska Road Commission designated a mail route from Kotzebue to Point Barrow. This system carried official scheduled mail to villages and trading posts throughout the northwest coast of Alaska. This service was in effect between 1920s and the 1950s, but was eventually replaced by air transportation (HSR).



Technical drawing documenting the Shelter Cabins at Cape Krusenstern. NPS Photo.

The two shelter cabins at Cape Krusenstern are associated with this mail route. The original shelter cabin has been referred to as Tukrok Cabin and ARC Shelter Cabin No.1. This structure was part of the original mail system and constructed in 1925. Shelter Cabin Number 1 was built with two rooms connected by a hallway. One room is believed to be the kitchen or dog area, and the larger room was most likely the bedroom. The cabin is a 10' x 14' frame building fixed on a 21'6" x 14' platform. The lumber for this cabin was milled and partially prefabricated before arriving to the site (HSR; AHR:CK01; AHR: CK02).

The second shelter cabin is referred to as ARC Shelter Cabin No. 2 and Aitiligauraq. This cabin was necessary later in the 1930s when the smaller villages of the area, once serving as stopping points along the route, joined into the Kotzebue area. It is not clear if this cabin was a preexisting trapping cabin or if it was constructed for the specific purpose of shelter along the route. Shelter Cabin Number 2 was built out of finely hewn logs pegged together with high quality craftsmanship. The cabin is a 15' x 12'10" structure with a shed roof addition (HSR; AHR: CK01; AHR: CK02). Both cabins are under the care of the Cape Krusenstern National Monument, but they are in poor 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.		CAKR lacks a Historic Resource Study. There is a region-wide history of NPS subsistence management for Alaska (Norris 2002) and the book <i>Arctic Citadel</i> (Allan 2013), which focuses on early exploration history in the Brooks Range.
	Sufficient research is conducted to establish the reasons for park establishment and a history of the NPS management of the site.		The park lacks an Administrative History, which would document the complex history of management of the area. The park also lacks a historic theme study, historic resource study, or any other work to inform management or future research endeavors.
Inventory	Cultural resources are inventoried and evaluated in consultation with State Historic Preservation Officers (SHPOs).		The park actively engages and consults with the SHPO on matters related to archeological, ethnographic, and historic resources.
Documentation	Percentage of historic properties with adequate National Register documentation.		There are no National Register Nominations for the historic resources of CAKR. A baseline of needs for National Register documentation has not been developed for this park.
	Percentage of historic properties with adequate Determinations of Eligibility (DOE) documentation.		Only 4 sites (1.2%) of recorded sites in CAKR have been determined eligible for the National Register. No other resources have been evaluated.

Resource Brief: Daily Observations from Sisualik, the Journals of Bob Uhl, 1990–2004

William R. “Bob” Kalluchuk Uhl was born in 1927 in California. His first introduction to northwest Alaska was in 1948 as a member of the U.S. Military. While stationed in Kotzebue, he met and married Carrie Williams. Carrie Williams Qisiliaq Uhl was born in 1922 in Kotzebue, Alaska. For most of her lifetime she lived in remote Alaska, away from town and any public services such as running water or electricity. Her family led a traditional Iñupiaq subsistence-based lifestyle, where they depended on hunting, fishing, and gathering to provide food for themselves and their extended family.

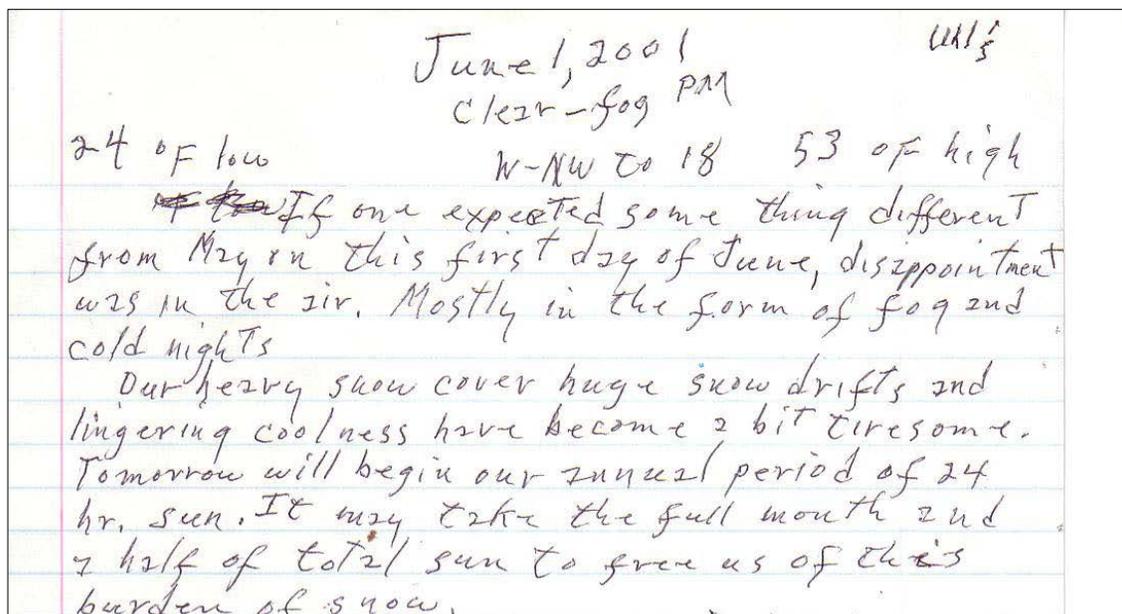
For over five decades, Bob and Carrie Uhl lived in rural camps. Summers were spent in a tent (and later in a tiny cabin) on the beach at Sisualik, where they were able to fish and hunt marine mammals. In the winter, they moved inland to a more sheltered cabin amid the trees at Sanningaruk, where trees provided wood for heat, a stream running under the winter ice provided water, and moose and caribou provided food. Bob and Carrie maintained a subsistence lifestyle at Cape Krusenstern for 54 years—beginning well before the establishment of Cape Krusenstern National Monument in 1980. In fact, they were the last full time residents of the monument.



Bob and Carrie Uhl. Photo by Greg Gusse.

From 1990 to 2004, Bob kept journals of daily observations; these unique accounts provide a wealth of information about weather, climate, flora, and fauna. Bob generously gave permission for the NPS to edit and publish his journals. Bob’s journals provide an invaluable window into a vanishing culture. They also provide a daily, 14-year record of resource observations made by a keen naturalist who spent 54 years observing and documenting the natural processes of the park and the subsistence practices of the resident Iñupiaq people.

The NPS is fortunate to have access to this historic record and is pleased to be able to share it with a broader audience through publications, websites, and even weekly posts to Twitter and Facebook. The information in the journals is valuable to students of both natural and cultural history. Bob’s pithy, charming writing style actually transfers well to 140 character quotes. His zest for recording subsistence living has the potential to inspire nostalgia in older generations of rural Alaskans as well as spark renewed interest in today’s youth.



Excerpt from Bob’s handwritten journal. 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.		The park currently has an adequate amount of research and reports to demonstrate the significance and context of the items in the museum collection; however, the park has the potential for both continued and expanded archeological, ethnological, historical, and natural history studies that would expand understanding.
	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.		CAKR has a current Scope of Collections Statement, signed in 2013, that received great input from the park staff.
	Percentage of museum collection baseline documents with current and complete information.		70% of museum collection baseline documents have current and complete information. Baseline documents currently needed include a Collections Management Plan and a Collections Condition Survey. The Alaska Regional Curatorial Center (ARCC), located in Anchorage, is the official repository for the CAKR museum collection.
Inventory	Archival and manuscript collections are surveyed and described in the Interior Collections Management System (ICMS) and finding aids are produced.		The majority of CAKR's archival collections are surveyed and described in ICMS. All archives for CAKR, and some multi-park archives (that involve CAKR) are listed under a unique directory (NWAK, Northwest Alaska Management Unit). A finding aid is also available.
	Percentage of existing collection that is accessioned and cataloged.		According to the 2015 Collections Management Report (CMR), the percentage of CAKR museum collections accessioned and cataloged is 73%. The backlog of items awaiting catalog addition is comprised of archeology and biology items.

Museum Collections (continued)

[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Inventory (continued)	Scope of Collection is consistently implemented; items or objects are researched to determine their appropriateness for inclusion in the museum/archive collection.		Since 2010, there has been consistent implementation of the Scope of Collections Statement (SOCS).
Documentation	Accession and deaccession files are complete with all appropriate signatures		All accession and deaccession files are complete with appropriate signatures.
Certified Condition	Percentage of museum collection reported in Collections Management Report (CMR) and checklist report in good condition.		<p>Overall the museum collections are in good condition and the storage area is environmentally stable and very secure.</p> <p>94% of the collection cataloged in ICMS is in good condition or better; there are 8,197 records in ICMS with 32% reported as excellent condition and 62% reported as good condition.</p> <p>A Collection Condition Survey will identify and address existing deficiencies, such as the need for rehousing.</p>

2.3. Visitor Experience

Visitor Numbers and Visitor Satisfaction

[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Number of Visitors	Number of visitors per year		The total of 18,225 visitors to CAKR in 2013 is higher than the 8,668 visitors in 2011. The 10-year annual average of visitors for 2003–2012 was 4,872. The park is remote and has no public roads, entrance station, or facilities. Non-local visitors rely on concessionaires for access to the park by aircraft. Visitation numbers are estimates by staff who conduct field work in the park. Counts include outside visitors plus local area residents who travel through the park. Web presence has increased actual visitation in the last 5 years.
Visitor Satisfaction	Percent of visitors who were satisfied with their visit		Park staff does not conduct visitor satisfaction surveys because the park is remote and there is limited ability to gather survey data. However, contact with visitors in the Northwest Arctic Heritage Center, community feedback, and social media suggest that visitors have significant appreciation for wilderness solitude and the effort it takes for a once in a lifetime trip in the park.

Resource Brief: Virtual Visitors

99 Ways to Find Your Park

CAPE KRUSENSTERN NATIONAL MONUMENT



DURATION: 2 minutes, 47 seconds
 DATE CREATED: 2015-08-13
 CREDIT: Julia Schock & Macy Kenworthy

Screenshot from a CAKR video celebrating the “Find Your Park” campaign. NPS Photo.

Cape Krusenstern National Monument is very remote, and it is often challenging for visitors to access and experience this wild land first-hand. Digital media presence is an increasingly effective means by which to reach the American public. Digital media allows the park to provide image-rich interpretation, enabling visitors to get a glimpse of faraway places that are critical parts of healthy ecosystems worldwide. During the summer of 2015, a Student Conservation Association intern created numerous videos highlighting the Western Arctic Parklands. One in particular celebrates the “Find Your Park” campaign for the NPS Centennial in 2016 and features a life-sized woolly mammoth (an iconic, prehistoric resource in the region) in the park. The skill of the videographer, coupled with contemporary, creative ideas resulted in a video that reached 68,055 people.

As of this writing, it has received 17,133 views, 1,092 likes, 53 comments, and 204 shares. Viewers got an unforgettable view of the park resources and the local Alaska Native community, thanks to the mammoth who was “enjoying her national park.” To view the video, [click here](#). “Go Digital” and “Step by Step” are two [Call to Action](#) items that park staff is committed to for the centennial and years beyond.

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		Park rangers go to classrooms to deliver in-person programs at 11 villages in northwest Alaska. K–12 students and their teachers get experiential, curriculum-based programs on science, history, and the mission of the NPS. The 5-year average (2010–2014) is 2,669 students served per year (Western Arctic National Parklands Servicewide Interpretive Report).
Ranger Programs	Number and quality of programs and attendance		Park rangers deliver formal and informal interpretive programs such as a weekly film series, workshops on local medicinal plants, science talks about current research, and impromptu map talks.
Junior Ranger Programs	Number and quality of programs and attendance		Park rangers deliver a unique suite of Junior Ranger program that enable youth to earn rewards by participating in Roving Rangers around Kotzebue, art classes, and completing activity booklets. The 5-year average (2011–2015) is 613 participants per year.
Special Events	Variety and longevity of events, community involvement		Park rangers, along with natural and cultural resource staff, cooperate to deliver special events around the community of Kotzebue and other villages. Events include Subsistence Resource Commission meetings, training, and science workshops. The 5-year average (2011–2015) is 195 participants per year.
Visitor Center	Contacts with park staff in the visitor center		The park makes contacts with visitors who come to the Northwest Arctic Heritage Center for general information, as well as attendees at public meetings coordinated by local groups. Local meeting numbers are stable, but general walk in numbers are down due to the fact that the visitor center building and exhibits need significant repair. A new welcome banner outside and a new Facebook page to highlight public events are in development to increase local visits. The 5-year average (2011–2015) is 4,363 visitors per year.
Community Programs	On and off-site programs in local community		Park rangers and staff cooperate to deliver community programs around the village of Kotzebue and other villages. Events include birdwatching trips, teacher in-service classes, KOTZ radio show, and a 4th of July education booth on current topics such as the Wilderness Act anniversary and bear safety. The 5-year average (2011–2015) is 1,889 participants per year.

Resource Brief: Northwest Arctic Heritage Center

The Northwest Arctic Heritage Center opened its doors to the public in December 2009. Both a winter and spring celebration welcomed the community and state dignitaries. Modern exhibits on cultural lifeways, the Western Arctic Parklands, and natural history bring people in the door to learn more. Many community members in nearby villages volunteered their time to tell stories that are now featured in listening stations (exhibits) for everyone to enjoy. Because the building is virtually the first facility seen after leaving the Kotzebue airport, the Heritage Center attracts nearly everyone who visits the village of Kotzebue. The opportunity to provide high quality interpretive services to all visitors is rewarding.



Northwest Arctic Heritage Center in Kotzebue. NPS Photo.

In addition to interpretive activities for visitors, community groups and other agencies use the facility for select purposes. In 2010, seven conferences from outside entities were held at the center and three events took place that were co-sponsored by the NPS.

Interpretive Media – Brochures, Exhibits, Signs, and Website



[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Wayside Signs	Condition and currency of signs		A landscape plan is currently being designed to provide visitors with a brand new outdoor learning space next to the Northwest Arctic Heritage Center. A select number of CAKR landscape and cultural features will be interpreted on a variety of signs within the ½ acre space. The landscaping and signage will be complete in 2017.
Exhibits	Heritage Center exhibits		<p>Exhibits in the Northwest Arctic Heritage Center are displayed in 3 main spaces.</p> <ul style="list-style-type: none"> Lobby – maps & native tools to orient visitors to the Western Arctic Parklands and indigenous Iñupiaq people. Exhibit Hall – diorama of artwork, landscape features, taxidermy animals, ethnographic stories, and archeological resources to tell the story of regional natural and cultural history. Meeting Room – rotating exhibits on all park resources. <p>Dry air and hard use by visitors is degrading the quality of exhibits in the Exhibit Hall. Vandalism has occurred. Exhibits are functional in the lobby and meeting room. Lighting in all exhibit areas needs repair and replacement bulbs.</p>

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

[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Print Media	Accuracy and availability of primary park publications		Park maps are available at Northwest Arctic Heritage Center and online. Park brochures are accurate, up-to-date, and inventoried. Interpretive staff manages a large supply of other applicable publications, including information about Arctic research and the natural/cultural history of CAKR.
Audio-visual Media	Orientation films		Online videos about specific park resources are growing yearly. No feature length film exists for CAKR yet. Media specialists have been hired yearly for the last 3 years. Park orientation digital slideshows are available for visitors.
	Multi-media development		A bank of 150 films on regional and worldwide conservation issues (with more added every year) exists and is shown to visitors regularly. Rangers give special attention to all locally made films. iPads are available with story maps, park videos, a new Iñupiaq legend video game (called “Never Alone”), and educational applications for kids and adults.
	Local radio spots		Interviews on local radio stations are frequently conducted in conjunction with press releases for special events, changes to regulations, and as other public information becomes available. Many local people listen to the weekly KOTZ radio show.
Websites	Currency and scope of website; number of website visitors		The park website was recently updated for the NPS Centennial. Park staff regularly adds content, and website views are slowly increasing. Poor data speed/ connectivity impede progress, but new high speed fiber-optic cable is anticipated in the future.
	Social media: Facebook updates and “likes,” overall activity		Twitter and Flickr accounts exist for Cape Krusenstern National Monument. A Northwest Arctic Heritage Center Facebook page will begin soon, and will provide up to date information on the Western Arctic Parklands, including CAKR. One blog exists and another will begin soon.

Accessibility


[web](#) ▶

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Mobility	ADA compliance		The park is a remote area managed as wilderness, with no roads, trails, or facilities. Accessibility is challenging for all visitors. An Accessibility Assessment was completed in 2014. At the Northwest Arctic Heritage Center, a ramp provides accessibility to the front door, a wheelchair is available to visitors, and bathrooms are accessible.

Accessibility (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Visual Accommodation	ADA compliance		No signs or facilities exist in the park, so there are no associated visual accommodations. In the Northwest Arctic Heritage Center, subtitles are available for film programs. A braille translation of the park map exists. Park staff plans to increase the Northwest Arctic Heritage Center exhibit visual accommodations based on the Accessibility Assessment completed in 2014.
Auditory Accommodation	ADA compliance		No signs or facilities exist in the park, so there are no associated auditory accommodations. In the Northwest Arctic Heritage Center, assisted listening devices exist for AV programs. A licensed American Sign Language interpreter is available locally by contract if a visitor requests the service. Park staff plans to increase the Northwest Arctic Heritage Center exhibit auditory accommodations based on the Accessibility Assessment completed in 2014.
Multi-lingual Resources	Audio and print materials in multiple languages bi-lingual staff		The park map exists in a Russian translation. Requests for multi-lingual materials at the Northwest Arctic Heritage Center are rare. Park staff plans to increase Northwest Arctic Heritage Center multi-lingual accommodations for more audio and print materials based on the Accessibility Assessment completed in 2014.

Safety


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Visitor Safety	Recordable incidents		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. No visitor injuries due to dangerous facilities or staff negligence have been reported in the Northwest Arctic Heritage Center. Park staff is developing a system for bear barrel loans and are working to address ramp icing at the Heritage Center.
Staff Safety and Training	Completion of required safety training		Because of the remote wilderness setting of the park, specialized training courses are required, including aviation management, wilderness first aid, and firearm safety. Operational Leadership Training has been completed by park staff; new seasonal staff receives training each year; and CPR, First Aid, and AED training are offered to staff on a space-available basis. Job Hazard Analysis is conducted before projects take place throughout the park. Safety messages are regularly given and distributed to staff members and a new safety committee is working to address current safety issues.

Resource Brief: Kotzebue Trade Fair

Drums, dancing, and doughnuts. Crafts, Chukotkans, and competition. Potlucks, performances, and pulls. Fur, food, and fashion. Every two years, a week-long trade fair and festival called Qatnut is held in Kotzebue. It honors the days when people on both sides of the Chukchi Sea gathered at the site of present day Kotzebue to trade things like seal oil, caribou meat, and birch baskets. People from many villages travel many miles to participate.

In 2013, NPS staff helped to make the biannual event a success. The NPS Shared Beringian Heritage Program made a big contribution by funding visa-free travel for 17 Russians to come from Uelen and Larentiya.

The event featured a wide variety of entertainment, including:

- A competition for best regional delicacies (Russian visitors entered fish soup, seal meat, and doughnuts in the competition)
- Dance performances (including a marvelous squirrel dance performed by a Russian-born Kotzebue resident)
- A messenger race and stick pull

Throughout the traditional dancing, games, and art displays, people applauded the competitors and shared traditional food to create a family atmosphere for kindred spirits. The next festival is scheduled for July 2017.



A Savoonga resident passes out muktuk to many people eager for a bite. NPS Photo by Elizabeth Shea.

Partnerships



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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
<p>Volunteers</p>	<p>Number of volunteers and hours contributed</p>		<p>Volunteer numbers (including Volunteers-in-Park and interns) go up every year. In the past 5 years, volunteers have donated 10,630 hours to the Western Arctic Parklands, including CAKR. Volunteers in the park require highly specialized skills to assist rangers and scientists in remote backcountry locations and indigenous communities. Volunteers contribute complex products such as ethnographic stories of traditional skills in the form of video productions (WEAR VIP annual activity & expense report).</p>

Partnerships (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Partnerships	Number of partnerships		<p>Community partnerships are very active, and local groups rent the Northwest Arctic Heritage Center meeting room often. Arctic parks have a strong 16-year relationship with the Northwest Arctic Borough School District. A partnership with Sulianich Art Store provides opportunities for cross-cultural training. Cooperative education programs are planned in with Selawik National Wildlife Refuge and the Alaska Department of Fish and Game. The park hopes to increase collaboration with Borough tourism and local craft experts for increased community workshops. Consultation-related partnerships include:</p> <ul style="list-style-type: none"> • 13 local city governments • Local and regional Native corporations (KIC, NANA) • Northwest Arctic Borough • Permit cooperation with the Alaska Department of Fish and Game • Other federal agencies • State agencies • 13 traditional village councils • Universities • Regional Native non-profit (Maniilaq Association)

Recreational Opportunities

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Sport Hunting and Fishing	Quality of recreational opportunities		<p>Non-local hunters are not allowed to harvest wildlife in the park, but are allowed to fish with an Alaska State fishing license. Arctic char, sheefish, and grayling attract a small number of non-local anglers to the rivers and lagoons in the summer. There are no entrance stations to count visitors, but recreational use is assessed by backcountry ranger patrols, business client counts, and observations by interpreters.</p>
Flightseeing, Hiking/ Backpacking, Floating	Quality of recreational opportunities		<p>Eligible wilderness covers a wide area of the park, so there are many opportunities for solitude, floating, and hiking. Planes can be chartered from several companies to get to areas for hiking and floating. No signs or trails exist, so visitors must navigate on their own and possess wilderness survival skills. Flightseeing tours enable visitors to view natural flowing rivers and unique permafrost features on the landscape. There are no entrance stations to count visitors and no backcountry permits are required.</p>

Recreational Opportunities (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Birding and Wildlife Observation	Quality of recreational opportunities		There are opportunities to see unique Arctic wildlife such as large bird migrations, caribou herds, and even small animals like singing voles. CAKR has large expanses of wetlands that provide good opportunities for birders interested in shorebirds and waterfowl. A herd of muskoxen in the park can be observed and their shed hair can often be seen tangled in the shrubs. Gyrfalcons, rough-legged hawks, and ravens nest on the bluffs of the Igichuck Hills. Planes can be chartered from several companies to access areas for wildlife viewing.

Scenic Resources


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Scenic Views	Scenic view quality & protection		<p>CAKR is notable both for its natural character and its human use. There are five major impairments to the scenic resource quality of the park: (1) marine debris, (2) the Red Dog mine haul road and Port Site, (3) lead and zinc dust, (4) refuse on allotments, and (5) a WWII bulldozed mountaintop with radio repeaters and climate stations.</p> <p>Marine debris accumulates on the beaches and includes a wide variety of human-generated items including fishing gear, plastic, garbage, foam blocks, and tires. The debris originates both from local and international sources. The topography surrounding the haul road and port site is flat and treeless, lacking view breaks that would help them blend into the landscape. The road has regular traffic from ore concentrate haul trucks and service vehicles. The 18-mile road across CAKR and large ore concentrate storage buildings at the port site are visible from a long distance. The roadsides have accumulated visible deposits of road dust that is contaminated with lead and zinc dusts that have escaped from vehicles and mining operations. The condition of the viewshed is obvious on overflights as road and mining operations are well established.</p> <p>Summer residence activities on allotment sites generate refuse that can't be removed easily because the sites are very remote. Two permanent climate monitoring stations have been installed, which may impact the viewshed on a local scale. A former WWII site on top of Radio Hill has a bulldozed gravel road up the mountainside and many acres of land scraped bare. Because the mountain is composed of limestone, only a moderate amount of revegetation has occurred. While these scars do change the natural quality of the site, they are also of historical interest.</p>

2.4. Wilderness Character and Stewardship

The Wilderness Act of 1964 requires the NPS to maintain Wilderness character, including the qualities of being “...untrammelled by man...undeveloped...natural,” and allowing for “...solitude or primitive and unconfined recreation.” A summary of wilderness character for the park is summarized below.

Overall Wilderness Character  web ▶		
Wilderness Quality	Condition Status/ Trend	Rationale
Natural		<p>The natural quality is thought to warrant moderate concern because although CAKR may appear remote and untouched, pollutants affect air and water quality and are found in many of the plants and animals. Sources vary from global deposition brought on winds and with snow and rain, to local sources like the Red Dog Mine. The road to the Red Dog Mine affects movement of caribou (Wilson et al. 2016), and fugitive dust transports heavy metals that degrade the surrounding ecosystem. Contaminants, which have included mercury and other heavy metals, persistent organic pollutants, and excess nitrogen, have the potential to affect the integrity of natural resources and the subsistence uses which rely on clear water and air, unfettered wildlife movements, and intact natural systems (Landres 2015). A former WWII site on top of Radio Hill has a bulldozed gravel road up the mountainside and many acres of land scraped bare. Because the mountain is composed of limestone, only a moderate amount of revegetation has occurred.</p> <p>Perhaps the most prominent and uncertain threat to the natural quality is climate change. CAKR is experiencing melting permafrost, changing vegetation composition, altered weather patterns, and less sea ice. In addition, animals are shifting or expanding their ranges. CAKR is also experiencing increased severity of coastal storms. The tree line may be shifting north with increasing temperatures. The western Arctic has some of the most intact fire regimes in the world, but this too may change with climate.</p>
Undeveloped		<p>The undeveloped quality of the CAKR wilderness warrants moderate concern. Use of aircraft, snowmachines, and motorboats in Alaskan wilderness areas is allowed under the Alaska Native Interest Lands Conservation Act of 1980 (ANILCA). Still, these uses affect the undeveloped quality of wilderness and motorized use represents one of the primary impacts to the undeveloped quality of the Cape Krusenstern wilderness. Motorized use includes use by visitors, commercial operators, scientists, locals, and agencies, including the NPS.</p> <p>Very few developments, exist within this wilderness, and while two administrative structures and small installations do exist, it is within the context of millions of acres of untouched land. For example, Radio Hill is an impacted WWII site that has been decommissioned; while its scars remain, the site is surrounded by untouched land.</p>

Overall Wilderness Character (continued)

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Wilderness Quality	Condition Status/ Trend	Rationale
<p>Untrammeled</p>		<p>Actions that intentionally manipulate, hinder, restrict, or control “the earth and its community of life” are considered trammeling actions. Actions occurring as part of research projects and administrative actions that have foreseeable and substantial impacts on the biophysical environment impact the untrammeled quality of wilderness. At this time, few authorized actions occur within the Cape Krusenstern Wilderness that manipulate wildlife or vegetation.</p> <p>Untrammeled quality is thought to warrant moderate concern. CAKR was home to a WWII installation and is bisected by an industrial road that has been shown to delay migration of caribou (Wilson et al. 2016). That being said, CAKR has large intact areas that have remained largely free from the influence of modern human control and manipulation. Intricate food webs and population fluctuations are largely unchecked by modern human interference, allowing communities to retain their diversity and complexity and find their own balance.</p>
<p>Solitude or Primitive and Unconfined Recreation Opportunity</p>		<p>Opportunities for solitude or primitive and unconfined recreation can be difficult to find as modernization and civilization continue to expand. The quality and presence of these attributes warrant moderate management concern. For example, sights and sounds associated with the Red Dog mining operation diminish these qualities. The sound of mining echoes across the hills, vehicle traffic and dust are prominent, and the patriotically painted storage facilities at the port site can be seen for miles.</p> <p>For the most part, however, visitors to CAKR are highly unlikely to encounter a ranger or other visitors. No permits are required; there are no trails, campsites, or other amenities. Visitors may encounter researchers or a local person, using the land in very different ways than it is used in most other wilderness areas. For some visitors, an encounter with someone using the land for subsistence forges a meaningful connection with and appreciation for the land itself and the human history associated with this place.</p>
<p>Other Features and Values</p>		<p>Archeological sites provide an invaluable record of floral, faunal, and human migration between Asia and North America central to the population of the North American continent. Paleontological sites are accentuated by evidence of Pleistocene mega fauna. These sites and the information they contain about prehistoric floral, faunal, and human migration are endangered by many factors, including rapid coastal erosion.</p>

Wilderness Stewardship


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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Stewardship to Preserve Wilderness Character	Key Information		CAKR lacks fundamental NPS Wilderness documents, including a Wilderness Baseline Assessment and a plan for wilderness character assessment and monitoring. The park held a Wilderness Character Narrative workshop in July 2016, but lacks a complete Wilderness Character Narrative.
	Management Operations		CAKR does not have staff solely responsible for wilderness documentation charged with gathering and synthesizing key information. The park National Environmental Protection Act (NEPA) coordinator and members of the compliance team make efforts to evaluate each project for impacts to natural resources, cultural resources, subsistence, and Wilderness. For example, a Wilderness Minimum Requirements Analysis (MRA) is used for those projects thought to have a moderate or greater impact.
	Status of Plans		The park held a Wilderness Narrative workshop in July 2016. The goal is to complete a Wilderness Narrative in 2016.
	Completed Training		The park has not completed wilderness training for all staff members.

2.5. Subsistence

Overall Condition, Opportunity and Continuity for Subsistence Activities



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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Up-to-date documentation is available about subsistence resources and their uses in communities eligible to harvest resources in the park/ preserve/ monument		<p>CAKR has three primary communities that are affiliated with the park and are heavily dependent on subsistence resources from the park: Kotzebue, Noatak, and Kivalina. These communities have NPS Resident Zone status. Additionally, residents of Deering, Buckland, Selawik, Noorvik, Kiana, Ambler, Shungnak, and Kobuk have NPS Resident Zone status, and some residents of these communities harvest resources from the park. Sharing of subsistence foods with relatives and friends is an important cultural practice, even extending beyond the region.</p> <p>Each of these communities has a baseline comprehensive community household harvest survey. In addition, several communities have more focused surveys related to use of specific subsistence resources, as well as sharing and trading activities. These studies roughly span the last thirty years; many of the more recent studies were completed within the several years.</p> <p>There is also extensive anthropological and historical literature, which provides descriptive information about subsistence resources.</p>
Opportunity and Continuity for Subsistence Activities	Proportion of users who are able to engage in all the subsistence uses they would like to pursue		<p>The opportunity to pursue key subsistence activities is decreasing. This is due to four primary reasons: 1) declines in the biological status of several important wildlife species (caribou, muskox, and moose); 2) reduction in access to resources due to climate change (lack of snow cover for winter travel); 3) a regulatory system that often conflicts with traditional harvest practices; and 4) increasingly higher costs of pursuing subsistence activities (Arctic Council 2009b).</p>
	Subsistence users are engaged in subsistence management		<p>Opportunities exist for local subsistence users to participate in a number of federal and state advisory groups (Federal Regional Subsistence Councils, Local Fish and Game Advisory Committees, and NPS Subsistence Resource Commissions) and special groups established for targeted recommendation (Western Arctic Caribou Herd Working Group, Unit 23 Working Group, and Statewide Sheep Management Group), which make recommendations to the regulatory boards (Federal Subsistence Board and State Boards of Fish and Game).</p> <p>During public meetings, many subsistence users state that they are insufficiently represented in the actual decision-making bodies, and/or they should share decision-making responsibility through some other regulatory structures, such as co-management arrangements (ICC 2014).</p>

Overall Condition, Opportunity and Continuity for Subsistence Activities (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Opportunity and Continuity for Subsistence Activities (continued)	Continuity of Subsistence Uses		<p>There is strong continuity of subsistence uses in outlying villages in terms of resources as well as the cultural systems of beliefs and practices in which those uses are embedded. The most noticeable area of change is in the area of adoption of new technologies such as snowmachines replacing dogsleds, and use of rapid fire firearms. The technology can reshape the harvest patterns.</p> <p>This continuity is somewhat less in regional centers such as Nome and Kotzebue where there is more variety in terms of ethnic and cultural composition of the population. However, the regional centers contain significant components of the underlying culture of the region in which the continuity remains strong.</p>
Harvest of Fish, Wildlife, and Vegetation	Fish Resource Availability		<p>Fish of several species comprise very significant components of the subsistence harvest for all the communities in the region. Overall, fish remain available (Menard et al. 2015).</p> <p>However, changes in run timings of anadromous species and changes in weather patterns that disrupt processing fish harvests, both possibly related to climate change, pose significant concerns for subsistence users. While perhaps not quite at the same level of awareness for many subsistence users, increasing ocean acidification may pose long-range concerns in terms of impacts to fisheries.</p>
	Terrestrial Wildlife Resource Availability		<p>Wildlife species of primary importance for subsistence users in the region are caribou, moose, muskox, and Dall's sheep. Muskox appear relatively stable in the immediate area but overall may be growing and expanding their range. Sheep have drastically declined and caribou have been declining over the past decade. Moose are at the northern limits of their range and tend to remain at a fairly low density. This has resulted in regulatory attempts to lower harvest by shortening seasons, closing seasons, reducing overall estimates of harvestable surplus, and restricting individual harvest by reducing the individual harvest limits and/or reducing the number of harvest permits that are made available. The result is a situation where the availability of important wildlife resources is being reduced for an increasing number of subsistence users (Dau 2013, Schmidt and Gorn 2013). This may also result in increased competition for whatever subsistence resources remain available.</p>

Overall Condition, Opportunity and Continuity for Subsistence Activities (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Harvest of Fish, Wildlife, and Vegetation (continued)	Marine Mammal Resource Availability		<p>Marine mammal resource availability is influenced both by animal populations and by access challenges to hunting these animals. Seals, walrus, and beluga are important subsistence commodities. These animals constitute 60%–80% of the local population’s subsistence harvest (Arctic Council 2009b).</p> <p>Currently, the availability of marine mammal resources is decreasing. Decreased availability is primarily due to deteriorating sea ice conditions—which reduces hunters’ access to the animals—but is compounded by a documented decline in the abundance of marine mammal species. Subsistence users experience difficulty accessing marine mammal hunting areas due to lack of sufficient sea ice; reduced boat access and timing of open water presence both influence hunting opportunities (Aurand and Essex 2012). Timing of sea ice presence has serious implications for when subsistence users can go out, and where animals can be processed (Arctic Council 2009b, ICC 2015). There are also increased safety risks due to ship traffic in the Chukchi Sea.</p>
	Vegetation Resource Availability		Vegetation resources (such as berries and greens) generally remain available, although there have been fluctuations in abundance and/or timing of availability of individual species. Climate change may lead to an increase in these fluctuations, as number of shrubs (including berry-producing shrubs) increases.

Resource Brief: Subsistence as a Way of Life in Northwest Alaska

Subsistence as a Way of Life

Since people first entered Alaska, they have (until very recently) depended upon the harvest of naturally occurring living resources (fish, wildlife and plants) from the land and sea. The majority of Alaska’s rural residents still depend upon these resources. This necessity of hunting, fishing, and gathering has given rise to both an economy and a way of life often referred to today as “subsistence.” Even today, given the increasingly rapid cultural change and globalization, subsistence remains at the core of life for the majority of northwest Alaska’s residents, most of whom are Alaska Natives.

The economic and nutritional importance of wild foods is significant; in 2012, residents of Arctic Alaska harvested 438 pounds per person of wild foods, and residents of Anchorage harvested 17 pounds per person ([ADF&G 2014](#)). The estimated replacement cost of those harvested wild foods ranges between approximately \$44 million and \$88 million ([ADF&G 2014](#)). Wild foods also contributed 280% of the minimum required protein and 39% of the required calories for people in Arctic Alaska, compared to 11% and 2% respectively in the Anchorage area ([ADF&G 2014](#)).

Less apparent is the fact that subsistence is entwined in the broader social and cultural patterns of the rural communities of northwest Alaska. The procurement of wild food helps shape the social organization and structure of a community, as well as its beliefs, attitudes, values, behaviors, and even the mental health of its members. Consider the role and place of an esteemed whaling captain, a skilled caribou hunter who brings in meat enough for many in the community, and a skilled seamstress who can convert caribou skins into clothing items. Elders are respected as repositories of the traditional knowledge that has ensured the survival of families and communities for countless generations.

Resource Brief: Subsistence as a Way of Life in Northwest Alaska (continued)

Subsistence lifestyles are also associated with a holistic view of the world as a system of interrelated elements (including people), held together by behavioral norms of sharing, respect, and mutual obligations.

Subsistence is characterized by a number of distinctive features:

1. it is heavily focused around a strong sense of place; harvesting is largely focused on the resources closer to home when they are adequate to support the group;
2. practices related to the harvesting, processing, distribution and consumption of resources generally take place within the framework of kinship and community ties;
3. cultural practices, beliefs and values related to subsistence are based on tradition, and are transmitted across generations largely by observation and practice supported in the oral traditions of stories, myths, and legends;
4. it facilitates a very detailed knowledge and understanding of the environment of the local area, which is made possible only by very close and sustained contact and interaction with that environment over a very long time;
5. as an economic system, it tends to be marked by efficiency; the methods and means of harvest as well as resource selection tend to favor maximizing the harvest amount while reducing the harvest effort, given the available technology and the characteristics and nature of the resource;
6. it features the utilization of a very wide range of different resources; and
7. it focuses on the community and not on the individual.



Iñupiaq subsistence skills, such as fish cutting, are taught at Camp Sivu. NPS Photo.

The importance of subsistence in the lives of people of and from the region can be seen in the persistence of two behavioral characteristics: (1) the expectation that a young hunter will give his first kill to an elder outside of his own family, thus reinforcing the value of sharing and the role of community provider and (2) the strong need to provide traditional foods to relatives who have left the community for any number of reasons, illustrating the great degree to which traditional foods are a part of who they are as a people.

The activities of subsistence users in northwest Alaska are largely structured around a cycle of biological events that make available for harvest the food resources that are needed by communities. These events include the spring and fall migrations of the Western Arctic Caribou Herd, as well as its distribution on the winter range; the summer runs of salmon up rivers and streams in the region; the spring and fall migrations of key marine mammal resources, such as whales and walrus; the spring and fall migrations of waterfowl; the winter freeze of sea ice, allowing access to polar bears and seals; the spring and early summer gathering of plant greens; and the summer ripening of berries.

The Communities

There are three park units in northwest Alaska centered around Kotzebue: Cape Krusenstern National Monument, Kobuk Valley National Park, and Noatak National Preserve. These parks have eleven closely associated communities (Kotzebue, Buckland, Deering, Kivalina, Noatak, Selawik, Noorvik, Kiana, Ambler, Shungnak and Kobuk) totaling 7,156 people, predominately Alaska Natives (about 89%). Excluding of Kotzebue—the regional center, which has a population of 3,209 people, including about 74% Alaska Native—the communities range in size from Deering (132 residents, about 87% Alaska Native) to Noorvik (668 residents, about 88% Alaska Native) (Population Data: Alaska DCCED 2016). In addition, there are occasionally some residents from outside of the area with customary and traditional use determinations who also seek resources from the parks. These eleven communities are almost entirely located either along a coastal area adjacent to marine waters, or inland and adjacent to major rivers. Because the availability of subsistence resources can vary significantly across both time and space, and because the harvest of resources tends to be locally focused, each community has a distinctive harvest pattern.

Resource Brief: Subsistence as a Way of Life in Northwest Alaska (continued)

Three communities are described here to illustrate the patterning (Harvest Data [ADF&G CSIS 2016](#)):

1. Kotzebue (population 3,209, 74% Alaska Native) is located at the tip of Baldwin Peninsula, which juts out into the Chukchi Sea. A 1991 harvest study found that fish, large land mammals, and marine mammals accounted for 97% of Kotzebue's total subsistence harvest. Fish of several species were the top contributor to the subsistence harvest (just over 40% of total harvest weight). Large land mammals accounted for nearly 30% of total harvest, and marine mammals accounted for nearly 27%.
2. Kobuk (population 151, 90% Alaska Native) is located inland, 151 air miles northeast of Kotzebue on the bank of the Kobuk River. A 2012 harvest study indicated that fish and large land mammals contributed to about 93% of the total harvest. Fish of several species (57% of total harvest weight) were the leading contributors to the subsistence harvest. Large land mammals (predominately caribou with some moose) accounted for just over 36% of the total harvest weight. The same survey estimated that 16,173 pounds of caribou were harvested, compared to 1,936 pounds of moose. This clearly suggests that a resource failure of caribou could adversely impact the community's ability to meet its subsistence needs.
3. Kiana (population 361, just over 90% Alaska Native) is located 51 air miles east of Kotzebue on the bank of the Kobuk River. A 2006 harvest survey indicated that fish of several species contributed to about 53% of the total harvest. Large land mammals accounted for almost 38% of total harvest (caribou at nearly 41,612 pounds compared to moose at 8,629 pounds), and plants provided an important (but quantitatively weak) 4% of total harvest.



Men retrieving seal harvested for various uses including meat, seal oil, and the hide. NPS Photo.

The Future – Challenges

The subsistence way of life will likely face significant challenges in the coming years. The three major threats to subsistence are:

1. *Global climate change.* Climate change may be the greatest long-term threat as ecosystems are transformed, including potentially significant changes in the abundance and distribution of key subsistence resources. In addition, there may be climate-associated difficulties in accessing resources (increased frequency and severity of storms, coastal erosion, thinning ice, longer periods of open water, and reduced snow cover limiting the use of snowmachines). Will people be able to adapt and still maintain a subsistence way of life?
2. *Development.* Development in the Arctic—such as mining, oil and gas development, and increased shipping activity through the Bering Strait—may have impacts from construction, operations, and accidents (ship collisions, groundings, oil spills into key habitat areas).
3. *External Influences.* The increasing influence of external management and regulatory systems that are disruptive or counter to subsistence practices may result in the erosion of the subsistence way of life. One example of this is that most Euro-American harvest limit restrictions in hunting are focused on the individual hunter (one moose per year, five caribou per year) whereas in subsistence-based communities, a relatively small number of hunters may be harvesting enough animals to meet a community's needs.

The challenges faced by subsistence users will be reflected in the challenges park managers also face as they continue to implement Federal Law in the form Public Law 96-487 (ANILCA of December 1980). ANILCA mandates that the NPS provides the opportunity for rural residents engaged in a subsistence way of life to continue to do so in accordance with recognized scientific principles of fish and wildlife management and the purposes for which each park unit was established.

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

- NPS's Arctic Network Inventory and Monitoring Program conducted monitoring in CAKR on vital signs including: muskoxen, brown bears, moose, terrestrial vegetation (including lichen), terrestrial landscape patterns, permafrost, caribou, yellow-billed loons, large lakes, shallow lakes, streams, fire, snowpack, air quality, and weather and climate.
- CAKR completed Shorezone mapping and videography of its entire coastline (including interiors of lagoons and estuaries). The resulting oil spill physical and biological risk maps and logistical aid maps are posted on Shorezone.org. This large project is part of a statewide effort including partnerships with the National Oceanographic and Atmospheric Administration, the Landscape Conservation Cooperative Programs, and the State of Alaska.
- CAKR and Noatak National Preserve partnered with Alaska Department of Fish and Game to complete an expanded survey of the Cape Thompson muskox population. This interagency survey has the largest spatial extent of any survey in the state.
- An aerial brown bear survey was conducted in the lower Noatak River within CAKR and Noatak in 2016; this was the first reliable population estimate for the area in over 20 years.
- CAKR obtained major funding to develop scientific and logistical preparedness for an oil spill. Major projects include:
 - Vessel traffic modeling
 - Community incident preparedness training
 - Ground truthing the U.S. Coast Guard's Geographic Response Strategies for spill response
 - Gathering baseline data on biophysical properties of lagoons and estuaries
 - Studying lagoon fish assemblages
 - Developing a coastal avian synthesis report
 - Studying waterbird/shorebird seasonal use patterns and abundance
 - Mapping of coastal vegetation including sensitive saltmarsh and marine vegetation
 - Studying yellow-billed loon genetics and contaminant burdens
 - Mapping waterbird habitat via remote sensing
 - Updating Coastal Environmental Sensitivity Index
- NPS partnered with the U.S. Forest Service to produce a model of the effects of climate change on the habitat of over 200 species of birds and mammals.
- A team of youth volunteers and staff held a marine debris cleanup in CAKR for a week in July 2015. A total of 22 km of beach was cleaned of fishing gear (ropes and nets), plastic garbage, foam, and other materials.
- Coastal erosion rates from 1950 to present were determined and mapped. Average erosion rates are currently approximately 0.7 m/yr.

Cultural Resources

- CAKR's archival processing has been brought up-to-date. 205 linear feet of archives with a finding aid were produced for all northwest Arctic parks including Bering Land Bridge, Cape Krusenstern, Kobuk Valley, and Noatak.
- In the summer of 2015, the National Park Service collaborated with Alaska Geographic, Bering Straits Native Corporation, Kawerak Incorporated, Carrie McClain Museum, and UAF Northwest Campus to host Nome Archaeology Camp, an opportunity for Alaskan teens to learn more about the heritage of the Bering Straits region through archeological methods, oral history, and museum studies.
- Since 2012, NPS has administered a vulnerability assessment program to identify the most significant and at-risk cultural and paleontological resources on the coast of Bering Land Bridge National Preserve and CAKR. These sites are in danger of being washed away by storm surges that are more and more frequent as the climate changes in arctic waters.
- The NPS financially supported several place name documentation projects in the region during the 1970s and 1990s. For a number of years, NPS staff has been working to identify existing Iñupiaq place names data sets that may be suited for digitization into a Geographic Information System (GIS). Although issues of cultural sensitivities may limit the degree to which the data is distributed and shared, Native communities who created the data will certainly benefit from the consolidation of this type of information into a GIS format.
- In a 2015 study by University of Alaska Fairbanks Anthropologists, interactions between local and non-local caribou hunters were analyzed and linked to traditional Iñupiaq management of access and use of resources. This study examined changes in caribou migration and its effect on local caribou hunting success, which has been perceived to be the result of the interaction with non-local hunters and commercial aircraft operators transporting non-locals.

Visitor Experience

- Artists-in-Residence Susan Watkins, Dean Cully, and Bob Winfree have each contributed a painting or photograph to represent the muskoxen and landscape of the park. All three pieces are on permanent display in the Northwest Arctic Heritage Center.
- High quality video of a muskox sparring match led to the development of a new video that educates the public on muskox behavior. Please enjoy the video at the [park website](#).
- SCA interns created a [video](#) that celebrates the Find Your Park campaign and features a life-sized woolly mammoth in Cape Krusenstern National Monument. 68,055 visitors got an unforgettable view of the park resources and the local Alaska Native community.
- NPS ethnographers recently completed the publication of journals from beloved local elder Bob Uhl. Rangers are highlighting Bob's 10 years of daily wisdom about Iñupiaq culture and the land through quotes from the journals on the CAKR Twitter feed every week. One great example: On this day in 1995, Bob wrote "Had a crane in the soup pot tonight... It was quite fat and quite good." Follow the park on Twitter @CKrusensternNPS.
- An SCA intern put her lifelong interest in anthropology to work by producing a video on an Alaska Native family of builders who created three wooden pieces—2 boats and a dogsled—that are displayed in the Northwest Arctic Heritage Center. The goal is to honor the family's lifetime achievements and help their knowledge of woodworking spark interest in the minds of future builders.
- A team of 30 volunteers and staff mounted a tremendous effort on the Coastal Clean-up Crew for Cape Krusenstern National Monument during summer 2016. They quantified data on all the debris collected on the beaches and categorized objects as foam, plastics, fishing gear, or non-ferrous metals. The results of the surveys are being compiled for a region-wide assessment of marine debris in NPS coastal park units.

Subsistence Use

- NPS continues to work within a regulatory framework to balance subsistence uses with conservation of wildlife populations. The NPS manages one muskox hunt in CAKR and coordinates with the State of Alaska.
- NPS released new regulation changes allowing customary and traditional uses of horns, antlers, and plant materials collected from parklands (Federal Register 2017).
- The Cape Krusenstern Subsistence Resource Commission (SRC) meets twice yearly to discuss regulatory wildlife and fisheries proposals and make recommendations, which may address major topics such as eligibility, access, harvest monitoring, methods and means of taking resources, and research needs. The SRC met in February 2016 to review and discuss the Noatak Fuel Haul Right-of-Way project, hunting and fishing proposals, wildlife survey results and resource reports, the park's General Management Plan, and the park's Hunt Plan. The SRC also met in November 2016 and is scheduled to meet in spring 2017.
- CAKR, in conjunction with the other Western Arctic Parklands, continues to support the Western Arctic Caribou Herd Working Group, which was established to "ensure conservation of the Western Arctic Caribou Herd, safeguard the spiritual and cultural well-being of Alaska Natives and the interests of all users of the herd, and integrate indigenous knowledge with Western Science."
- CAKR, in conjunction with the other Western Arctic Parklands, continues to support and participate in the Unit 23 Working Group, whose goal is to protect subsistence uses and identify and minimize user conflicts resulting from the influx of fall hunters to Game Management Unit 23.
- NPS embarked on a project to investigate whitefish health and seasonal dynamics in and around lagoons in Cape Krusenstern National Monument and the fishery catches of three neighboring communities (including Kotzebue and Kivalina). A key output will be a poster depicting the "Story of the Lagoons" which will be produced in collaboration with the Native Village of Kotzebue.

Wilderness

- CAKR completed the mapping of current wilderness boundaries and calculation of current wilderness acreage.
- Western Arctic Parklands compiled the legislative history of Wilderness in Noatak National Preserve, Kobuk Valley National Park, and Cape Krusenstern.
- CAKR held a Wilderness Character Narrative workshop in July 2016. The baseline document is in draft.
- Western Arctic Parklands have begun to identify future wilderness planning needs.

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

Cape Krusenstern is managed as a unit within the Western Arctic Parklands (WEAR), which protect a northwest Alaskan Arctic landscape of rugged beauty. WEAR includes Cape Krusenstern National Monument, Kobuk Valley National Park, and Noatak National Preserve. Together, these parks represent over 9 million acres of arctic tundra and boreal forest atop permafrost, and large expanses of the Brooks Range, lowlands, and coastal plains. These parklands are well-known for their abundant wildlife including the Western Arctic Caribou Herd (one of the largest caribou herds in North America), brown bears, Dall's sheep, moose, and migratory birds from five continents. Included in these holdings are 300 km of world-class soft-sediment coastlines comprised of fractal-patterned lagoons teeming with waterbirds, salt-marshes, brackish wetlands, and a wide assortment of arctic marine mammals. Established by ANILCA in 1980, these parks not only protect habitat for and populations of fish and wildlife, but also provide opportunities for the continuing subsistence and cultural heritage of the Iñupiaq people who have lived here for millennia.

As the issues of the outside world reach these remote parks, the NPS must adapt. Landscape and ecosystem change driven by climate change is beginning and is likely to catalyze fundamental changes to the appearance and function of these parks. In the future, the NPS may find itself in the incongruous position of managing a boreal landscape set aside to protect arctic tundra and free-roaming caribou herds when they may no longer occur there. The rise of the Arctic shipping industry brings a large set of challenges and risks to coastal and aquatic ecosystems. Managing for subsistence and wildlife amidst this transformation is complex both philosophically and practically.

As the Western Arctic Parklands move forward in changing times, the major management challenges facing these parks include:

- The effects of climate change on ecosystem parts, processes, and services
- Wildlife management
- Current and threatened impacts from outside park boundaries
- Logistical challenges unique to WEAR parks

4.1 Climate-driven Challenges

The Arctic has been warming at twice the rate of the temperate latitudes, which has led to several physical and ecological changes with many more anticipated. Downscaled models ([Rupp and Loya 2009a, b, c](#)) predict that these parklands are expected to experience warming of up to 10 °F mean annual temperature over the next 60 years. Sea ice has retreated to historic lows in both extent and thickness, and researchers predict an ice-free summer Arctic Ocean by 2035. With a changing climate comes a host of current and potential issues requiring adaptation in terrestrial, coastal, and aquatic environments.

4.1.1 Terrestrial

There are myriad changes predicted to occur on CAKR's ecosystem over the coming decades and within the century. The most dramatic of these include:

- Tall shrub increase and the movement of forest into much of CAKR's currently open dwarf and low shrub tundra
- Loss of ungulate lichen winter range and open tundra currently hosting abundant lichen cover types
- Permafrost thaw and degradation of ice wedge polygons
- Increased fire frequency leading to more of the landscape being in an early successional state with fewer lichens
- Increases in winter icing events leading to wildlife winter forage difficulties
- Changes in the composition of wildlife and bird communities with declines in tundra-adapted species and increases in boreal species
- Reduction in the availability of and access to key wildlife species hunted for subsistence by local residents, especially caribou
- Mismatch of migration, forage and pollination timing because of earlier green-up and longer snow-free season

While recognizing that preventing many of these changes is beyond park managers' control, the NPS may consider a suite of adaptations.

Vegetation and Ecosystem Change

Arctic warming has led to the increase of tall shrubs on previously dwarf-shrub tundra throughout the world's arctic ecosystems (Tape et al. 2006). Currently, about a quarter of vegetation plots sampled by the NPS showed modest shrub increase and afforestation since 1980 (Swanson 2013), with changes concentrated in lowlands habitats. A recent vegetation model concluded that a large proportion of WEAR is likely to experience increase in tall shrub cover during coming decades (Swanson 2015). A recent pan-arctic study showed significant ice wedge degradation (Liljedahl et al. 2016) in the circumpolar north and NPS research (Swanson 2013) showed minor degradation on 10% of plots with wedges present.

Future climate scenarios forecast arctic ecosystems that are drastically different from those that occur now (Murphy et al. 2010). Open tundra habitats within CAKR that currently support abundant and diverse lichen communities will likely be replaced by taller shrublands and forests which host far less lichen biomass (Marcot et al. 2015, Walker et al. 2006). Increasing fire frequency is likely to compound this problem. Lichen winter range is the key winter forage for the Western Arctic Caribou Herd and other ungulate species. Without this extensive winter range, herds are more likely to be smaller and spatially isolated as is the case with the herds in interior Alaska.

Potential Adaptation: NPS should consider how to obtain the best predictive data on ecosystem change and develop a suite of possible mitigation strategies. Supporting landcover monitoring and research by the NPS and a broad consortium of partners is a key first step. Promoting discussions on adaptive management of landscape change with stakeholders including local communities, federal and state agencies, and the broader public is quickly rising in importance along with rising temperatures.

Caribou and Habitat

The Western Arctic Caribou Herd is a major subsistence resource for northwest Alaska and reached 490,000 animals in 2003 (Western Arctic Caribou Herd Working Group 2011). The population has declined over 50 percent since 2003. In 2016, the population was estimated at 201,000 animals (Parrett 2016). The heritage, traditions, and subsistence needs of Alaska Natives in approximately 40 local communities have been shaped by the availability of the caribou (Western Arctic Caribou Herd Working Group 2011). The presence and relative abundance of the Western Arctic Caribou Herd has substantial impacts on the populations of wolves, bears, and wolverines in the area. Arctic herds of caribou are known for their large population fluctuations. Although this characteristic of arctic caribou herds is well known by local area residents, it provides little solace when this important subsistence resource becomes scarce.

Available habitat for the Western Arctic Caribou Herd is likely to decline under predicted climate change scenarios (Marcot et al. 2015). Primary forage for caribou includes leaves, grasses, and sedges in the summer and lichen in the fall and winter (Miller 2003). These food sources are likely to decline over the long term, with a warming climate due to tall shrub and tree increase in open tundra communities (Holt and Neitlich 2010, Joly et al. 2009). Lichen winter range may potentially suffer additional decline from more frequent wildfire (Racine et al. 2006). Models investigating the effects of climate and fire on Western Arctic Caribou habitat project a fire-mediated decrease in the extent of caribou winter range and an increase in moose habitat due to a decrease in lichen and an increase in shrubs (Joly et al. 2012). Lichen winter range may also decline due to increasing inputs of nitrogen and sulfur from regional development and shipping (Linder et al. 2013). Caribou are parasitized by blood-sucking insects including mosquitoes, botflies and warble flies. Activity and harassment of caribou by these parasites are correlated with warmer temperatures (Witter et al. 2012). Under severe conditions, these parasites can impact foraging by caribou and impact their fat reserves.

Historically, caribou arrive on the calving grounds and give birth to their calves synchronously in early summer when vegetation is at its most nutritious. Increasingly early green-up may place these cycles out of sync (Post et al. 2008), potentially impacting the energetics and reproductive success of caribou.

Potential Adaptation: NPS should continue to engage with partners to continue to study and manage caribou and their habitat in a changing ecosystem.

Fire

Data suggest that fires are increasing in frequency, extent, and severity in northern Alaska, including those in tundra areas. Fire can exert strong landscape-scale effects on vegetation, wildlife, permafrost, nutrient cycling, carbon storage, hydrology, and water and air quality. In some instances, a repeat fire regime can favor a landscape dominated by early successional vegetation (e.g., grasses and sedges) and reduce the dwarf shrub-lichen tundra components key to ungulate forage.

Potential Adaptation: NPS should continue to consider the implications of fire suppression options in order to save lichen winter range.

Permafrost

Most of the Western Arctic Parklands are underlain by continuous permafrost (soil that remains frozen for two or more years). Under current climatic conditions and projected global climate change scenarios, permafrost is vulnerable to thawing (Jorgenson and Osterkamp 2005). The rate of permafrost degradation is expected to increase and the consequences of this thaw include:

- Thermokarst formation (i.e., subsidence, collapse, erosion, and ground surface instability caused by thawing permafrost)
- Land surface drying (and subsequent ecosystem changes)
- Disappearance of many shallow lakes and formation of a much smaller number of new lakes
- Altered stream flow with increased sedimentation and erosion
- Release of stored carbon, methane, and contaminants (e.g., mercury)
- Formation of thaw slumps (small landslides)

Potential Adaptation: NPS should continue to monitor permafrost and could increase research of thaw-driven landscape change.

Winter Icing Events

Climate projections for northern Alaska predict that winter temperatures will increase by over 35% (Rupp and Loya 2009a, b, c). The combination of greater precipitation and warmer temperatures provides greater potential for icing events following rain-on-snow events or mid-winter thaws. The WEAR parks, including CAKR, have experienced 3–4 thaw-refreeze events/year over the last decade (Wilson et al. 2013). Mammalian herbivores face challenges obtaining adequate winter forage during years with particularly bad winter icing. Winter icing events have increased over the past decade and this trend is expected to continue.

Potential Adaptation: NPS could consider multi-agency partnerships to identify areas less prone to icing events as critical areas for caribou and other wildlife species.

Life Cycle Mismatches

Potential mismatches may occur for caribou and their summer forage, ptarmigan and hare and their camouflage (color camouflage timing problems due to earlier snow melt, Zimova et al. 2014), migratory birds and their prey (van Gils 2016, Clausen and Clausen 2013), and co-occurrence of pollinators and flowers.

Potential Adaptation: NPS could consider multi-agency partnerships to identify the extent of mismatches occurring and projected for caribou and other species.

Wildlife Winners and Losers

A recent modeling effort (Marcot et al. 2015) provided a predictive framework describing how climate change may affect habitat, wildlife species, and ecosystems in the future. With the increase in forest and tall shrub ecosystems and decline in open habitats, 26 mammal species and 68 bird species are expected to face habitat decline and population decrease. Some species, such as moose and boreal forest birds may experience a population increase with better habitat.

Potential Adaptation: NPS should continue to participate in international conservation efforts; this is key to building the network for migratory species, especially birds, facing habitat decline from climate, development, and pollution. Assisted migration has also frequently been proposed as a solution for plants and animals challenged by changing climate and distributional limitations. NPS may potentially be faced with some decisions on assisted migration either as a donor or recipient.

4.1.2 Aquatic

In parallel with changes on the land, CAKR's aquatic resources are expected to change dramatically, presenting a number of management challenges. Shallow lakes and ponds have shown a modest decrease in number and size, a trend expected to intensify. Aquatic habitat for birds will be accordingly reduced. Rivers will warm and become more filled with sediment seasonally, presenting challenges to arctic fisheries. As peat decomposes, it is expected to release nitrogen and mercury into surface waters.

Fisheries

Local residents rely on fisheries for subsistence, particularly chum salmon, sheefish, and several other species of whitefish from lagoons. The thermal and hydrologic regime of aquatic systems in northern Alaska are particularly susceptible to increased temperatures associated with climate change due to the presence of permafrost (IPCC 2013) and the influence of aquatic ice. While warmer temperatures in winter may increase primary productivity and create more winter habitat, they may also change the distribution of fish species. As permafrost thaws, riparian bluffs are likely to erode more quickly; this in turn is likely to introduce new sediment into the streams, which may influence water quality and spawning success. Release of nutrient nitrogen from permafrost thaw may influence the abundance of primary producers, dissolved oxygen levels, and ultimately fish. Ocean acidification is likely to reduce the abundance of carbonate-based plankton that form the base of the food chain for anadromous fish in the North Pacific and arctic Alaska (Healey 2011).

Potential Adaptation: The Western Arctic Parklands do not currently have a fish biologist, but need to work more proactively with other NPS fish biologists and cooperators to develop a robust fisheries program.

Contaminants

Despite their remoteness, northern Alaska parks receive steady inputs of mercury and persistent organic pollutants from global sources. Long-lived fish species occupying high trophic levels such as northern pike, burbot, and sheefish may bioaccumulate certain pollutants. A 2006 survey that included two lakes in Arctic parks (Landers et al. 2008) found that concentrations of methyl-mercury in lake trout in these lakes were higher than recommended for human consumption. Thawing permafrost has the potential to release additional mercury into the environment. Concentrations of the banned pesticide Dieldrin were above advisory levels for fish-eating mammals and birds. Release of nutrient nitrogen from permafrost thaw may influence the abundance of primary producers, dissolved oxygen levels, and ultimately fish.

Potential Adaptation: NPS should continue to monitor fish for toxic substances and communicate advisories with local communities.

Waterbirds

The disappearance of shallow lakes will reduce lake fish habitat as well as the habitat and food for waterbirds. Changes in the abundance and distribution of fish may also influence the abundance and distribution of piscivorous birds. As described above, participation with national and international conservation efforts is paramount.

Potential Adaptation: NPS should consider increasing international cooperation on migratory species.

4.1.3 Coastal and Marine

Shipping and Risks of Oil Spills

The rapid retreat of Arctic Ocean summer sea ice has brought significant changes to the shipping industry, and, as such, to the challenges of protecting sensitive coastal areas. The southern Chukchi Sea (just north of the Bering Strait) is poised to become one of the most crucial and highly used waterways in the world. The Bering Strait is the only connection from the Pacific Ocean into Arctic waters and ultimately to northern Europe and Canada. The Northern Sea Route to Europe and North America from Asia is now in use by cargo ships and fuel tankers, and there is projected to be a 13-fold increase in daily traffic by 2017 from 2009 transit estimates ([Arctic Council 2009](#)). Transit shipping traffic has increased exponentially at the Port of Nome since 2010 (Harbormaster, pers. comm.). Arctic shipping lanes through the Chukchi Sea are adjacent to Cape Krusenstern National Monument. Reductions in sea ice leave the northern sea routes open for longer periods into the late fall, increasing shipping vulnerability to late fall storms. In addition to transit traffic, local marine shipping is also projected to increase in order to support oil development and exploration, industrial development and expansion, and growing communities in north and northwest Alaska ([U.S. CMTS 2013](#)).

As shipping traffic increases, so does the risk of spills and vessel incidents. Given the rise in demand for infrastructure to support burgeoning demand, the Army Corps of Engineers has been conducting site assessments for a new deep water port to support trans-Arctic vessel traffic with two of the three potential siting options located in the general area. Preparing for a coastal incident has become one of the top management priorities for WEAR. Other key issues associated with shipping traffic increase are: dumping and vessel-related pollution in the Chukchi and Bering Seas; collisions with marine mammals; disturbance of communication and migration routes for marine mammals and fish due to undersea vessel noise pollution; potential decrease in subsistence marine mammal resources. The advent of cruise ship tourism also means that vessels will be hugging the shoreline to get a glimpse of wildlife and the landscape. These nearshore routes (and possible land deployments via small craft) mean greater risk for incidents and disturbance.

Potential Adaptation: The Western Arctic Parklands should continue to gather baseline data on lagoons and shorebirds, and ground-truth the proposed logistics of spill response in sensitive habitats. WEAR should also engage with the cruise ship and shipping industries on marine transit routing and cruise ship standards of care to reduce risks of a coastal incident. WEAR should also continue to partner with cooperators on marine mammal abundance, distribution, behavior, and ecology in Kotzebue Sound.

Coastal Erosion

Rates of coastline erosion in CAKR have increased from 0.2 m/yr (the long term average) to 0.7 m/yr over the past decade. Sand bars adjacent to the closed lagoon systems and upland bluffs are eroding most rapidly. The later onset of shorefast ice in the fall has exposed the coastline to powerful fall storm surges. The village of Kivalina is threatened by coastal erosion and their landfill is routinely overwashed, which has contributed marine debris to the southern Chukchi Sea. Coastal erosion has also eaten into private land allotments and claimed structures that people depend on for subsistence hunting. Coastal erosion washes away archeological sites and also directly impacts beaches, nearshore ecosystems, and terrestrial habitat. Release of sediment and organic carbon alters nutrient fluxes in nearshore marine and lagoon ecosystems (Jorgenson and Brown 2005).

Potential Adaptation: NPS should consider adaptive management to mitigate the impacts of erosion on allotments and structures. NPS also has a continued interest in working with affected villages to find solutions to coastal solid waste containment.

Loss of Cultural Resources

As the coastal zones and interior watersheds in WEAR are systemically impacted by erosion, an important record of human land use and migration across Eastern Beringia (14,000+ years ago) is being erased at an unprecedented rate. Landscape erosion along coastal beaches, bluffs, and river banks may accelerate with storm surge events, high spring floods, thawing permafrost, and dune deflation.

Potential Adaptation: Although poorly funded, the Western Arctic Parklands are currently conducting an inventory to identify the parks' most significant and at-risk cultural and paleontological resources along the parks' coasts and interior watersheds. This effort will aid park managers in understanding threats to these resources, and help them develop survey and mitigation priorities. WEAR needs to explore other potential partnerships as rapidly as possible to assist in this endeavor.

4.1.4 Subsistence

CAKR was created in part to provide for subsistence opportunity for local residents. A large fraction of subsistence harvest in the Kotzebue Sound region is represented by marine mammals, most notably several species of ice seals. Local hunters report that conditions on the sea ice are much more dangerous than in past years due to a thinned ice pack, and that the windows of hunting opportunity are far less than in the past (NOAA 2012). Whitefish, including the locally endemic sheefish, are a key subsistence resource for local communities (Georgette and Shiedt 2005). Coastal erosion as a result of climate change has the potential to alter the coastal subsistence fisheries for whitefish, because new dynamics of lagoon breaching will alter overwintering patterns of whitefish (Whiting et al. 2011). Local fishermen have observed the loss of “countless numbers” of whitefish in some areas of Kotzebue Sound, emphasizing the need to understand factors driving such perceived declines. Furthermore, increases in shipping and development in the region have increased risks of oil spills and coastal modification due to activities such as: maritime transport associated with oil and gas activities, consideration of deep-water ports in the region, and international shipping along the Northern Sea Route.

On land, subsistence opportunity for caribou is likely to face increasing hardship as the herd numbers have dropped over 50% from approximately 500,000 and the Western Arctic Caribou Herd is likely to face habitat constriction due to changing vegetation. The Western Arctic Caribou Herd’s annual migration south after the summer calving is the time at which local residents harvest caribou. The timing and pathways of migration have changed over the past decade, which has led to much more hunting uncertainty and has created the potential for conflict over sport hunting closure dates to protect subsistence opportunity.

Potential adaptations: NPS subsistence managers should continue to be regularly engaged with local communities and advisory groups to discuss adaptation to climate change.

4.2 Wildlife-related Challenges

Protecting habitat for and populations of fish and wildlife is a central tenet of ANILCA. ANILCA also protects resources related to subsistence needs; provides for subsistence use by local residents in Cape Krusenstern; and provides for non-consumptive uses including recreation in all park units.

Wildlife management in the park must balance the multiple uses provided for by ANILCA within the resource management framework unique to parks created by ANILCA. Like other park units in the nation, the Western Arctic Parklands are overseen by a Superintendent; national parks in Alaska, however, also include management that involves local stakeholders.

As per ANILCA, wildlife management in the parks as it relates to subsistence includes involvement of local residents and Native Alaskans through Regional Advisory Councils (RACs) and Subsistence Resource Commissions (SRCs). RACs are composed of residents of the region and provide a forum for expressing opinions, making recommendations, evaluating proposed regulations, and participating in decisions related to subsistence uses of fish and wildlife within the region. CAKR falls under the purview of the Northwest Arctic RAC.

4.2.1 Wildlife Management Challenges

There are several important challenges to wildlife management in WEAR parks. The parks lack data on wildlife populations that are critical to meeting ANILCA’s mandates of protecting habitat for and populations of fish and wildlife, providing for subsistence, protecting resources related to subsistence needs, and providing for non-consumptive uses. Aerial surveys and monitoring are conducted for moose, brown bears, and Dall’s sheep to determine population trends over time. Aerial surveys alone, however, do not provide information on movement, demographics, and habitat use that are key to managing populations. This lack of data leaves the parks unable to appropriately respond to proposed State and Federal wildlife regulatory proposals that affect park wildlife resources, including the management of predators. WEAR lacks critical wildlife data primarily because of the lack of funding for wildlife studies. Although, the parks are highly visited, especially by local residents, the parks do not generate user fees. For many parks, user fees help fund wildlife and other projects. Also, WEAR parks compete for wildlife funding from a limited pot of money with other parks that are able to fund projects from visitor fees.

Additional challenges stem from divergent park uses including subsistence hunting and gathering, recreational boating, and wildlife watching. Some of these uses can be at odds with others, which presents management challenges of mitigating the effects of these activities on park resources as well as the impacts of the different user groups on each other’s activities.

Other challenges relating to wildlife management are appropriate staffing to provide for the logistics of permitting of hunts and enforcing of wildlife regulations over the >9 million acres comprising the WEAR parks.

Potential Adaptations: WEAR parks could advocate for the need to secure funding for wildlife projects in order to better respond to proposed wildlife actions and to protect habitat for and populations of fish and wildlife. To better fund wildlife projects, WEAR could point out the inconsistency of non-fee based parks competing with fee-based parks for limited funds of money.

4.2.2 Key Species-specific Challenges

Brown Bears

Important information gaps exist for brown bears in the Western Arctic Parklands, including CAKR—reliable population estimates, movements, demographics, and habitat use information have not been produced in over 20 years. As of this writing, there are five wildlife proposals under consideration by the Alaska Board of Game to facilitate or increase bear harvest in Game Management Unit 23, of which CAKR is a part. A significant management challenge is for the Western Arctic Parklands to respond to these proposals without data. Most brown bears in Unit 23 are harvested out of the Noatak drainage; impacts of the Red Dog Mine have caused den abandonment and direct mortality ([Ayres 1991](#)), and future pressures include nearby mining prospects, plans to develop a wind farm along the Delong Mountain Transportation System (DMTS), and a proposed road from Ambler to the DMTS. During the last 20 years, the Arctic has warmed, leading to phenological changes, and the commercial salmon fishery has declined causing more salmon to reach spawning areas far inland; both of these factors may have changed bear habitat use. Residents of Unit 23 report seeing more bears, suggest bears are contributing to the decline of the Western Arctic Caribou Herd through predation, and consider bears a nuisance or threat. Brown bears are a NPS Arctic Network Vital Sign; five parks are slated for population census via aerial survey once every 4–5 years. A population estimation method and an occupancy modeling approach was developed and employed in the lower Noatak River drainage including Noatak National Preserve and CAKR in May 2016; data are being finalized and analyzed. Aerial survey data, however, cannot provide information about habitat use, movements, demographics, or whether parks are acting as population sources or sinks.

Potential Adaptations: NPS should conduct studies of habitat use, movements, demographics, and predation to better inform wildlife management decisions related to bears, their prey, and potential mitigations of human-bear conflict.

Caribou

Caribou present a management challenge for the Western Arctic Parklands due to their importance for subsistence hunting, cultural continuity for Iñupiaq people, and sport hunting. During the mid-1970s the population reached an all-time low of 75,000 caribou ([Dau 2011](#)), but then steadily increased to 490,000 animals in 2003 ([Dau 2011](#)). The Western Arctic Caribou Herd is currently at the low end of its population cycle. Since 2003 the herd has declined over 50 percent and now numbers 201,000 animals ([Parrett 2016](#)). Residents of Unit 23 report seeing more bears and wolves, suggest bears and wolves are contributing to the decline of caribou through predation, and consider these predators a nuisance or threat. In general, however, the health and success of the various caribou herds in the region is stable, with some natural fluctuation.

The Western Arctic Caribou Herd moves fluidly across the boundaries of many jurisdictions and harvest and management requires involvement of many groups. Because of the importance of the herd as a resource, the Western Arctic Caribou Herd Working Group (WACH WG) was established to “ensure conservation of the Western Arctic Caribou Herd, safeguard the spiritual and cultural well-being of Alaska Natives and the interests of all users of the herd, and to integrate indigenous knowledge with Western Science” ([WACH WG 2011](#)).

Potential Adaptations: NPS should continue to support the work of the WACH WG and ensure that staff is involved in research and monitoring studies of the Western Arctic Caribou Herd that will inform management decisions related to caribou and their habitat.

Muskoxen

Muskoxen represent a unique conundrum for managers. Once common in Alaska, muskoxen were heavily hunted and extirpated from Alaska by the mid- to late-1800s (Lent 1988, Allen 1912). Muskoxen were reintroduced to Alaska in 1935 and now occur in Noatak National Preserve and Cape Krusenstern (Gunn and Forchhammer 2008, ADF&G 2016b). As a result of their extirpation, several generations of Iñupiaq people did not experience hunting muskoxen and living on the landscape with them. Key management issues include establishing an allowable harvest for muskoxen and engaging the State of Alaska in population management. There has been increased interest in expanding subsistence hunting opportunity in the Cape Thompson population that inhabits CAKR and Noatak. Also, recent concern about the overharvest of adult bulls and subsequent declines in muskoxen populations (Schmidt and Gorn 2013) has highlighted the need for more frequent and precise estimates of abundance and sex and age composition of the population. Since 1988, population estimates and composition surveys have been conducted on the Cape Thompson muskoxen population in what is called the “core area” in and adjacent to CAKR. Since 2004, the Cape Thompson population declined in the core area or shifted eastward into what has been called the “expanded area” in Noatak National Preserve (Schmidt and Westing 2011). To investigate this in 2011, the NPS and the Alaska Department of Fish and Game conducted an aerial survey of an expanded area—encompassing the whole Cape Thompson population—and found that at least half of the population resided in the expanded area. This survey was repeated in 2016, and the results showed that the population in the expanded area did not significantly change in size between 2011 (576 animals) and 2016 (556 animals) (Schmidt et al. 2016). When looking at the data from 1988 to present in the core area, it appears the population declined from a high of about 370 animals in 2005 to around 220–230 animals in 2011 and has stabilized at that level. The proportion of adult males to females within the core population and in CAKR, however, decreased between 2011 and 2016, which gives managers pause for thought when managing muskoxen harvest in this area.

Potential Adaptations: Continue aerial population and composition surveys of muskoxen. Encourage the State of Alaska to determine a total allowable harvest for muskoxen and to coordinate management of harvest. Thereafter, develop a management plan for the Western Arctic Parklands.

Moose

Moose occur in all of the Western Arctic Parklands, but calf recruitment and population numbers are low throughout much of Unit 23 (Westing 2012), of which CAKR is a part. Of the WEAR park units, moose abundance is generally highest along the Kobuk River downstream (west) of Kobuk Valley National Park. Sport hunting is prohibited in CAKR and Kobuk Valley National Park, but subsistence harvest and predation remain a significant source of mortality. Management challenges for moose include better understanding which factors—other than predation and harvest, such as browse condition—may contribute to population declines.

Potential Adaptations: NPS should continue aerial population and composition surveys and conduct studies of range condition to look at factors other than predation and hunting that might be limiting moose populations.

4.2.3 Wildlife Conflict

Wildlife, in addition to being important resources for subsistence, can be the source of conflicts with local residents. Addressing wildlife conflicts in a non-lethal way is a management challenge for the Western Arctic Parklands. For example, local residents believe that there are numerous bears in Game Management Unit 23. Local residents have reported bears damaging cabins, bears taking fish from drying racks, and a general concern for human safety. People have also expressed concerns over wolves becoming more brazen near villages and more numerous in general. Muskoxen also present challenges resulting in conflicts with residents. For example, muskoxen knock over grave markers and trample graves while they attempt to rub on grave markers. Additionally, residents report feeling intimidated by muskoxen while berry picking.

Potential Adaptations: NPS should convene a wildlife conflicts working group that includes participation from and solicits input from various agencies and local groups. WEAR could develop a plan on how it will manage conflicts on parklands in cooperation with other agencies.

4.3 External Challenges

A number of current impacts and future threats to CAKR's natural resources come from external sources including mining, air pollution, marine debris, introduction of invasive species, and illegal activity. Red Dog Mine has a congressionally-granted 18 mile road easement through Cape Krusenstern for the transport of lead and zinc concentrates. This activity has resulted in the release of heavy metal-containing fugitive dusts into the environment over many years. As a result, lichens have been killed alongside the road and reduced out to approximately 2 km on either side of the road (Exponent 2007a, b). Following the findings of elevated contaminant levels in CAKR, Red Dog invested considerably in dust control measures, and subsequent measurements have shown improvement. The next round of contaminant and lichen remeasurements in CAKR is in 2017. There have been a significant number of spills along the haul road including a release of 8,000 gallons of diesel fuel and lead and zinc concentrate spills. These have been successfully cleaned up; however, scars from cleanup excavations remain and are in various states of recovery. Some may not return to native conditions in the foreseeable future. Recent research has also shown delay of caribou migration in the vicinity of the haul road.

Other emerging threats include proposed mining, likely increase in regional pollution, increased shipping and traffic through the Bering Strait, increase in marine debris, increased potential for invasive species, and ongoing illegal activity including looting of archeological and paleontological resources, poaching, and wanton waste. Regional pollution throughout northwest Alaska is likely to increase significantly as both shipping and onshore oil development (in National Petroleum Reserve – Alaska) increase. Marine debris from local and international sources has also been increasing and poses threats to wildlife and food safety. An increase in international vessel traffic is likely to bring an increase in trash, derelict fishing gear, and release of foreign marine species. Locally, some low-lying communities are struggling to contain solid waste as coastal erosion and high storm surges increase, and landfilled materials are increasingly being swept out to sea. While invasive species are not yet an issue, terrestrial and aquatic invasive species have been reported in Alaska and there are obvious potential vectors into the parks. Finally, there is a great deal of collection of Pleistocene fossils (e.g., mammoth remains) and human artifacts in the region and NPS suspects that materials are being illegally removed from park lands.

4.4 Logistical Challenges

Working in the Arctic presents unique logistical challenges. Fieldwork in these remote, roadless parks requires access by boat or plane and is hampered by high costs of supplies, poor weather, and lack of infrastructure. The Western Arctic Parklands are understaffed and struggle with high staff turnover, difficulty hiring local residents (due to low federal wages compared to the high cost of living in Kotzebue), lack of housing, and slow telecommunications. Parks have started to test creative arrangements for basing certain operations (e.g., aviation management, law enforcement, science, administration) more centrally in Alaska, which may help WEAR and other remote Alaska park units.

Potential Adaptation: NPS should continue to explore shared employee arrangements, basing more logistical services from NPS primary hubs, and other creative solutions to high staff turnover.

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

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See Also:

[Collection of Natural Resource-Related References](#)

[Collection of Cultural Resource-Related References](#)

[Collection of Visitor Experience-Related References](#)

[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)	Law enacted by the federal government that includes 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.
Arctic Network (ARCN)	One of 32 I&M networks established as part of the NPS Inventory and Monitoring Program . The Arctic Network provides scientific data and expertise for natural resources in five parks located in Alaska.
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.
Climate Friendly Park	The NPS Climate Friendly Park designation requires meeting three milestones: completing an application; completing a comprehensive greenhouse gas (GHG) inventory; and completing a Climate Action Plan, which is the actions, policies, programs, and measures a park will put into place to reduce its GHG emissions.
Cultural Landscapes Inventory (CLI)	A Cultural Landscapes Inventory describes historically significant landscapes within a park. The inventory identifies and documents each landscape's location, size, physical development, condition, characteristics, and features, as well as other information useful to park management.
Cultural Landscape Report (CLR)	A Cultural Landscape Report is the principal treatment document for cultural landscapes and the primary tool for long-term management of those landscapes. It guides management and treatment decisions about a landscape's physical attributes, biotic systems, and use when that use contributes to historical significance.
Curation	National parks are the stewards of numerous types of objects, field notes, publications, maps, artifacts, photographs, and more. The assemblage of these materials comprises a museum collection. Curation is the process of managing, preserving, and safeguarding a collection according to professional museum and archival practices.
Exotic Plant Management Team (EPMT)	One of the ways the NPS is combating invasive plants is through the Exotic Plant Management Team Program. The program supports 16 Exotic Plant Management Teams working in more than 225 park units. EPMTs are led by individuals with specialized knowledge and experience in invasive plant management and control. Each field-based team operates over a wide geographic area and serves multiple parks.
Facility Condition Index (FCI)	FCI is the cost of repairing an asset (e.g., a building, road, bridge, or trail) divided by the cost of replacing it. The lower the FCI number, the better the condition of the resource.

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.
National Historical Park (NHP)	Historic areas in the National Park System that have great physical extent and complexity. NHPs are automatically listed on the National Register of Historic Places.
National Historical Landmark (NHL)	National Historic Landmarks are nationally significant historic places designated by the Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United States. Today, fewer than 2,500 historic places bear this national distinction.
National Natural Landmark (NNL)	The National Natural Landmarks Program recognizes and encourages the conservation of sites that contain outstanding biological and geological resources, regardless of landownership type. It is the only natural areas program of national scope that recognizes the best examples of biological and geological features in both public and private ownership.
Native American Graves Protection and Repatriation Act (NAGPRA)	A federal law passed in 1990. NAGPRA provides a process for museums and federal agencies to return certain Native American cultural items (e.g., human remains, funerary objects, sacred objects, objects of cultural patrimony) to lineal descendants and culturally-affiliated Indian tribes and Native Hawaiian organizations.
Natural Resource Condition Assessment (NRCA)	A synthesis of existing scientific data and knowledge, from multiple sources, that helps answer the question: what are current conditions of important park natural resources? NRCAs provide a mix of new insights and useful scientific data about current park resource conditions and factors influencing those conditions. NRCAs have practical value to park managers and help them conduct formal planning and develop strategies on how to best protect or restore park resources.
Priority Resource or Value	This term refers to the Fundamental and Other Important Resources and Values of a park. These can include natural, cultural, and historic resources as well as opportunities for learning, discovery, and enjoyment. Priority Resources or Values include features that have been identified in park Foundation Documents, as well as other park assets or values that have been developed or recognized over the course of park operations. Priority Resources or Values warrant primary consideration during park planning and management because they are critical to a park's purpose and significance.
Project Management Information System (PMIS)	A servicewide intranet application within the National Park Service to manage information about requests for project funding. It enables parks and NPS offices to submit project proposals to be reviewed, approved, and prioritized at park units, regional directorates, and the Washington Office.
Resource Management	The term "resources" in NPS encompasses the many natural, cultural, historical, or sociological features and assets associated with parks. Resource management includes the knowledge, understanding, and long-term stewardship and preservation of these resources.
Specific Measure of Condition	One or more specific measurements used to quantify or qualitatively evaluate the condition of an Indicator at a particular place and time. There may be one or more Specific Measures of Condition for each Indicator of Condition.
Visitor and Resource Protection (VRP)	VRP includes, among other responsibilities, protecting and preserving park natural and cultural resources, enforcing laws that protect people and the parks, fire management, search and rescue, managing large-scale incidents, and on-the-ground customer service.

Volunteers In Parks Program (VIP)	The Volunteers In Parks Program was authorized by Public Law 91–357 enacted 1970. The primary purpose of the VIP program is to provide a vehicle through which the National Park Service can accept and utilize voluntary help and services from the public. The major objective of the program is to utilize this voluntary help in such a way that is mutually beneficial to the National Park Service and the volunteer. Volunteers are accepted from the public without regard to race, creed, religion, age, sex, sexual orientation, national origin, or disability.
Western Arctic Parklands (WEAR)	WEAR is a group of 3 remote, Arctic National Park units managed by one team. WEAR includes Cape Krusenstern National Monument, Kobuk Valley National Park, and Noatak National Preserve. Before 2016, the group also included Bering Land Bridge National Preserve, which now has its own dedicated staff.
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 .