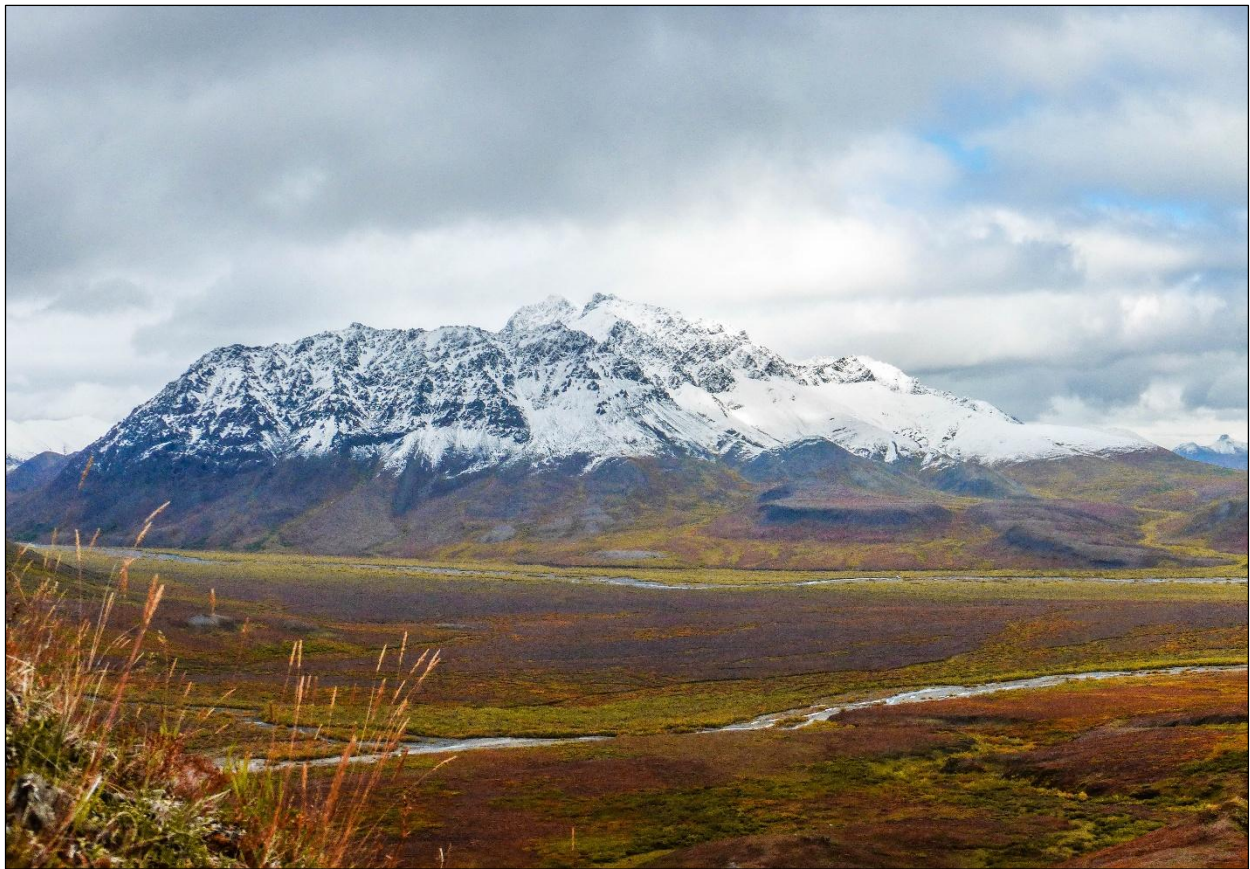




Noatak Wilderness Character Baseline Assessment

Building Blocks for Wilderness Stewardship

Natural Resource Report NPS/NOAT/NRR—2015/979



ON THE COVER

Photograph of Copter Peak, Noatak National Preserve.
Photograph by Nyssa Landres, National Park Service.

Noatak Wilderness Character Baseline Assessment

Building Blocks for Wilderness Stewardship

Natural Resource Report NPS/NOAT/NRR—2015/979

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June 2015

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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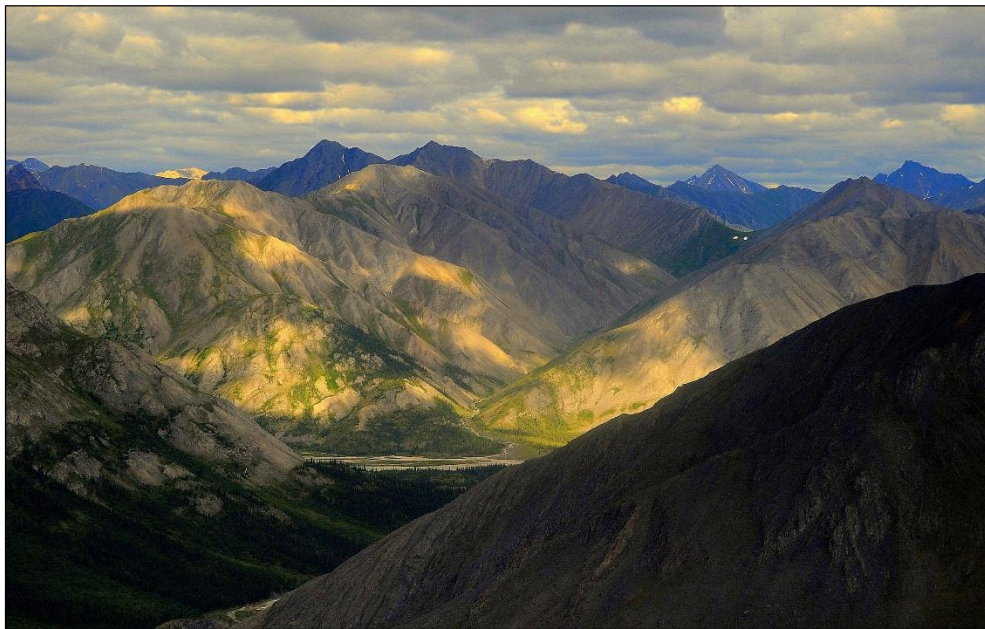
Executive summary

This report is the baseline assessment of wilderness character for the Noatak Wilderness. The intent of the assessment is to facilitate a comprehensive understanding of a) the key features of the Noatak's wilderness character, and b) how the wilderness character of the Noatak is changing over time. Together, this information provides a holistic understanding of the Noatak Wilderness and what sets it apart from other public lands, and other wilderness areas, nationwide.

This baseline assessment defines 20 measures of wilderness character that will be used to monitor change in the wilderness character of the Noatak into the future. For each of these 20 measures, the measures' relevance to the wilderness character of the Noatak is described, as are specific monitoring protocols to assure consistent monitoring methods over time. The measures were identified based on national guidance, and selected at the local level through a collaborative and iterative process with preserve staff.

The legislative mandate of the Wilderness Act of 1964 is to preserve the wilderness character of the area, a mandate affirmed in National Park Service policy. To inform how wilderness character is changing over time, this report specifies the current status of the measure, as well as the trend in each measure since the designation of the Noatak Wilderness in 1980. Overall, wilderness character across the Noatak Wilderness has had a downward trend since 1980. An in-depth summary and discussion of the trends in wilderness character since designation for each quality of wilderness character is described in the Conclusions section of this report.

This report is intended to serve as a standalone document to assist in ongoing wilderness character monitoring for the Noatak Wilderness. Ultimately, the purpose of this baseline assessment is to help improve wilderness stewardship and preserve the area's wilderness character.



Imelyak River headwaters. Photo by Ken Hill, NPS.

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Thank you all for your contributions and support.



Fall colors near unnamed lake. Photo by Jon McDonagh, NPS.

List of Acronyms

ADF&G – Alaska Department of Fish & Game
AKEPIC – Alaska Exotic Plants Information Clearinghouse
ALD – Active layer detachment
AMS – Asset Management System
ANCSA – Alaska Native Claims Settlement Act of 1973
ANILCA – Alaska Native Interest Lands Conservation Act of 1980
ARCN – Arctic Network Inventory & Monitory Program
ASMIS – Archeological Sites Management Information System
BELA – Bering Land Bridge National Preserve
BHIMS – Bear-Human Incident Management System
BLM – Bureau of Land Management
EIS – Environmental Impact Statement
CAKR – Cape Krustenstern National Monument
CFR – Code of Federal Regulations
CUA – Commercial Use Agreement
EA – Environmental Assessment
FBMS – Financial and Business Management System
FS – Forest Service (U.S. Department of Agriculture)
FSB – Federal Subsistence Board
FWS – U.S. Fish and Wildlife Service
IRMA – Integrated Resource Management Applications Portal
GIS – Geographic Information System
GMU – General Management Unit
GPS – Global Positioning System
KOVA – Kobuk Valley National Park
MHIMS – Musk Oxen-Human Incident Management System
MRA – Minimum Requirements Analysis
MRLC – Multi-Resolution Land Characteristics Consortium
NADP – National Atmospheric Deposition Program
NEPA – National Environmental Policy Act of 1979
NIFC – National Interagency Fire Center
NLCD – National Land Cover Database
NOAT – Noatak National Preserve
NPS – National Park Service
NWPS – National Wilderness Preservation System
OAS – Office of Aviation Services
RTS – Retrogressive thaw slump
SUP – Special Use Permit
WCMD – Wilderness Character Monitoring Database
WCM – Wilderness Character Monitoring
WEAR – Western Arctic National Parklands
WFMI – Wildland Fire Management Information

Introduction

The Wilderness Act of 1964 (16 U.S.C. § 1131) was passed by a nearly unanimous vote in the United States Congress to protect natural lands from the threats of “expanding settlement and growing mechanization.” The primary mandate given by the Wilderness Act is to “preserve the wilderness character of the area,” a responsibility given to each agency that administers any area designated as wilderness (Section 4(b)).

Wilderness character is a holistic concept based on the interaction of (1) biophysical environments primarily free from modern human manipulation and impact, (2) personal experiences in natural environments generally free from the encumbrances and signs of modern society, and (3) symbolic meanings of humility, restraint, and interdependence that inspire human connection with nature. Taken together, these tangible and intangible values define wilderness character and distinguish wilderness from other all lands (Landres et al. *in press*). This definition of wilderness character was developed by an interagency monitoring team – including the Department of the Interior Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, and the U.S. Forest Service (Department of Agriculture) – to establish a common understanding of wilderness character. Developed in 2015, this definition builds on 15 years of experience developing and implementing wilderness character monitoring.

Wilderness character encompasses the five qualities that are described in the definition of wilderness from Section 2(c) of the Wilderness Act. These five qualities are collectively used to monitor how stewardship actions, impacts from modernization, and changes occurring from outside the wilderness itself, preserve or degrade a wilderness over time. The five qualities apply to all wilderness areas – regardless of their size, location, administering federal agency, or other unique place-specific attributes since they are based on the legal definition of wilderness in the Act. Descriptions of the five qualities as derived from Section 2(c) of the Wilderness Act are below.

Untrammeled

Wilderness is “...an area where the earth and its community of life are untrammeled by man”

Wilderness ecological systems are essentially unhindered and free from the intentional actions of modern human control or manipulation when the Untrammeled Quality is preserved.

Natural

Wilderness “...is protected and managed so as to preserve its natural conditions”

Wilderness ecological systems are substantially free from the effects of modern civilization when the Natural Quality is preserved.

Undeveloped

Wilderness is “...an area of undeveloped Federal land ... without permanent improvements or human habitation”

Wilderness retains its primeval character and influence, and is essentially without permanent improvement or modern human occupation when the Undeveloped Quality is preserved.

Solitude or Primitive and Unconfined Recreation

Wilderness "...has outstanding opportunities for solitude or a primitive and unconfined type of recreation"

Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation when the quality of solitude or primitive and unconfined recreation is preserved.

Other Features of Value

Wilderness "...may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value"

Other tangible features of scientific, educational, scenic, or historical value in wilderness preserve wilderness character when they are preserved.

In addition to the five tangible qualities of wilderness character, wilderness also has important intangible aspects that are difficult or impossible to quantify or monitor. These intangible aspects are diverse and can include the scenic beauty, spiritual experience, immensity of an area, and the opportunity for self-discovery, self-reliance, and challenge that comes from wilderness settings. Currently, these intangible aspects of wilderness can only be addressed in narrative form.

In 2008, an interagency Team published *Keeping It Wild: An Interagency Strategy for Monitoring Trends in Wilderness Character Across the National Wilderness Preservation System* (Landres et al., 2008). Based on the lessons learned during the implementation of the monitoring strategy outlined in *Keeping It Wild* from 2008 to 2014 across the National Wilderness Preservation System (NWPS), the framework of wilderness character monitoring was revised and replaced by *Keeping It Wild 2: An Updated Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System* (Landres et al. *in press*). The wilderness character monitoring strategy for the Noatak Wilderness contained in this document reflects the revised strategy based on *Keeping It Wild 2*.

The updated framework of wilderness character monitoring is based on the qualities defined above. Each quality is divided into a hierarchical set of monitoring questions, indicators, and measures to assess trends in wilderness character over time. Monitoring questions frame wilderness character monitoring to answer particular management questions; indicators are distinct and important elements within each monitoring question; and measures are a specific aspect of wilderness on which data are collected to assess trend of an indicator (Landres et al. 2008 and *in press*). Expanded definitions of qualities, monitoring questions, indicators, and measures are available in Appendix A. While the qualities, monitoring questions, and indicators are nationally consistent, measures are specific and sometimes unique to individual wilderness areas (Figure 1).

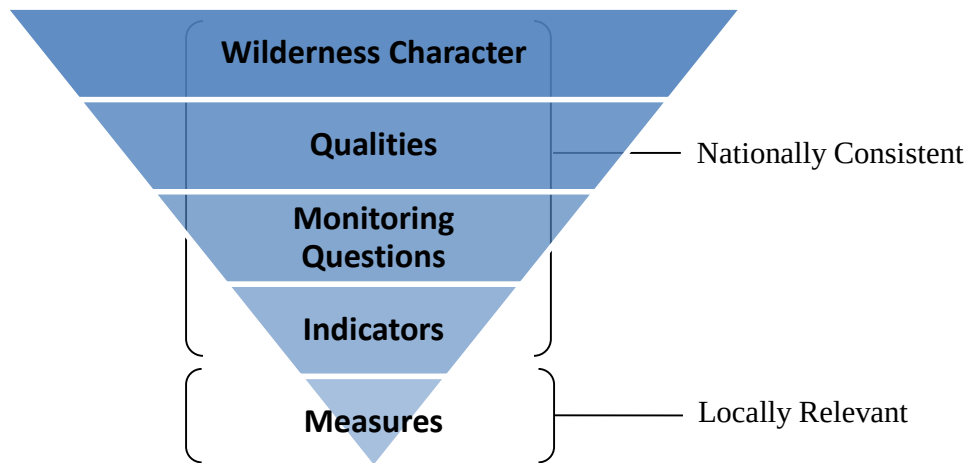


Figure 1. Keeping It Wild hierarchical framework.

This framework balances national and local needs for monitoring by defining locally relevant measures whose trends can be compiled at higher levels for national or regional reporting. This interagency monitoring strategy:

- Provides on-the-ground information to assess trends and make defensible decisions;
- Provides valuable information on wilderness on regional and national scales;
- Provides a set of key wilderness stewardship goals;
- Communicates a common definition of wilderness character;
- Communicates a tangible vision of wilderness within the agency and to the public;
- Clarifies how stewardship decisions and actions influence wilderness;
- Evaluates and documents the effects of actions taken inside the wilderness and effects from threats outside the wilderness;
- Synthesizes data into a single, holistic assessment of wilderness character;
- Creates a legacy of staff experience and knowledge of a wilderness;
- Improves on-the-ground wilderness stewardship.

This monitoring strategy offers a consistent means for documenting the status and trends in wilderness character and wilderness management within a wilderness. Under this monitoring strategy, trends in wilderness character are classified as upward (positive), downward (negative), or stable. These trends are both nationally consistent and independent of the unique aspects specific to any given wilderness; therefore, trends in wilderness character can be compared between wildernesses or across regions. These trends cannot be used to “rate” or “grade” stewardship, however, since they are meaningless when taken out of the context of wilderness character monitoring—wilderness character monitoring is a tool to holistically assess the preservation of wilderness character, not to place judgment on managers. Similarly, while *trends* can be compared between wildernesses, comparing *wilderness character itself* among different wildernesses is inappropriate. Each wilderness is unique in its legislative and administrative direction, and in its

social and biophysical setting; therefore wilderness character in a particular wilderness cannot, and will not, be compared to that of another wilderness.

The purpose of this report, the measures of wilderness character, and the wilderness character narrative is to improve wilderness stewardship by informing managers' understanding of the wilderness they manage, how wilderness character is changing over time, and why changes may have occurred. The following report establishes a baseline condition and monitoring strategy for the Noatak Wilderness based on the five qualities of wilderness character and measures that are specific to the Noatak Wilderness and are indicative of local trends in wilderness character. An online Wilderness Character Monitoring Database (at <https://wc.wilderness.net/>) accompanies this document and includes entries for all measures and baseline data specific to this wilderness where trends in wilderness character can be monitored.

Wilderness character in the National Park Service

Preserving wilderness character in the National Park Service (NPS) is vital to national wilderness preservation. The NPS administers 40% (43,932,843 acres) of designated wilderness within the NWPS with approximately 52% of the total acreage in the NPS designated as wilderness. A total of 83% of NPS lands are formally eligible, proposed, potential, or recommended wilderness – more total land and a greater proportion of land than any other wilderness management agency.

NPS policy affirms the mandate of the Wilderness Act to preserve wilderness character. The NPS 2006 Management Policies on Wilderness Preservation and Management assert preservation of wilderness character as one of the first and foremost directives and cite wilderness character as a consideration for a range of actions spanning resource management, environmental compliance, analysis of minimum requirements, protection of cultural resources, management of facilities and signs, and interpretation and education.

Director's Order #41: Wilderness Stewardship, signed in 2013, provides specific direction for the preservation of wilderness character, stating that each wilderness park:

- “will integrate the concept of wilderness character into park planning, management, and monitoring,”
- “should develop a wilderness character narrative,”
- “will conduct a wilderness character baseline assessment...and conduct ongoing monitoring of trends.”

Director's Order #41 also references the five qualities of wilderness character in *Keeping It Wild*, which likewise form the basis of this document, and directs managers to the NPS User Guide (described below) to inform the implementation of these wilderness character directives.

Spurred by NPS policy and building on the framework of *Keeping It Wild*, the National Park Service Wilderness Character Integration Team published *Keeping It Wild in the National Park Service: A User Guide to Integrating Wilderness Character into Park Planning, Management, and Monitoring* (hereafter referred to as the NPS User Guide) in 2014 (Figure 2). The purpose of the NPS User Guide is to provide a NPS-specific reference tool to help managers “integrate wilderness character into park planning, management, and monitoring” while serving as a companion document to the 2014 *Wilderness Stewardship Plan Handbook: Planning to Preserve Wilderness Character*. Both documents are included as part of Reference Manual 41: Wilderness Stewardship, which acts as the primary level 3 guidance for wilderness stewardship in the NPS.

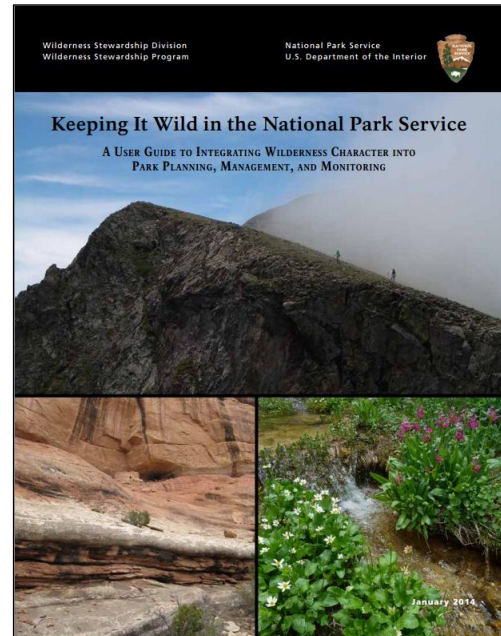


Figure 2. Keeping It Wild in the National Park Service, front cover.

This assessment of wilderness character for the Noatak Wilderness is intended to fulfill the first step of the directive in Director’s Order 41 which states “wilderness parks will conduct a wilderness character assessment, which includes identifying what should be measured, establishing baseline data, and conducting ongoing monitoring of trends.” Additionally, this document is intended to fulfill the NPS User Guide recommendation that encourages every park with wilderness resources “to identify any immediate concerns in wilderness, and to inform managers and the public about the current status of wilderness character.”

Administrative setting of the Noatak Wilderness

The Noatak National Preserve (NOAT) and Noatak Wilderness were established in 1980 under the Alaska National Interest Lands Conservation Act (ANILCA). The purposes for which the Noatak Preserve and Wilderness (also referred to collectively as “the Noatak”) were established are described in section 201 of ANILCA and are listed below.

- “To maintain the environmental integrity of the Noatak River and adjacent uplands with the preserve in such a manner as to assure the continuation of geological and biological processes unimpaired by adverse human activity;”
- “To protect habitat for and populations of fish and wildlife, including but not limited to caribou, grizzly bears, Dall sheep, moose, wolves, waterfowl, raptors, and other species of birds;”
- “To protect archeological resources;”
- “To provide opportunities for scientific research” (Public Law 96-487).

Further information on these purposes can be found in the Noatak National Preserve Foundation Statement, available online at: <http://www.nps.gov/noat/parkmgmt/upload/NOAT-FS-july-2009.pdf>.

All lands in the Noatak National Preserve that are designated and eligible as wilderness are managed as wilderness. This approach is in accordance with NPS policy to manage lands eligible for wilderness designation as wilderness, and with the mandate to preserve their wilderness character. As a result, this wilderness character monitoring report encompasses all 6.5 million acres that are designated and eligible as wilderness. A detailed breakdown of wilderness status in the Noatak National Preserve is depicted in Table 1 and in Figure 3.

Table 1. Acres of wilderness in Noatak National Preserve

Designated wilderness	Eligible as wilderness	Ineligible as wilderness
5,814,000 acres	728,000 acres	31,000 acres
Total area encompassed by this report: 6,573,000 acres		

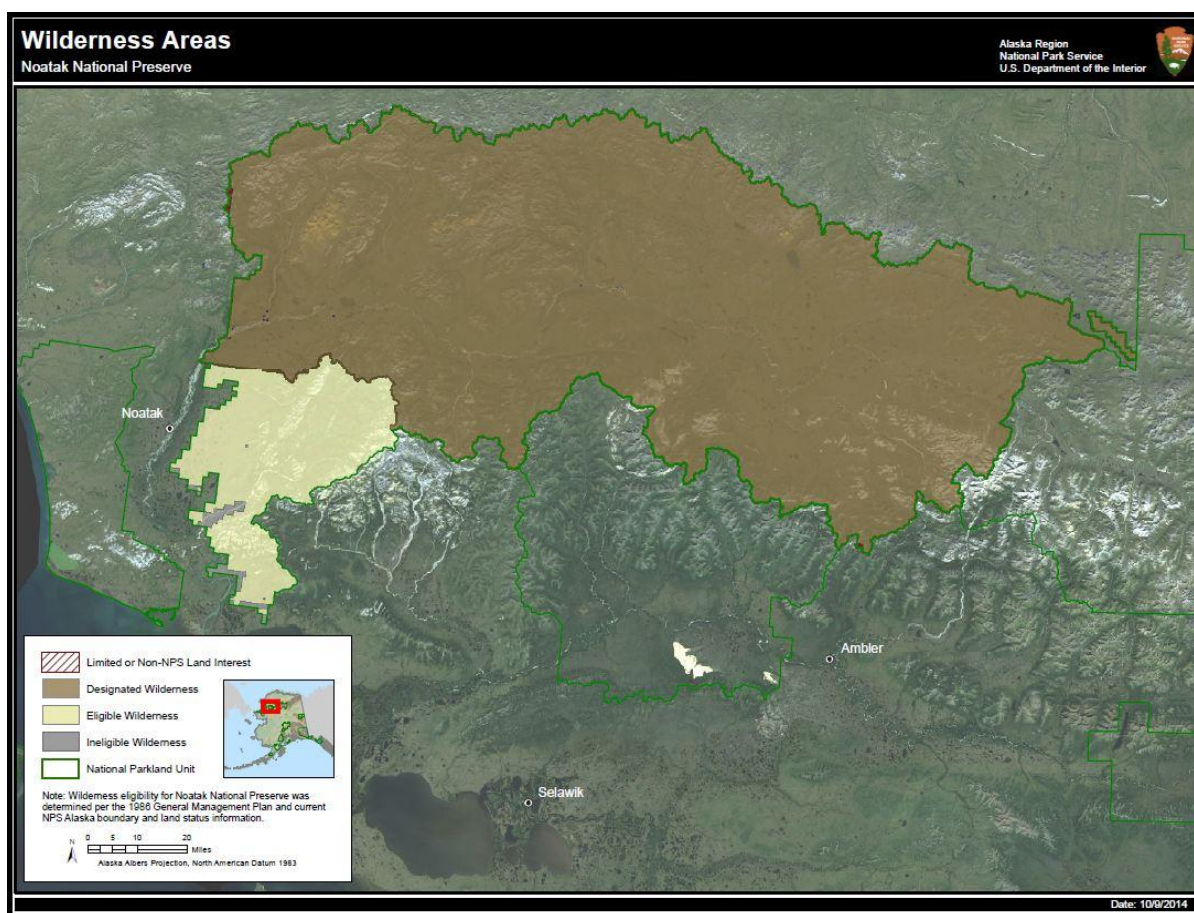


Figure 3. Map of the Noatak Wilderness.

The Noatak National Preserve is managed as part of Western Arctic National Parklands (WEAR), a complex of four parklands which are managed from Kotzebue, Alaska. The other parklands managed as part of WEAR are Kobuk Valley National Park (KOVA), Cape Krusenstern National Monument (CAKR), and Bering Land Bridge National Preserve (BELA).

Geographic setting of the Noatak Wilderness

The Noatak Wilderness is located in Northwestern Alaska in the western Brooks Range. Predominately surrounded by other public lands, the Noatak Wilderness lies at the center of a vast network of protected lands. While these lands have varying levels of conservation protection, the expanse of remote, adjoining protected areas makes land ownership boundaries difficult to identify and almost impossible on the ground without a global positioning system (GPS) unit.

To the north, the Noatak Wilderness is bordered by the National Petroleum Reserve, managed by the Bureau of Land Management (BLM). To the south, the Noatak National Preserve is bordered by Kobuk Valley National Park, the Squirrel River Special Recreation Management Area, managed by the BLM, and the Ambler Mining District, managed by the State of Alaska. To the west, the Noatak National Preserve is bordered by NANA Regional Corporation land and other native selections. To the east, Gates of the Arctic Wilderness borders the Noatak National Preserve to create over 13 million acres of designated wilderness. These land ownership boundaries are depicted in Figure 4.

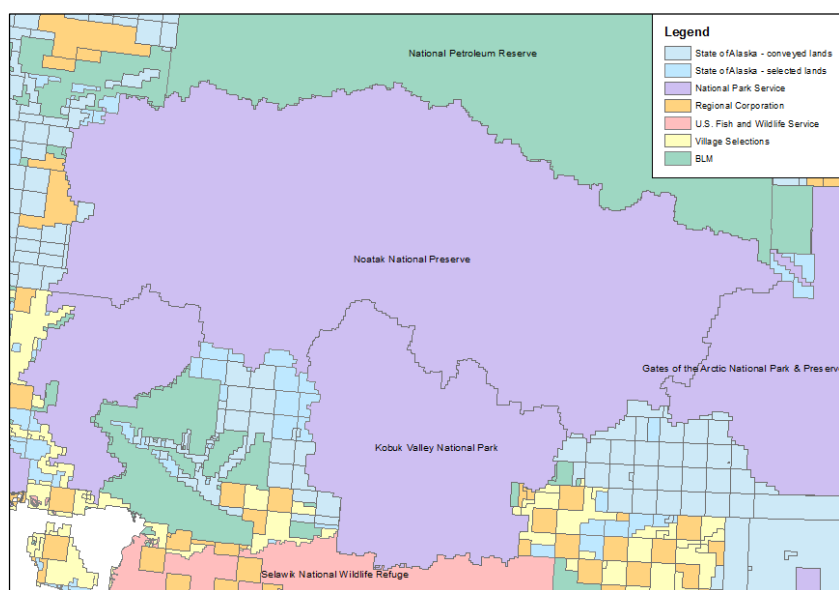


Figure 4. Land ownership near the Noatak National Preserve. NPS data.

When the Noatak Wilderness is considered as part of this regional view, the preserve becomes part of a network of federal lands managed as wilderness that spans 18 million acres, including lands in Gates of the Arctic National Park & Preserve, Kobuk Valley National Park, and Selawik National Wildlife Refuge, located on the southern edge of Kobuk Valley National Park.

In this corner of bush Alaska without access by road, population centers are small and dispersed. The Northwest Arctic Borough encompasses all of the communities near the preserve, though the Noatak National Preserve also includes lands that are within the North Slope Borough. The Northwest Arctic Borough includes 13 arctic and subarctic villages and a population of approximately 7,500 individuals (U.S. Census data 2010). Of these villages, residents of Noatak, Kotzebue, and Ambler are likely the most frequent users of the preserve, though residents of Noorvik, Kiana, Shugnak,

Kobuk, Selawik, Kivalina, Deering, and Buckland also use the preserve on occasion. Kotzebue is the largest population center in the region, with a population of approximately 3,300 individuals (U.S. Census data 2010).



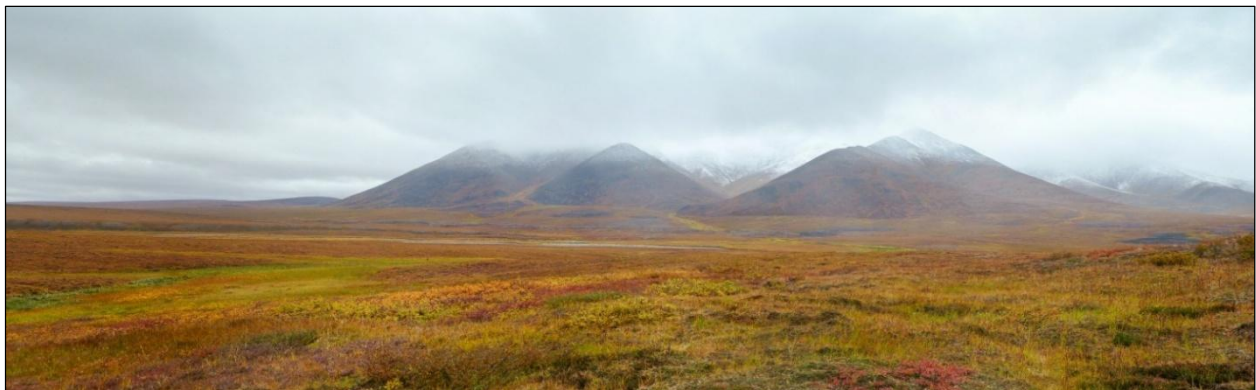
Snowy mountains. Photo by Marci Johnson, NPS.

Noatak Wilderness Character Narrative

The Noatak Wilderness is a tenacious landscape. Treading the rim of the Arctic Circle and resting at the edge of the continent, the Noatak Wilderness is encircled by mountains and underlain by permafrost. This expansive landscape extends from the western terminus of the Brooks Range to the headwaters of the Noatak River in the east – over 300 miles of unaltered, untamed landscape. Mountain spines frame the river's path as it flows to the Chukchi Sea in meandering arcs. In this remote landscape, the Noatak Wilderness serves as an icon of diversity, complexity, and naturalness, and represents an opportunity for subsistence lifeways to live on.

The Iñupiat of Northwest Alaska have lived here for thousands of years and their history is embedded in the landscape – depressions of house pits set on river banks and caribou hunting lookouts marked by rock cairns atop ridges. The Iñupiat Ilitqusiat – that which makes us who we are – defines values of humility and respect for nature: values which continue in this landscape, where wilderness helps bridge the values and land ethic of Native Alaskans and those of people from around the world.

With more than 6 million acres of designated wilderness, this landscape is a shifting mosaic of seasons and life that form the rich environments of the Noatak Wilderness. Deep winters envelop the landscape into folds of snow and ice and summers release their energy in a flourish of activity. Wildlife creatively adapts to the dramatic changes in season by hibernating, growing extra fur, or even changing color from summer brown to winter white, like the ptarmigan, ermine, and Alaska hare. Plants find resourceful ways to thrive in this harsh climate, forming as dwarfed ground willows and lupines, and low growing mosses and lichens.



Mountains near the Nigu River in early fall. Photo by Peter Landres.

In many ways, this place is much the same as it was thousands of years ago. Now, as our world is beginning to experience dramatic and widespread change, this wilderness is at a crossroads. Encroaching development and climate change threaten to dramatically alter this environment but also present a unique opportunity to preserve the exceptional wilderness character of this vast and diverse wilderness.

Untrammeled

Wilderness is essentially unhindered and free from the intentional actions of modern human control or manipulation.



River in the Noatak National Preserve. Photo by Phil Wescott, NPS.

The Noatak River remains one of the largest unmanipulated river systems in the world. From its headwaters in the Brooks Range, the river cuts through hundreds of miles of rugged mountains, symmetrical glacially sculpted valleys, boreal forests, and open tundra. Tightly winding river bends and oxbow lakes assert that the Noatak has defined and redefined its own course for thousands of years. Designated as a Wild and Scenic River, the Noatak River is truly untrammeled.

Fires are unhindered as they race across the region. Often lit by a tendril of lightning, fires in

Northwest Alaska can blacken thousands of acres until they burn out of their own accord. The only influences these fires face are occasional fuel reduction projects around cabins and allotments. Still, the Noatak maintains natural fire intervals unchanged over centuries and life quickly returns following a fire, ushered in by Canadian bluejoint grass and cottongrass tussock.

Boundaries within the Noatak Wilderness are natural geographic features, such as watersheds – no arbitrarily drawn fences or lines confine this landscape. The community of life here has a noticeable freedom and many species will travel hundreds of miles in their lifetime unimpeded and without encountering restraints from modern civilization.

In the context of such an expansive wilderness, human actions seldom have significant impacts on the community of life. Still, the Untrammeled Quality of the Noatak Wilderness is influenced by actions affecting predator populations and some research activities. Climate change may also influence the Untrammeled Quality in the future, for instance, as fuel management increases in response to greater wildfire incidence or efforts to contain invasive or non-native species increase as habitats shift.

Natural

Wilderness maintains ecological systems that are substantially free from the effects of modern civilization.

The Noatak Wilderness is constantly in motion. Thousands of birds and free-roaming ungulates pass through each year. The largest caribou herd in Alaska – the Western Arctic Caribou Herd – migrates through the Noatak Wilderness biannually, creating rivers of caribou whose hooves beat intricate webs of trails into the hillsides. Salmon and other fish circulate through the rivers and streams. Dall sheep traverse the craggy DeLong and Baird mountains, while brown bears lumber across the tundra.

Birds cross the sky, migrating from around the world, including peregrine falcons, golden eagles, montane nesting shorebirds, songbirds, and several Asiatic species. The Noatak Wilderness teems with mosquitoes and flies in summer, and white arctic foxes dart across the frozen tundra in winter. Even the night sky is in motion as northern lights dance through the darkness.

Tundra typifies the Noatak Wilderness with its subtle beauty and complex relationships that are only revealed upon a closer look. Tundra

and lichens govern this landscape, providing enough biomass to fuel local ecosystems, feed hundreds of thousands of caribou, as well as influence global systems. The small forms of lichens are tangled together and roughly 900 species with unique colors and shapes are found here, ranging from reindeer lichens with slender white arms, to boreal cup lichens with small red caps.

One of the richest floral assemblages in northern latitudes is found in the Noatak Wilderness, spanning across 5 ecoregions and reaching from sea level to 5,000 feet in elevation. At higher elevations, saxifrages with small pink and white flowers poke above the low-lying mat of lichens. In the lower Noatak, spruce forests fill the valleys and lowlands, while in the upper Noatak, twelve species of willow, alder, birch, and other shrubs transition to river terraces where cranberries, crowberries, and blueberries offer sustenance for bears and visitors alike. In the fall months, cooler temperatures and the waning sunlight bring vibrant change to the hillsides – shrubs and berry bushes turn vivid crimson and willows along river banks turn golden, foreshadowing the monochrome snow, ice, and darkness that will soon cover the region.



Fall color in the Noatak Wilderness. Photo by Jon McDonagh, NPS.



Grizzly bear on the bank of the Noatak River. Photo by Mike Thompson, NPS.

Time is etched into the Noatak Wilderness where the mountains are folded and faulted from the uplift and intrusion of colliding tectonic plates. Having remained unglaciated for the past 20,000 years, the Noatak river basin shows its age in eroded cliffs and river bluffs, while moraines and alluvial deposits mark the extent of mountain glaciers that once filled the valleys of the Kugururok, Kaluktavik, and Kelly Rivers – tributaries of the Noatak. Over the years, these slow moving changes have wrought dynamic change across this region and shaped the Noatak we see today.

Water links this region into a flowing system of rivers, waterfalls, braided streams, and chains of lakes. Flat expanses of wetlands and shallow lakes interspersed through the tundra help fuel ecosystems and are cradles of biodiversity. Despite the remoteness and untouched appearance of

these resources, pollutants affect air and water quality here and can also be 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 just beyond the western edge of the wilderness. 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 here, which are imperative to the Natural Quality of the Noatak Wilderness and to subsistence uses which rely on clear water and air, unfettered wildlife movements, and intact natural systems.



Unnamed stream. Photo NPS.

Climate change however, is the most prominent and uncertain threat to the Natural Quality of the Noatak Wilderness and its effects are already being felt: thawing permafrost causes areas to slump and change shape; regional weather patterns are becoming less predictable and winter icing events with rain-on-snow or mid-winter thaws are increasing; vegetation composition is changing as shrubs move into the tundra and the arctic tree line shifts northward; and animals like the beaver are shifting or expanding their ranges. As habitats shift, non-native, invasive and exotic species such as elodea or pineapple weed may begin to spread, particularly around landing strips and river corridors where new species may be introduced by travelers.

Undeveloped

Wilderness retains its primeval character and influence, and is essentially without permanent improvements or modern human occupation.

The Noatak Wilderness has evaded many influences of modern civilization. Visitors find few barriers between themselves and the landscape here as few developments or improvements are present. Visitors are continually reminded of the unforgiving verity of life above the Arctic Circle as they contend with the unpredictable and unapologetic Noatak Wilderness on their own.

An occasional research installation or administrative structure emerges from the hillside, or perhaps a cabin or some debris can be seen. But camouflaged by the vastness of the surrounding geography and buried beneath snow during winter, these developments are virtually unnoticeable and the Noatak retains a feeling of freedom from modern influences. When visitors do come upon a development however, their experience can be significantly impacted, as developments are an unexpected artifact of the outside world in a landscape that appears remote and untouched.



Climate monitoring station near Howard Pass. Photo by Ken Hill, NPS.

In the summer, local people construct seasonal fish camps along the banks of the Noatak where strips of salmon and caribou meat are hung to dry. Once food for the winter is gathered and before ice forms in the river, these camps are disassembled, leaving behind subtle traces of a continued tradition. Dog mushing also has a rich history here and served as the primary mode of winter transport for hundreds of years, even precluding the need for

motorized transport until recent decades. Dog mushing is a continued tradition in the region and represents an important component of Alaskan culture.

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 Noatak Wilderness. Access and travel to the wilderness is difficult and visitors, commercial operators, scientists, locals, and agencies, including the National Park Service, typically access the wilderness by motorized methods. As a result, the Undeveloped Quality of the Noatak Wilderness presents a paradox: because the area is undeveloped, access is challenging and users often rely on motorized transport to travel to the wilderness, in turn increasing impacts to the Undeveloped Quality of the area. Yet in this vast landscape, the whine of engines quickly fades as the small planes are swallowed by the sky and dwarfed by the mountains.

During the summer months, users rely on motorboats or airplanes to access the wilderness, which concentrates most use along corridors of accessibility; impacts are sometimes seen in narrow social trails leading from popular plane landing sites to river put-ins. In the winter, snowmachines provide local residents greater



Mountains in spring. Photo by Marci Johnson, NPS.

access to portions of the wilderness. In addition, helicopters are periodically used to conduct law enforcement and scientific activities.

Requests to conduct research have increased in recent years, with corresponding rises in requests for motorized access, installations, and temporary camps. Individually, and across millions of acres of wilderness, these uses have relatively little impact, but cumulatively, they have the potential to significantly impact the Undeveloped Quality of the Noatak Wilderness. Scientific value is an integral purpose of the area and the knowledge gained from these studies can help improve wilderness stewardship, but research must be balanced for its affects to the other qualities of wilderness character, as well as the benefits and costs each project brings to the wilderness.

Opportunities for Solitude or Primitive and Unconfined Recreation

Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation.



Lone hiker on tundra. Photo by Linda Jeschke, NPS.

Solitude in the Noatak Wilderness rustles through willows with the wind and glints off the braided stream of the Noatak River with the sun. Looking across the vast river valley, wildlife appears as specks on far hillsides. Scale is misleading and visitors are often deceived on their arrival – what looks to be a few miles away is often far in the distance, so immense is the landscape. This is the solitude visitors find in this wilderness and with it, freedom from the confines of modern society and the unbounded pursuit of renewal, self-discovery, and challenge.

Very few of the National Park Service’s visitors make it to this far-flung corner of the continent, only accessible by boat or plane. For those visitors who do, they find millions of acres of unparalleled, unrestrained, unstructured freedom. Sounds of wind, water, and wolves remind visitors of their remoteness from cities and civilization. As visitors roam up ridges and across the tundra, they will experience a sense of smallness and a feeling of deep connection as they walk in ancient Iñupiat footsteps that may not have been followed for thousands of years. Visitors become immersed in this landscape, swallowed by the rolling tundra and snow-capped peaks.

Visitors are unlikely to encounter another person and may find themselves in places that are unnamed on the map they carry. They may however, encounter local people gathering berries, hunting, or fishing. For most visitors, an encounter with someone subsisting on the land forges a meaningful connection and an appreciation for the land itself and the human history associated with this place.

The Noatak Wilderness is an embrace of freedom and an unstructured environment. Backpackers, campers, and river floaters do not pay fees or apply for permits. They will find no established trails – the only paths are those formed by wildlife as they too cross the landscape. This freedom also forces

visitors to experience the wilderness on its own terms, where swiftly changing weather, wildlife movements, harsh topography, and remoteness can require visitors to alter their route at a moment's notice or stay tent-bound for days.

One of the greatest influences on the opportunities for solitude and unconfined recreation in the Noatak is the landscape itself. Recreation is often constrained by navigable waterways and aircraft landing areas, concentrating use in these areas and diminishing opportunities for solitude there. Research and administrative activities face similar limitations, and also impact visitor's opportunities for solitude from the presence of researchers or administrators themselves, as well as any camps they set up and any planes or helicopters they may require. The difficulty of access contributes to the Noatak's unmatched opportunities for solitude, but limits opportunities for unconfined recreation for visitors – the wilderness is only accessed by aircraft, boat, or snowmachine, and the cost of travel to gateway communities, combined with the cost of travelling into the wilderness itself can be prohibitive.

Yet for all the challenges associated with this wilderness – geographic location, access, logistics, weather, terrain, insects, or cost – the Noatak Wilderness provides exceptional and unique experiences. This is a place of deep spiritual connection. In the Noatak Wilderness, there is no single feature, waypoint, or main attraction. The attraction is the entire wilderness itself in its wild remoteness and incomparable vastness.

Other Features of Value

Wilderness may also contain other features of scientific, educational, scenic, or historical value.

The Noatak Wilderness preserves many features of scientific, ecological, historical, and cultural value. For its lack of manipulation by modern technologies, ecological integrity, location in Northwest Alaska and on the precipitous edge of climate change, the Noatak Wilderness provides unparalleled opportunities for research, which are preserved here and affirmed in the status of the Preserve and Wilderness as a United Nations Biosphere Reserve. Scientific research is an explicit purpose of the Noatak and research in many fields is conducted here. Perhaps one of the biggest threats to the scientific study of wilderness values here is research itself, especially in combination with impacts from administrative uses and visitation. These uses must be balanced with the other qualities of the Noatak's wilderness character to preserve the unparalleled opportunities for research available here.



Inuksuk. Photo by Peter Landres.

Artifacts going back continuously over 13,000 years assert the cultural history that is infused through the region. Preserved by permafrost, these artifacts are among the longest cultural record in the Northern hemisphere. For outsiders, these artifacts describe Inupiat lifeways as they have transpired

over thousands of years. But for the Iñupiat, these artifacts affirm that this land is sacred with the spirits of their ancestors living on here. Today, these artifacts provide a glimpse into a history that defines this region and the people who live here, contributing to the wilderness and its unique wilderness character. Ethnographic values are also part of this landscape, where a rich history of oral tradition has passed knowledge of subsistence lifestyles across generations and likewise contributes to the unique wilderness character of the Noatak. Effects from climate change however, pose a significant threat to these artifacts as erosion, thawing permafrost, and flooding manipulate the sites themselves.

Subsistence uses of the land live on in the Noatak Wilderness, showing the sociocultural traditions and values of those who continue to thrive in this challenging environment. Hunting, trapping, and gathering berries and other resources are common and allow many local people to subsist off the land as they have for thousands of years. Each year, caribou, moose, salmon, sheefish, Dolly Varden trout, and other animals are taken from this wilderness and the meat is stored to help families survive through the winter. Into the future however, ongoing cultural uses in the Noatak may change with societal norms and as technologies influence subsistence lifeways.

Iñupiat Homeland

The Iñupiat are intrinsic within this landscape and have been for thousands of years. This landscape has helped shape their cultural identity as they thrived here, living off of the land. The people know where the animals will be – how the animals behave and how they move across the land. The people knew when to hunt caribou at *Tapachalik*, also known as Desperation Lake, and how to extract marrow from the leg bones of caribou bulls. The people know how to use the intestines of bearded seals as windows and rain jackets. The people know how to catch salmon and preserve it for the long winter. The people know this land; it is their livelihood and it is their home.

The Iñupiat understand the connectivity in this land. Here, the weather, seasons, river currents, animal tracks and movements, ice patterns, time of day, and countless other factors combine to create a holistic understanding of this landscape. The Iñupiat use all of this to know where to find Arctic char in frozen lakes and when to harvest greens before the leaves become bitter. Knowledge of these subtle interactions defines Iñupiat lifeways, where personal knowledge is combined with knowledge of past generations to create a dynamic and holistic view of the land that is necessary to survive here.

Knowledge of this land and its resources has been passed down through generations and Iñupiat elders, families, and traditions are the bearers of this knowledge. When elders speak, telling stories of places, hunting, and survival, everyone listens and learns. *Malgutchiak Saputiñik* is the “twins’ fish weir” where a stone formation was built in the river; *Salliñauraq* is the “little seining place.” Yet this information is larger than words on a page and cannot be fully captured in a book because it lives on in the people with more detail and nuance than can be described – it must be lived. This is the only way to truly know each bend in the Noatak River by name and use. Intricate knowledge is associated with every inch of this wilderness, asserting that local people with their history and culture are indelibly linked to the landscape and its character.

Many changes have come in recent centuries, brought by the arrival of new peoples and cultures. And the local villages have adapted; change and adaptation are constant for the Iñupiat. When caribou herds declined or snow fell earlier than normal, the people adapted. When modern technologies arrived in villages bringing firearms, diesel fuel, snowmobiles, and powerboats, the people adapted. Yet through these changes the land remains vital to Iñupiat culture and a deep respect is maintained for this wilderness and its inhabitants.

The Iñupiat see no boundaries as they look across this landscape – there is no line where wilderness begins or ends. Yet people see that change and development are coming to the region. Protected areas and wilderness are seen as places where traditional ways of life can continue, assuring that a way of life lives on in which humans are part of the natural world.

For the Iñupiat and all visitors, a profound sense of gratitude is conveyed by the Noatak – for this place, for life, and the opportunity to experience it. The Noatak has the unparalleled ability to make its guests feel small, humble, and vulnerable, but it also has the ability to open the spirit. Preserving the integrity of the Noatak and its wilderness character is an imperative balancing act so future generations of all peoples may find solace in this landscape with the untamed vastness and unlimited opportunities that are the Noatak Wilderness.

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Wilderness Character Monitoring Baseline

The baseline assessment of wilderness character for the Noatak Wilderness is described in this section. Spanning from how each measure were chosen, to how each will be monitored into the future, this section provides a comprehensive picture of what wilderness character monitoring for the Noatak Wilderness will look like.

Wilderness character monitoring measures

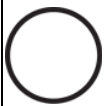
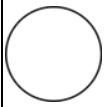
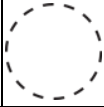
This section describes in detail the measures selected to monitor the Noatak Wilderness. Together, these measures constitute the baseline assessment of wilderness character for the Noatak Wilderness. This baseline assessment describes the first year in which all measures report data and when consistent monitoring protocol are established. For the Noatak Wilderness, the year of this baseline assessment is 2014. The mandate of the Wilderness Act and NPS policy however, is to preserve wilderness character beginning when the wilderness is designated. Consequently, each measure also includes an indication of “trend since wilderness designation” to provide a more comprehensive picture of wilderness character and how it’s changing over time.

For each measure, the following aspects are described: baseline data value, year(s) of data, trend since wilderness designation, background information, measure description & collection protocol, data source, data frequency, and significant change. The content and purpose of each of these sections is described below.

- **Baseline data value** – specifies the data value for each measure entered into the WCMD for the baseline year, which is 2014 for wilderness character monitoring in the Noatak Wilderness. Please note that the WCMD uses “year measured” to refer to the year of any given data value (e.g., the “year measured” of the “2014 data value” is 2014).
- **Year(s) of data** – specifies the year(s) in which the data were collected. Depending on the structure of the measure, the “year of data” may not be the same as the baseline year. For example, the “year of data” for a 2014 data value might be 2014, or 2013, or 2009-2013, or Fiscal Year 2013, etc. This terminology matches what is used in the WCMD.
- **Trend since wilderness designation** – provides an indication of the current status and trend for the measure since the Noatak Wilderness was established in 1980. Trends are depicted based on the symbols in Table 2, and can be “upward,” “downward,” or “stable.” These trends are based on professional judgment by resource specialists when data are unavailable. More information on how legacy data is incorporated into ongoing wilderness character monitoring is available in *Keeping It Wild 2* (Landres et al. *in press*, p. 15 in April 15, 2015 draft).
- **Condition status** – refers to the current condition of the measure. Condition status was determined by relevant literature and documentation on the history of the measure, and professional judgement by resource specialists.
- **Background information** – defines the context and relevance for the measure at an individual wilderness and addresses why the measure was selected.

- **Measure description and collection protocol** – defines what is being measured and how, including the process through which data is compiled or gathered. “Collection protocol” is defined and used in this document to refer to the process by which data is gathered from existing sources and does not include in-the-field data collection instructions. If field data collection protocols are relevant to a measure and available, a location of where the protocol can be found is included.
- **Data source** – defines where information for the measure can be found into the future. The intent of this section is to encourage written documentation of wilderness character so that information is accessible into the future.
- **Data frequency** – defines how often data for this measure should be entered into the WCMD. Frequency is typically determined by the time frame in which data become available under existing monitoring protocols for use in wilderness monitoring.
- **Data adequacy** – defines the reliability of the data to assess trends in the measure. Data adequacy is based on data quantity and data quality. Data quantity refers to the level of confidence that all appropriate data records have been gathered. Data quality refers to the level of confidence about the source(s) of data and whether the data are of sufficient quality to reliably identify trends in the measure. Further information on the role of data quantity and quality in wilderness character monitoring is available in the Forest Service Technical Guide (Landres et al. 2009, p. 26, hereafter referred to as the “FS Technical Guide”). Subjective evaluation of these two aspects is used to determine data adequacy as high, medium, or low. Please note that the WCMD refers to data adequacy as “data confidence.”
- **Significant change** – defines how much change a measure must undergo to indicate a changing trend in wilderness character for a particular measure. “Significant change” is defined and used in this document differently than definitions used by other departments within the NPS and is not intended to mean “statistically significant change” nor imply use of the Environmental Impact Statement (EIS) process under the National Environmental Protection Act (NEPA).

Table 2. Key to status, trend, and confidence symbols.

Condition status		Trend since wilderness designation		Data adequacy	
	Warrants Significant Concern		Upward trend in the measure		High
	Warrants Moderate Concern		Stable trend in the measure		Medium
	Resource is in Good Condition		Downward trend in the measure		Low

Together, these sections provide a comprehensive overview of each measure, provide transparency into wilderness character monitoring measures selected at the preserve, and form the basis of the wilderness character monitoring strategy of the Noatak Wilderness. A summary of the information in this report most pertinent to day-to-day use by preserve staff is located on the WEAR shared drive Wilderness folder.

Process used to identify measures

The process used to identify and select measures to monitor wilderness character is outlined below. All actions were carried out by the Wilderness Planner unless otherwise specified.

- **Gather information** – Background information was gathered to understand the wilderness and preserve including the history, ecosystems, and potential threats in the future. This information was gathered by reading background and guiding documents for the wilderness and preserve, working with preserve staff and other individuals, and visiting the wilderness.
- **Create list of possible measures** – Preliminary measures were identified and compiled for all indicators based on the information gathered and a 2012 workshop with preserve staff. Several measures were based on measures described in wilderness character monitoring documents – including the FS Technical Guide (Landres et al. 2009), National Park Service User Guide (NPS 2014), U.S. Fish and Wildlife Service (USFWS) Wilderness Character Monitoring reports (USFWS unpublished data), *Keeping It Wild* (Landres et al. 2008), *Keeping It Wild 2* (Landres et al. *in press*), and refined to suit the Noatak Wilderness.
- **Refine measures** – Measures were prioritized and refined through discussing measures with staff and evaluating the significance, feasibility, vulnerability, and reliability of measures (see table in Appendix B). The availability of reports and scientific information currently and into the future was also considered.
- **Approval of measures** – The final list of measures was developed and submitted to Adrienne Lindholm (Alaska Region NPS Wilderness Coordinator) and Peter Landres (Ecologist, Aldo Leopold Wilderness Research Institute).
- **Write report** – Each measure was described, including background information, collection protocol, data adequacy, data source, and significant change. All measures were written into the final report and the report was submitted to supervisors.
- **Locate and synthesize data** – Available scientific information for each measure was collected by contacting relevant individuals and pulling information from the internet and parklands shared drive. Data were processed as necessary.
- **Enter data** – Data were entered into the WCMD, at <http://wc.wilderness.net/>.
- **Incorporate comments** – Changes, edits, and feedback from preserve staff and wilderness supervisors were received by Wilderness Planner. Edits were incorporated into the final draft.
- **Approval of final report** – Report was finalized and approved by supervisors, including the WEAR Superintendent and Alaska Region NPS Wilderness Coordinator.

Overview of wilderness character monitoring measures

The table below lists all 20 wilderness character measures that comprise the Noatak Wilderness character monitoring baseline. Each measure is described in more detail in its respective section later in the report. Additional measures may be used to monitor the Noatak Wilderness in the future; these measures lack the data necessary to be included at this time and are listed in the “Measures suggested for future use” section.

Table 3. Wilderness character monitoring measures used for the Noatak Wilderness

Quality	Indicator	Measure
Untrammeled	Actions authorized by the federal land manager that intentionally manipulate the biophysical environment	1-1: Number of actions that manipulate wildlife or vegetation 1-2: Percent of wildfires suppressed
	Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment	1-3: Number of unauthorized actions that manipulate plants, wildlife, insects, fish, pathogens, soil, water, or fire
Natural	Plants	2-1: Number of non-native plant species
	Animals	2-2: Number of human-wildlife incidents
	Air and water	2-3: Acidifying and fertilizing pollutants
	Ecological processes	2-4: Extent of landscape connectivity
Undeveloped	Presence of non-recreational structures, installations, and developments	3-1: Number of sub-surface installations
		3-2: Number of above-ground developments
		3-3: Weight of abandoned debris
	Presence of inholdings	3-4: Acres of inholdings
	Use of motor vehicles, motorized equipment, or mechanical transport	3-5: Number of helicopter supported projects
		3-6: Hours of fixed-wing aircraft flight time
		3-7: Miles of administrative snowmachine use
Solitude or Primitive and Unconfined Recreation	Remoteness from sights and sounds of people <i>inside</i> the wilderness	4-1: Number of visitors
		4-2: Number of researcher-days
	Remoteness from occupied and modified areas <i>outside</i> the wilderness	4-3: Average number of aircraft overflights
	Facilities that decrease self-reliant recreation	4-4: Number of aircraft landing sites
	Management restrictions on visitor behavior	4-5: Index of management restrictions
Other Features of Value	Deterioration or loss of integral cultural features	5-1: Percent of impacted and threatened cultural resource sites

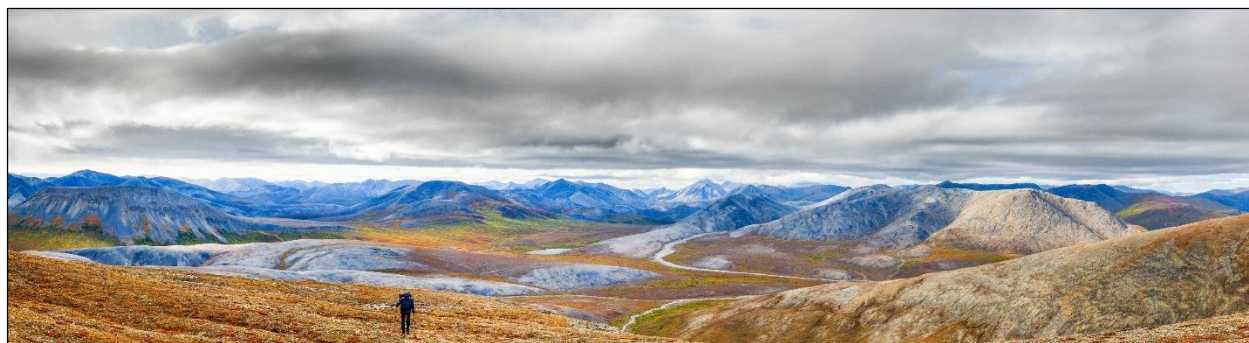
Untrammelled Quality

Wilderness is essentially unhindered and free from modern human actions that control or manipulate the community of life.

The Untrammelled Quality of wilderness character tracks the actions of humans in wilderness that intentionally manipulate the biophysical environment. Actions that intentionally manipulate or control ecological systems inside wilderness degrade the Untrammelled Quality of wilderness character. This is true regardless of what instigated the action or if benefits to other qualities of wilderness character are gained by the action. Withholding action is a key concept for understanding this quality; management of wilderness, in contrast to management of other types of land, should be approached with restraint and humility. When monitoring the Untrammelled Quality we can track either the decision to manipulate the biophysical environment, or the opportunity for humans to let natural processes occur without intervention. Further information on determining whether an action meets criteria to be included in the Untrammelled Quality of wilderness character can be found in the “What is a trammeling action?” document, included as Appendix C of this report.

Table 4. Measures of the Untrammelled Quality used to monitor the Noatak Wilderness

Indicator	Measure	Frequency	Data Adequacy	Significant Change	Baseline Value
Actions authorized by the federal land manager that intentionally manipulate the biophysical environment	1-1: Number of actions that manipulate wildlife or vegetation	1 year	High	Any	0 actions
	1-2: Percent of wildfires suppressed	5 years	High	p-value ≤ 0.05	0%
Actions not authorized by the federal manager that intentionally manipulate the biophysical environment	1-3: Number of unauthorized actions that manipulate plants, wildlife, insects, fish, pathogens, soil, water, or fire	5 years	Low	Any	0 actions



Hiker near the Nakolik River in the Noatak Wilderness. Photo by Nyssa Landres, NPS.

Untrammelled Quality

Actions authorized by the federal land manager that intentionally manipulate the biophysical environment

1-1: Number of actions that manipulate wildlife or vegetation

Wilderness character monitoring baseline

Baseline data value: 0 actions

Year of data: 2014 (calendar year)

Trend since wilderness designation



Condition: Good

Trend: Stable

Confidence: High

Background & Context

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 Untrammelled Quality of wilderness. This measure focuses on intentional manipulations of wildlife or vegetation because they are the most relevant types of trammeling actions in the Noatak Wilderness and are highly relevant to its wilderness character. Manipulations of other parts of the biophysical environment are not included in this measure because they are highly unlikely to occur.

At this time, few authorized actions occur within the Noatak Wilderness that manipulate wildlife or vegetation. However, actions that intentionally manipulate wildlife or vegetation have the potential to occur here in the future. Examples of actions that would be included here are wildlife collaring, control of nuisance wildlife such as porcupines or Arctic ground squirrels, facilitated migration or control of shifting wildlife habitats due to climate change, spraying of herbicide, and any other large-scale vegetation control efforts.

Measure Description & Collection Protocol

This measure monitors the number of administratively-authorized actions that intentionally manipulate wildlife or vegetation. To determine whether an authorized action that manipulates wildlife or vegetation is or is not a trammeling action, the document “What is trammeling action?” should be consulted, available in Appendix C. The number of actions reported is based on guidance in Tables 5 and 6 (next page). This measure uses the total number of actions that occur in one calendar year and *does not* use a weighting system to evaluate actions based on their predicted or potential magnitude based on guidance in *Keeping It Wild 2* (Landres et al. *in press*, pp. 28-29 in April 15, 2015 draft).

Scale is an important consideration in counting trammeling actions, but only to a certain point. If it is determined that the magnitude of an action’s consequences will exceed a certain threshold, the action is counted as a trammeling. All trammeling actions that cross this threshold are counted equally, regardless of the extent of their effects (e.g., spraying herbicide on 100 acres is equivalent to spraying herbicide on 1,000 acres; treating one invasive plant species is equivalent to treating five invasive plant species). Below that threshold, however, actions are not considered significant enough to be counted as a trammeling action (e.g., hand pulling a couple of invasive plants, removing one or two hazard trees, etc.). The intent of this measure is to track whether management programs are trending

toward more or less human manipulation in the wilderness; therefore, this approach to counting trammeling actions focuses on the *decision* to trammel, and not on the *magnitude* of trammeling's effects.

To obtain information on the number of trammeling actions occurring in the Noatak Wilderness in any given year, a variety of sources must be consulted. Possible sources include: Special Use Permits (SUPs), Minimum Requirements Analyses (MRAs), notes and records from the Natural Resources Division, and research applications and permits (available through the Integrated Resource Managed Applications Portal, also referred to as IRMA). The total number of actions to intentionally manipulate wildlife in the Noatak Wilderness is entered into the WCMD annually. Over time, an increase in the number of trammeling actions would indicate a downward trend for this measure.

Table 5. General guidance for counting trammeling actions

In general:			
- Only count actions that are of sufficient scale (that cross the threshold); - All actions above the threshold are counted equally; - Actions are counted once per year for every year the action occurs; - MRAs or NEPA analyses can often (though not always) be used to indicate actions in wilderness.			

Table 6. Protocol for counting trammeling actions (adapted from the FS Technical Guide, p. 55)

Type of action	Example	Counting rule	Reporting
Single action at a single location	Spotted knapweed treated in a single location	Count as one action	Report one action
Single action at multiple locations	Spotted knapweed treated in several locations	Count as one action	Report one action for the single species regardless of the number of locations
Multiple actions at a single location	Spotted knapweed and Canada thistle are sprayed in the same location	Count as multiple actions	Report one action for each species; e.g., one treatment on two species = two actions
Multiple actions at multiple locations	Mechanical treatment is used in addition to herbicide	Count as multiple actions	Report one action for each treatment on each species; e.g., two treatments on two species = four actions
Action occurs within a single year	Herbicide treatment occurs between June and July 2015	Count as one action	Report one action
Action spans multiple years with interruption	Herbicide treatment initiated in August 2015 ends in April 2016, and is reinitiated in August 2016	Count as multiple actions	Report as one action in year 2015 and one action in year 2016

Data Source

SUPs, MRAs, and EIS or Environment Assessment (EA) reports; also by contacting the preserve Natural Resources Division.

Note: Documentation may come up with park codes of “NOAT” or “WEAR.” *Both* must be searched.

Data Adequacy

High – data quantity and quality are high because this measure only counts authorized actions, which are reliably and completely documented.

Frequency

Annually – every calendar year data for this measure will be entered into the WCMD.

Significant Change

Any change is considered significant for this measure.



Hiker in the Noatak Wilderness. Photo by Nyssa Landres, NPS.

Untrammeled Quality

Actions authorized by the federal land manager that intentionally manipulate the biophysical environment

1-2: Percent of wildfires suppressed

Wilderness character monitoring baseline

Baseline data value: 0%

Years of data: 2010-2014 (calendar years)

Trend since wilderness designation



Condition: Good

Trend: Stable

Confidence: High

Background & Context

Wildfires in the Noatak Wilderness typically burn thousands of acres each year. The integrity of natural fire regimes are preserved in the Noatak Wilderness, where the primary influence on fires are local variables such as vegetation composition and local-scale climate, among other factors (Higuera et al. 2011). The majority of wildfires in the Noatak are naturally ignited by lightning, but there are occasionally human-caused fires, or fires used for management purposes such as prescribed burns. Fires typically only receive a suppression response when the fire threatens an allotment, cabin, or lands beyond preserve boundaries that do not support natural fire regimes. Given the great extent of fire activity in the Noatak Wilderness and the extent of natural autonomy the fires are given here, the percentage of fires that receive a suppression response is significant to the Untrammeled Quality of the Noatak's wilderness character.



Tundra fire in Noatak National Preserve. Photo by Dan Stevenson, NPS.

Measure Description & Collection Protocol

This measure monitors the percent of naturally ignited wildfires occurring within five calendar years that receive a suppression response. Suppression responses are evaluated based on the Fire Protection Type (sometimes referred to as Fire Protection Code) assigned to the fire. The Fire Protection Type is comprised of two numbers: the first number indicates the general type of fire (wildfire, prescribed fire, natural outs, etc.), the second number indicates what corresponding management response was taken. If the Fire Protection Type does not adequately convey whether the fire was suppressed, any manipulation of the fire is considered a suppression activity. A key to the Fire Protection Types can be found in the document "NPS Wildland Fire Report Form: Instructions and Forms" (revised 2007) and can be found online through the National Interagency Fire Center (NIFC). The most common codes assigned to fires in the Noatak Wilderness are 14 and 22, both of which are considered "non-suppressed."



Tundra fire near Eli River. Photo by Ken Hill, NPS.

Data are obtained through Wildland Fire Management Information (WFMI) databases, which are housed by NIFC. New users must request access to the database to view and download records to calculate the value for this measure. Once access is obtained, fire data for the Noatak can be downloaded in a variety of formats, all of which include the Fire Protection Type for each fire, along with other pertinent information such as the fire year and location. Data can thus be queried to show the

Fire Protection Types for all fires in Noatak for the year being monitored. The final value entered into the WCMD is the percent of all fires over five calendar years with a Fire Protection Type that indicates a suppression response was not initiated. Over time, an increase in the percentage of fires that receive a suppression response would indicate a downward trend for this measure.

Data Source

WFMI databases; “NPS Wildland Fire Report Form: Instructions and Forms” available online at: https://www.nifc.blm.gov/fire_reporting/NPS/doc/NPS_Wildland_Fire_Report_Form_Instructions_Oct_2007.pdf (accessed June 2014).

Data Adequacy

High – data quality and quantity for this measure are high because data on all fires are reported with high accuracy and completeness.

Frequency

Every 5 calendar years data for this measure is entered into the WCMD.

Significant Change

Linear regression analysis, $\alpha = 0.05$, for all data 1980-present is used to determine if there is a significant trend in the measure. At this time there is no statistically significant trend in the data (p-value = 0.14).

Table 7. Legacy data, percent of fires suppressed

Five-year intervals	Number of naturally caused fires	Number of fires suppressed	Percent of fires suppressed
1980-1984	45	24	53%
1985-1989	11	0	0%
1990-1994	5	0	0%
1995-1999	2	0	0%
2000-2004	18	0	0%
2005-2009	33	0	0%
2010-2014	70	0	0%

Untrammelled Quality

Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment

1-3: Number of unauthorized actions that manipulate plants, wildlife, insects, fish, pathogens, soil, water, or fire

Wilderness character monitoring baseline

Baseline data value: 0 actions
Years of data: 2010-2014 (calendar years)

Trend since wilderness designation



Condition: Good
Trend: Stable
Confidence: Low

Background & Context

Unauthorized trammeling actions in the Noatak Wilderness are rare, but significant to wilderness character. Examples of actions that would be counted in this measure include unauthorized actions by other agencies, citizen groups, or individuals that intentionally manipulate the biophysical environment. Actions such as accidental ignition of human caused fire and Defense of Life and Property (DLP, defined on p. 31) actions are not considered trammeling actions because the actions are not taken to intentionally manipulate the biophysical environment.

Measure Description & Collection Protocol

This measure monitors the number of actions not authorized by the NPS that are taken by individuals, citizen groups, or other agencies and are intended to manipulate any component of the biophysical environment at a broad-scale (e.g., purposeful release of non-native species, predator control actions in excess of legal limits, etc.). Actions taken by the State of Alaska with the NPS knowledge and approval are considered authorized actions and not included under this measure.

Any unauthorized trammeling action of sufficient scale is included in this count. All unauthorized trammeling actions are counted for the past five calendar years following the same protocols outlined in measure 1-1 (actions that manipulate wildlife or vegetation) when possible. Over time, an increase in the number of unauthorized actions intended to manipulate the biophysical environment would indicate a downward trend for this measure.

Data Source

Law enforcement records.

Data Adequacy

Low – data quantity and quality are partial and medium, respectively, because actions may occur without the knowledge of the NPS given the size and remoteness of much of the wilderness.

Frequency

Every 5 calendar years data for this measure will be entered into the WCMD.

Significant Change

Any change is considered significant for this measure.

Natural Quality

Wilderness maintains ecological systems that are substantially free from the effects of modern civilization.

The Natural Quality of wilderness character assesses the integrity of local ecosystems and their freedom to change and develop without human manipulation. The Natural Quality tracks the effects of human actions and modern civilization on natural ecosystems (in contrast to the Untrammeled Quality which tracks the actions themselves). Ecosystems include all living and non-living things in an area, as well as the interactions between them. Within wilderness, changes to the Natural Quality can be caused directly or indirectly, intentionally or unintentionally. Monitoring ecosystem changes inside wilderness is key to understanding how human actions impact the Natural Quality of wilderness. The majority of data used to monitor measures of the Natural Quality for the Noatak Wilderness are drawn from existing regional monitoring programs to minimize duplicative efforts.

Table 8. Measures of the Natural Quality used to monitor the Noatak Wilderness

Indicator	Measure	Frequency	Data Adequacy	Significant Change	Baseline Value
Plants	2-1: Number of non-native plant species	5 years	Low	Any	0 species
Animals	2-2: Number of human-wildlife incidents	1 year	Low	≥2 incidents	1 incident
Air and water	2-3: Acidifying and fertilizing pollutants	5 years	Medium	Any	3
Ecological processes	2-4: Extent of landscape connectivity	5 years	High	p-value ≤ 0.05	98.94%



Tundra near Desperation Lake. Photo by Nyssa Landres, NPS.

Natural Quality

Plants

2-1: Number of non-native plant species

Wilderness character monitoring baseline	Trend since wilderness designation	
Baseline data value: 0 species Years of data: 2010-2014 (calendar years)		Condition: Good Trend: Stable Confidence: Low

Background & Context

The Noatak Wilderness is home to complex native communities of plants and animals that have developed over thousands of years. The delicate composition of native plant communities is threatened by the influx of invasive plants, which are considered one of the greatest threats to biodiversity (Hooper et al. 2005). Likewise, climate change has the potential to affect the transport and introduction of new species and how they become established (Hellmann et al. 2008). Invasive plants display rapid growth, spread with little or no human assistance, and are expensive to remove and difficult to control once established (Hejda et al. 2009). Invasive plants are a concern because they can threaten the genetic integrity of native flora through hybridization, can out-compete native plant species for limited resources, and can change the structure and function of ecosystems (Walker and Smith 1997). Establishment of invasive plants can also result in a loss of habitat and food sources for native insects, birds, fish, and other wildlife (Hejda et al. 2009).

In the Noatak, the primary areas of concern for the introduction of non-native species are travel corridors, such as the Noatak River, aircraft landing sites, and other locations that receive frequent use. In addition, due to the large size of the Noatak Wilderness, there are concerns about the staff's capacity to detect invasive species before they become widespread. At this time, no non-native or exotic plant species are known to be present in the Noatak Wilderness.

Measure Description & Collection Protocol

This measure monitors the number of non-native or exotic plant species documented within the Noatak Wilderness. All species considered non-native or exotic by the Alaska Exotic Plant Management Team are counted within this measure. This measure monitors the *total* number of known non-native species present in the Noatak Wilderness, not only new discoveries. For instance, if pineapple weed is discovered in 2014, it would contribute a value of "1" to the total value entered into the WCMD every entry thereafter unless pineapple weed is eradicated. As of 2014, there are no known non-native or exotic plant species present in the Noatak Wilderness. However, there is significant potential for non-native plant species to be introduced or found. A list of invasive plant species common to Alaska is available in Table 9, along with the invasiveness ranking of each species on a scale of 1-100, where 100 is the most invasive and 1 is the least, as evaluated by the Alaska Exotic Plant Management Team. The total number of known non-native plant species present in the Noatak Wilderness is entered into the WCMD every five years. Over time, an increase in the number of non-native plant species would indicate a downward trend for this measure.

Definitions

- *Non-native plant species* – plants whose presence in a given area is due to the accidental or intentional introduction by humans.
- *Invasive* – exotic plant species that produce viable offspring in large numbers and have the potential to establish and spread in natural areas.

Data Source

Alaska Exotic Plant Management Team data *and* through Alaska Exotic Plants Information Clearinghouse (AKEPIC), available online at: <http://aknhp.uaa.alaska.edu/maps-js/integrated-map/akepic.php> (accessed August 2014). Both sources should be checked.

Data Adequacy

Low – data quantity and quality are low and medium, respectively, for this measure because data are drawn from the research and datasets of the Alaska Exotic Plant Management Team, which only visits the Noatak Wilderness sporadically. However, data that is collected is of good quality.

Frequency

Every 5 calendar years data for this measure will be entered in to the WCMD.

Significant Change

Any change is considered significant for this measure.

Table 9. Non-native species in the region

Common name	Scientific name	Relative threat level
Common Plantain	<i>Pantago major</i>	44
Herb Sophia	<i>Descurainia sophia</i>	41
Common Dandelion	<i>Taraxacum officianale</i>	58
Foxtail Barley	<i>Hordeum jubatum</i>	63
Shepherd's Purse	<i>Capsella bursa-pastoris</i>	40
Lambsquarters	<i>Chenopodium album</i>	37
Night-flowering Silene	<i>Silene noctiflora</i>	42
Quackgrass*	<i>Elymus repens</i>	59
Mouse-ear Chickweed	<i>Cerastium fontanum</i>	36
Annual Bluegrass	<i>Poa annua</i>	46
Narrowleaf Hawksbeard	<i>Crepis tectorum</i>	56
Elodea**	<i>Elodea canadensis</i>	Unavailable
Bird cherry†	<i>Prunus padus</i>	Unavailable

*Quackgrass is currently of great concern and has been found within 50 miles of the preserve.

**Elodea is an aquatic plant currently found in interior Alaska. It is a species of high concern for the Noatak River and its tributaries.

†Bird cherry tree was found at Walker Lake in Gates of the Arctic National Park in 2012.

Natural Quality

Animals

2-2: Number of human-wildlife incidents

Wilderness character monitoring baseline	Trend since wilderness designation
Baseline data value: 1 incident Year of data: 2014 (calendar year)	 Condition: Warrants moderate concern Trend: Downward Confidence: Low

Background & Context

Wildlife is one of the most iconic aspects of many remote Alaskan parklands. When wildlife and humans encounter each other, it can be dangerous for both parties. Human-wildlife incidents can indicate habituation to humans and deviations from natural behavior patterns. This type of distinct change in the behavior and nature of wildlife correspondingly indicates a change in the Natural Quality of wilderness character.

Measure Description & Collection Protocol

This measure monitors the number of human-wildlife incidents that occur within the Noatak Wilderness over one calendar year. Examples of human-wildlife incidents would include any instances of DLP (defined below), reported instances of wildlife damaging property, consuming human food or garbage, or the deployment of bear spray.

Data on the number of DLPs occurring with the Noatak National Preserve can be obtained by contacting the Alaska Department of Fish & Game (ADF&G). Other instances of human-wildlife incidents are available in the Bear-Human Incident Management System (BHIMS), the Musk Oxen-Human Incident Management System (MHIMS), and any other records of human-wildlife incidents. The number of incidents obtained from these databases are summed, regardless of species, and the total number of human-wildlife incidents is entered into the WCMD. Over time, an increase in the number of human-wildlife incidents would indicate a downward trend for this measure.

Definitions

- *Defensive of Life and Property (DLP)* – when life or property is at risk, individuals may kill game as a defense of life and property. Under Alaska State law, DLP actions are monitored by the ADF&G. All DLP actions are required to be reported to the agency in writing within 15 days of the incident, and surrender the skull and hide (for bears, wolves, etc.) or meat (for moose, caribou, etc.) to the state (5AAC 92.410). ADF&G maintains these records.
- *Incident* – an interaction between wildlife and a human in which wildlife act aggressively. The results of such an interaction can be either benign or injurious to the human.

Data Source

ADF&G databases on DLP actions, available by contacting the Division of Wildlife Conservation; BHMIS, MHIMS and other incident databases available on regional shared drives or by contacting preserve Natural Resources Division.

Data Adequacy

Low – data quantity is partial because data acquisition is through self-reporting and incidents often go unreported. Data quality is low because incident reports are often incomplete. Professional judgement may be used to evaluate or interpret measure over time because of its low data adequacy, for instance, the trend since 1980 was evaluated based on professional judgement.

Frequency

Annually – every calendar year data for this measure will be entered into the WCMD.

Significant Change

A change of 2 incidents or greater is considered significant for this measure.



Wolf tracks on a stream bank. Photo by Doug Demarest, NPS.

Natural Quality

Air and water

2-3: Acidifying and fertilizing pollutants

Wilderness character monitoring baseline	Trend since wilderness designation	
Baseline data value: 3 Years of data: 2010-2014 (calendar years)		Condition: Warrants moderate concern Trend: Downward Confidence: Medium

Background & Context

Pollutants have become a growing concern for air and water quality in the Noatak in recent years. Of particular concern are pollutants that cause acidification or fertilization, such as nitrogen and sulfur, and these are correspondingly monitored as part of the Arctic Network Inventory and Monitoring Program (ARCN) Vital Sign of Wet and Dry Deposition (Lawler et al. 2009). Although the Noatak Wilderness is far away from large cities, pollutants can come from both global deposition brought on winds and with snow and rain, and local sources like the Red Dog Mine just beyond the western edge of the wilderness. Contaminants found in the wilderness have included excess nitrogen and sulfur, mercury and other heavy metals, and persistent organic pollutants (Landers et al. 2008). For the Noatak region, rising levels of sulfur and nitrogen (often from coal-burning in Asia) have the potential to degrade tundra, alpine vegetation, and boreal forest epiphytes, all of which are highly sensitive to these pollutants (Lawler et al. 2009; Sullivan et al. 2011).

Measure Description & Collection Protocol

This measure monitors the condition of acidifying and fertilizing pollutants in the Noatak through air quality assessments conducted by ARCN. This measure represents a holistic state-of-understanding of the status of the acidifying and fertilizing pollutants in the Noatak Wilderness as evaluated by ARCN. As of 2014, this measure draws on multiple values and monitoring methods collected over time and interpreted by ARCN for the Wet and Dry Deposition Vital Sign. Current sampling methods include using the moss *Hylocomium splendens* as a passive sampler, assessing the effects of observed pollutant levels on changes in lichen community structure in long-term vegetation monitoring plots, and incorporating data from the nearest National Atmospheric Deposition Program (NADP) air quality monitoring stations.

In their reports, the ARCN draws conclusions on the changing amounts and impacts of these pollutants in the Noatak. Based on their conclusions, a score is assigned using the index in Table 10. This index pertains only to amounts of acidifying and fertilizing pollutants. Even if other pollutants (such as mercury and other heavy metals) are found to significantly affect other resources, that information is not counted here. To supplement this index, the guidance developed by the national Inventory and Monitoring Branch of Air Quality to evaluate the concentration of nitrogen or sulfur in wet deposition are depicted in Table 11. The categories described in Table 11 are used to inform the overall score assigned based on Table 10. All documents used to assess pollutant levels and determine the assigned score for the Noatak Wilderness must be cited in the “Comments” section of

the WCMD. Over time, an increase in the index score would indicate a downward trend for this measure.

Table 10. Index to evaluate pollutant levels

Assessment of pollutant levels	Score
Low	1
Low-Moderate	2
Moderate	3
High	4
Very high	5

Table 11. Evaluating nitrogen and sulfur concentration

Nitrogen OR Sulfur levels (kg/ha)	Status
<1 kg/ha	Good
1-3	Moderate
>3	Significant concern

Data Source

ARCN reports for the Wet and Dry Deposition Vital Sign, available online at: <http://science.nature.nps.gov/im/units/arcn/vitalsign.cfm?vsid=3> (accessed July 2014); or by contacting Vital Sign PI.

Data Adequacy

Medium – data quantity and quality are moderate because of the lack of consistent monitoring methods available at this time and the ongoing development of monitoring protocol. Data adequacy may be revised as consistent monitoring protocols are finalized.

Frequency

Every 5 calendar years data for this measure will be entered into the WCMD.

Significant Change

Any change is considered significant for this measure.

Natural Quality

Ecological processes

2-4: Extent of landscape connectivity

Wilderness character monitoring baseline

Baseline data value: 98.94%

Years of data: 2010-2014 (calendar years)

Trend since wilderness designation



Condition: Good

Trend: Downward

Confidence: High

Background & Context

Landscape connectivity can be defined as the degree to which a landscape facilitates or impedes movement between resources patches (Taylor et al. 1993). Conversely, fragmentation is considered the disruption of continuity (Lord & Norton 1990). Landscape connectivity and fragmentation are of particular relevance to ecosystem processes because they are vital to landscape structure, (Taylor et al. 1993), metapopulation dynamics (Levins 1970), and depending on the extent of fragmentation, can have a strong bearing on biodiversity (Fahrig 2003). Both connectivity and fragmentation, are commonly assessed via habitat loss (Harrison and Bruna 1999). While the pattern and distribution of habitat loss is an important component of fragmentation and connectivity (Tischendorf & Fahrig 2000; Harrison & Bruna 1999), the limited extent of habitat loss near the Noatak Wilderness make the distribution of habitat loss less meaningful to include at this time.

As a conservation area, the lands encompassed within the Noatak Wilderness are not threatened by fragmentation. However, not all of the lands surrounding the Noatak possess the same level of protection. Some adjacent lands, including areas in the National Petroleum Reserve (managed by the BLM), and areas managed by the State of Alaska, have the potential for resource extraction and other development. Because ecosystem processes and species movements occur across Northwestern Alaska, habitat changes in these surrounding areas affect the integrity of the landscape that includes the Noatak Wilderness.

Localized loss of habitat from human development and alteration is a key component contributing to landscape fragmentation and connectivity. At this time, there is minimal human development that contributes to a loss of connectivity with the Noatak Wilderness. Still, the extent of landscape connectivity is highly relevant to ecological processes and the wilderness character of the area.

Measure Description & Collection Protocol

This measure monitors the percentage of the area within a 10-mile buffer of the edge of the Noatak Wilderness where ecosystems have been explicitly modified or changed by modern humans. This includes any major development, as well as any other appreciable impacts to landscape connectivity by modern human activity. Data are obtained via the National Land Cover Database (NLCD) for Alaska. The land cover dataset for Alaska is downloaded from the Multi-Resolution Land Characteristics Consortium (MRLC) website.

The dataset is imported into a geographic information system (GIS) and clipped to a 10-mile buffer around the preserve boundary. Based on this clip, the total number of 30-meter raster squares that are

classified as “developed” of any intensity, or are known to be developed even if not specifically indicated in the dataset, are subtracted from the total number of pixels. The number that remains reflects the number of “unmodified” pixels, which is then divided by the total number of pixels in the 10-mile buffer zone around the wilderness (excluding the area of the wilderness itself). This results in a percentage of area that is not affected by human-caused change, which is entered into the WCMD. Over time, an increase in the percentage of areas affected by human-caused change would indicate a downward trend for this measure.

Data Source

MRLC website, available online at: <http://www.mrlc.gov/nlcd2011.php> (accessed March 2015), National Land Cover Database for Alaska.

Data Adequacy

High – data quantity is complete because data are available for the complete area needed for analysis. Data quality is medium because the resolution is small enough (30 meters) to capture the majority of developments, but is not considered entirely sufficient because some developments are not coded correctly and need to be verified prior to incorporation in wilderness character monitoring.

Frequency

Every 5 calendar years data for this measure will be entered into the WCMD.

Significant Change

Linear regression analysis, $\alpha = 0.05$, for all data available is used to determine if there is a significant trend in the measure. No trend is available at this time.

Table 12. Detailed data, extent of landscape connectivity

Total number of pixels:	19,069,508
Number of human-modified pixels:	202,417
Number of unaffected pixels:	18,867,091
Percentage of intact landscape connectivity:	98.94%

Undeveloped Quality

Wilderness retains its primeval character and influence, and is essentially without permanent improvement or modern human occupation.

The Undeveloped Quality of wilderness is the most familiar and recognizable quality of wilderness for many people. Without buildings, evidence of other humans, or improvements on the landscape, the Undeveloped Quality of wilderness speaks to “man himself as a visitor who does not remain” and the absence of lasting improvements to the landscape that would change this visitor relationship. Motor vehicles, motorized equipment, and mechanical transport also affect how humans interact with wilderness landscapes. These uses likewise diminish the primeval character and influence of wilderness, and are correspondingly monitored within the Undeveloped Quality of wilderness character.

Table 13. Measures of the Undeveloped Quality used to monitor the Noatak Wilderness

Indicator	Measure	Frequency	Data Adequacy	Significant Change	Baseline Value
Presence of non-recreational structures, installations, and developments	3-1: Number of sub-surface installations	1 year	High	p-value ≤ 0.05	287 sub-surface installations
	3-2: Number of above-ground developments	1 year	High	Any	17 above-ground developments
	3-3: Weight of abandoned debris	5 years	Medium	≥ 500 lbs	7,600 lbs
Presence of inholdings	3-4: Acres of inholdings	5 years	High	Any	2,164 acres
Use of motor vehicles, motorized equipment, or mechanical transport	3-5: Number of helicopter supported projects	1 year	High	≥ 2 projects	6 projects
	3-6: Hours of fixed-wing aircraft flight time	1 year	Medium	p-value ≤ 0.05	305 hours
	3-7: Miles of administrative snowmachine use	1 year	Medium	p-value ≤ 0.05	528 miles

Undeveloped Quality

Presence of non-recreational structures, installations, and developments

3-1: Number of sub-surface installations

Wilderness character monitoring baseline	Trend since wilderness designation
Baseline data value: 287 sub-surface installations Year of data: 2014 (calendar year)	 Condition: Warrants moderate concern Trend: Downward Confidence: High

Background & Context

The presence of permanent, non-recreational structures directly affects the Undeveloped Quality of the Noatak Wilderness. While sub-surface installations (e.g., rebar site markers) do not affect the viewshed of the wilderness, they are permanent installations in wilderness and thus important to monitor because they influence wilderness character. These sub-surface or near surface installations are typically used to mark research plots or specific resources, such as those markers used for cultural resources documentation. These installations constitute the majority of installations in the Noatak Wilderness as of 2014.

Measure Description & Collection Protocol

This measure monitors the number of permanent, sub-surface installations in the Noatak Wilderness.

All sub-surface and flush-with-surface installations in the Noatak Wilderness are counted in this measure, including sub-surface rebar stakes that mark study locations and number cultural resource site markers that are typically flush to the ground surface. Any installations in place longer than six months are considered permanent for the purposes of this measure, in accordance with monitoring protocols developed by the Alaska Region GIS Team.

Data on installations in Alaska National Parks are coordinated and managed by the Alaska Region GIS Team following the release of a memorandum, "Implementation of Science in Wilderness Working Group Recommendations," signed by the Regional Director in July 2010. This memorandum called for a baseline GIS layer of installations and facilities in parks to be established and maintained for all Alaska National Parks. This measure draws directly on that data.

The installations dataset can be found in Alaska Pak Theme Manager through ArcGIS, where installations are divided into four categories: "instrumentation," "communications," "markers," and "generic." Installations are also classified as "above surface," "below surface," or "flush with surface." To obtain the data on the number of research plot markers, the marker layer must be queried for the number of installations that are "below surface" or "flush with surface." To obtain data for the number of cultural resource site markers, the Cultural Resources Division must be contacted. The number of installations derived from each source is summed and the total number of sub-surface installations is entered into the WCMD. Over time, an increase in the number of sub-surface installations would indicate a downward trend for this measure.

Definitions

Sub-surface installation – any installation that is completely below ground level, or does not extend higher than the ground surface at any point. If an installation has both above-ground and sub-surface components (e.g., a weather station that is set in the ground), the installation is considered above-surface.

Data Source

“Installations in Wilderness” dataset developed and maintained by the Alaska Region GIS team. Data from this layer are available through the Alaska Pak in ArcGIS, or by contacting the regional GIS team. Cultural resource monumentation data is obtained by contacting the preserve Cultural Resource Division.

Data Adequacy

High – data adequacy is high because the database contains comprehensive information on installations in the Noatak Wilderness and protocols are in place to update this information periodically.

Frequency

Annually – every calendar year data for this measure will be entered into the WCMD.

Significant Change

Linear regression analysis, $\alpha = 0.05$, for all data 1980-present is used to determine if any site has a significant trend. At this time there, is a statistically significant downward trend in the data (p-value = 0.0004).

Table 14. Legacy data, number of sub-surface installations

Year	Additional sub-surface installations placed	Total sub-surface installations present
1980	0	0
2004	12	12
2011	103	115
2013	93	208
2014	79	287

Undeveloped Quality

Presence of non-recreational structures, installations, and developments

3-2: Number of above-ground developments

Wilderness character monitoring baseline

Baseline data value: 17 above-ground developments
Year of data: 2014 (calendar year)

Trend since wilderness designation



Condition: Good
Trend: Downward
Confidence: High

Background & Context

The presence of permanent, non-recreational installations and structures directly influences the Undeveloped Quality of the Noatak Wilderness. In particular, installations that rise above ground level are often highly visible due to the region's predominantly low-lying vegetation and expansive views. As of 2014, the majority of installations in the Noatak are sub-surface or flush-with-surface installations (monitored in measure 3-1). Larger, above-ground developments are fewer in number and range from scientific equipment such as weather monitoring stations, to ranger stations.

ANILCA allows for the construction of permanent installations for subsistence purposes. Proposed developments typically prompt an EA under NEPA and a MRA to be conducted before being constructed. The development of any installations or structures, regardless of their purpose, influences the Undeveloped Quality of the area's wilderness character.



Kelly River Ranger Station. Photo by Phil Wescott, NPS.

Measure Description & Collection Protocol

This measure monitors the number of permanent, non-recreational, above-ground installations and structures in the Noatak Wilderness. The total number of installations and structures present in the wilderness is counted annually. Any installations in place longer than six months are considered permanent for the purposes of this measure, in accordance with monitoring protocols developed by the Alaska Region GIS Team.

Data on installations in Alaska National Parks are coordinated and managed by the Alaska Region GIS Team following the release of a memorandum, "Implementation of Science in Wilderness Working Group Recommendations," signed by the Regional Director in July 2010. This memorandum called for a baseline GIS layer of installations and facilities in parks to be established and maintained for all Alaska National Parks. This measure draws directly on that data.

The installations dataset can be found in Alaska Pak Theme Manager through ArcGIS, where installations are divided into four categories: "instrumentation," "communications," "markers," and "generic." Installations are also classified as "above surface," "below surface," or "flush with



Climate monitoring station in the Noatak Wilderness. Photo by Ken Hill, NPS.

surface.” To obtain the data on the number of research plot markers, the marker layer must be queried for the number of installations that are “below surface” or “flush with surface.” To obtain data for the number of cultural resource site markers, the Cultural Resources Division must be contacted. The number of installations derived from each source is summed and the total number of sub-surface installations is entered into the WCMD. Over time, an increase in the number of above-ground developments would indicate a downward trend for this measure.

Definitions

Above-ground development – any installation or structure that extends above the surface of the ground. If an installation has both above-ground and sub-surface components (e.g., a weather station that is set in the ground), the installation is considered above-ground.

Data Source

“Installations in Wilderness” dataset developed and maintained by the Alaska Region GIS team. Data from this layer are available through the Alaska Pak in ArcGIS, or by contacting the regional GIS Team.

Data Adequacy

High – data adequacy is high because the database contains comprehensive information on installations in the Noatak Wilderness and protocols are in place to update this information periodically.

Frequency

Annually – every calendar year data for this measure will be entered into the WCMD.

Significant Change

Any change is considered significant for this measure.

Table 15. Legacy data, number of above-ground developments

Year	Additional installations placed	Total installations present
1980	0	6
1986	1	7
1987	1	8
1989	1	9
2009	2	11
2011	3	14
2012	2	16
2014	1	17

Table 16. Detailed data, above-ground developments

Type of installation	Number
Instrumentation	11
Administrative installation	6
Total value entered into WCMD:	17

Undeveloped Quality

Presence of non-recreational structures, installations, and developments

3-3: Weight of abandoned debris

Wilderness character monitoring baseline

Baseline data value: 7,600 lbs
Years of data: 2010-2014 (calendar years)

Trend since wilderness designation



Condition: Warrants moderate concern
Trend: Upward
Confidence: Medium

Background & Context

Large trash in wilderness is an issue that affects many of Alaska's wilderness areas as a result of activities that occurred prior to the area's designation as wilderness, such as mining operations or military exercises. In the Noatak Wilderness, debris includes remnants from military training exercises in the 1960s, discarded 55-gallon drums, trespass cabins, downed aircraft, abandoned snowmachines, and abandoned caches or other large items. Consistent with guidance in *Keeping It Wild 2*, this "mega-trash" is considered to affect the Undeveloped Quality of wilderness.



Abandoned trailer in the Noatak Wilderness. Photo by Dan Stevenson, NPS.

The total weight of known trash items in wilderness represents a highly significant measure for wilderness character monitoring. With this information, managers are able to easily assess both the impact of debris on wilderness character and the direct benefit to wilderness character from stewardship actions to remove it.

In 2007, managers of the Noatak Wilderness began an initiative to remove old fuel pods from the wilderness. Over the subsequent seven years, approximately 24,000 lbs of debris and trash (mostly fuel pods) were removed. No known fuel pods remain in the Noatak Wilderness as of 2014.

Measure Description & Collection Protocol

This measure monitors the weight of all known debris in the Noatak Wilderness. Micro-trash (small items such as small amounts of trash found at campsites, wrappers, ropes, or other small items) is not monitored as a part of this measure. The value reported in the WCMD is necessarily an estimate and

may rise significantly if new locations of discarded debris are discovered. The total weight of known debris present in the wilderness is entered into the WCMD every five calendar years, so as to more accurately capture changes in information about the weight of debris in wilderness and to capture the effects of stewardship actions. Over time, a decrease in the total weight of abandoned debris in wilderness (e.g., via the discovery of additional large debris) would indicate an upward trend for this measure.

Data Source

Chief Ranger and Backcountry or Law Enforcement Rangers.

Data Adequacy

Medium – data quality is medium because many numbers relating to item quantity and weight are estimated due to the nature of the debris. Data quantity is partial because only known debris can be included.

Frequency

Every 5 calendar years data for this measure will be entered in to the WCMD.

Significant Change

Change of 500 lbs or greater is considered significant for this measure.

Table 17. Legacy data, weight of abandoned debris

Year	Weight of known debris
1980 – 2006	32,000 lbs
2007-2009	20,000 lbs
2010-2012	8,000 lbs
2013-present	7,600 lbs

Table 18. Detailed data, baseline value of weight of abandoned debris

Item	Known number	Weight (lbs)	Total (lbs)
55-gallon drum	120	45	5,400
Fuel pod	0	0	0
5-gallon gas can	150	8	1,200
Abandoned snowmachine	1	400	400
Abandoned jeep trailer	1	600	600
Weight of debris in wilderness:			7,600 lbs

Undeveloped Quality

Presence of inholdings

3-4: Acres of inholdings

Wilderness character monitoring baseline	Trend since wilderness designation
Baseline data value: 2,164 acres Years of data: 2010-2014 (fiscal years)	 Condition: Good Trend: Stable Confidence: High

Background & Context

Inholdings, including allotments, are prevalent in Alaskan wilderness and the Noatak National Preserve. The acres of inholdings is significant to wilderness character because inholdings are not subject to the same management restrictions as the surrounding lands that are managed as wilderness. These lands can be developed for purposes at the discretion of the landowner, and thereby have the potential to significantly impact the wilderness area. As of 2014, there are eight developments on inholdings inside the Noatak Wilderness.

Measure Description & Collection Protocol

This measure monitors the total acres of inholdings and allotments present within the Noatak Wilderness boundary. Acres of Native Corporation selections are not included in this measure because they are not inholdings or allotments. While Native Corporation selections may be subject to the same levels of protection as the surrounding wilderness depending on their location, they are generally considered as “Limited or Non-NPS Interest Lands” until their land status is resolved.

Data can be obtained by querying the NPS Land Status Geodatabase through the AK Pak Theme Manager. The total acres of privately held inholdings and allotments within the Noatak Wilderness, including those that are natively owned, is reported in the WCMD. Over time, a decrease in the total acres of inholdings would indicate an upward trend for this measure.

Data Source

NPS Land Status Geodatabase available through the AK Pak Theme Manager, or by contacting the Lands Department at the Alaska Regional Office.

Data Adequacy

High – data quantity and quality are high because of the formal process by which inholdings are acquired as well as the involvement of the Lands Department of the Alaska Regional Office which thoroughly documents these transfers.

Frequency

Every 5 fiscal years data for this measure is entered into the WCMD.

Significant Change

Any change is considered significant for this measure.

Table 19. Supplemental data, acres of inholdings

Ownership	Acres
Inholdings/allotments	2,164
Native Corporation selections	3,205

Undeveloped Quality

Use of motor vehicles, motorized equipment, or mechanical transport

3-5: Number of helicopter supported projects

Wilderness character monitoring baseline

Baseline data value: 6 projects
Year of data: 2014 (calendar year)

Trend since wilderness designation



Condition: Good
Trend: Stable
Confidence: High

Background & Context

Under the provisions of the Wilderness Act, helicopters are to be used in wilderness only when they are the “minimum tool necessary to meet minimum requirements for the administration of the area for the purpose of [the Wilderness Act, Section 4(c)].” With its remoteness and difficulty of access, helicopters are sometimes necessary to reach locations in the Noatak Wilderness. Helicopters are used for a variety of projects, ranging from research to law enforcement, on a situation-dependent basis when the necessary point of access is not near a known landing strip or a lake viable for landing a float plane. Unlike fixed-wing aircraft which require landing strips or lakes to take off or land, helicopters have virtually no restrictions on access. With developing technologies, helicopters may, in some circumstances, be quieter than fixed-wing aircraft. However, they are not mentioned in ANILCA as an allowable use, in contrast to fixed-wing aircraft, and thus hold a different place in the law and management framework of the preserve.

While private helicopters are not monitored within this measure, this use may become more common in the Noatak Wilderness in the future. As fuel efficiency rises and the cost of helicopters themselves decreases, more local pilots who may or may not be aware of restrictions in the area may use privately owned helicopters to access areas in the Noatak Wilderness. Private helicopters may be used to access inholdings.



Helicopter removing abandoned fuel pod from the Noatak Wilderness. Photo by Dan Stevenson, NPS.

Measure Description & Collection Protocol

This measure monitors the number of projects that are supported by helicopters. The number of helicopter hours involved in each project is not counted in order to more fairly account for when helicopters are the minimum tool required to fulfill stewardship needs. Emergency use of helicopters

is not counted as part of this measure. The total number of helicopter supported projects is obtained by contacting the preserve's Research Coordinator and Law Enforcement Division. Over time, an increase in the number of helicopter supported projects would indicate a downward trend for this measure.

Data Source

Compliance documentation collected by the preserve Research Coordinator.

Data Adequacy

High – data quantity and quality are high because all helicopter supported projects are authorized by the preserve compliance team, thus providing complete and reliable data.

Frequency

Annually – every calendar year data for this measure will be entered into the WCMD.

Significant Change

A change of 2 or more projects is considered significant for this measure.

Table 20. Legacy data, number of helicopter supported projects

Year	Number of projects
2011	6 projects
2012	6 projects
2013	8 projects
2014	6 projects



Helicopter in Noatak Wilderness. Photo by Dan Stevenson, NPS.

Undeveloped Quality

Use of motor vehicles, motorized equipment, or mechanical transport

3-6: Hours of fixed-wing aircraft flight time

Wilderness character monitoring baseline

Baseline data value: 305 hours
Year of data: 2014 (fiscal year)

Trend since wilderness designation



Condition: Good
Trend: Stable
Confidence: Medium

Background & Context

Fixed-wing aircraft are one of the primary modes of access to Alaskan wilderness areas due to the remoteness and scale of the landscape. Although allowed under ANILCA and Department of Interior regulations for specified purposes, use of fixed-wing



Cessna 206 in the Noatak Wilderness. Photo by Josh Morehouse, NPS.

aircraft, including float planes and wheeled planes, in wilderness impacts wilderness character and is therefore relevant to monitor in the Noatak Wilderness. The majority of preserve operations use fixed-wing aircraft for transport to and from preserve locations.

Measure Description & Collection Protocol

This measure monitors the hours of fixed-wing aircraft flight time in the Noatak Wilderness. All hours of administratively authorized, non-emergency flight time are counted here, including law enforcement flights, researcher flights, survey flights, and flights for visitors from regional or other offices. Flights conducted by private pilots or vendors for visitor, commercial, or hunting purposes are not counted here, as they cannot be reliably monitored at this time.

Data for this measure are obtained from the annual Office of Aviation Services (OAS) reports. These reports provide a breakdown of aircraft flight time by park in the Northern Hub zone, which includes all of the WEAR parklands. All flight hours pertaining to the Noatak Wilderness and for which WEAR pays for fuel and flight time should be included in this measure. Thus, even when the

flight is empty, its hours are counted; for instance, as would occur when a flight is dropping off a crew and will fly without NPS passengers on its return flight (known as “deadhead” flights). In other words, hours from both the flight to, and from, the site will be counted.

Data may also be obtained by querying OAS datasets based on the cost of fixed-wing flight time billed to the preserve. For this method, OAS database managers must be given the appropriate cost centers and billee code. When queried in this way, all WEAR operations are returned and so must be filtered by working with each Division (i.e., Law Enforcement, Natural Resources, Cultural Resources, Maintenance, etc.) to determine which flight hours pertained to the Noatak. The Division flight hours are then summed to calculate the total flight hours for the wilderness.

To calculate the total number of flight hours reported, the total hours estimated by each Division are summed, is entered into the WCMD. Data are reported based on fiscal year for this measure so as to allow for data acquisition using budget records. Over time, an increase in the number of hours of fixed-wing aircraft time would indicate a downward trend for this measure.

Data Source

OAS annual reports, available by contacting the Northern Hub Aviation Manager. Alternately, OAS datasets can be queried by cost center and WEAR billee code in the Financial Business Management System (FBMS) and Asset Management System (AMS), respectively.

Data Adequacy

Medium – data quantity and quality are partial and medium, respectively, because hours and flights are often not distinguished between parklands. Likewise, time spent flying to the preserve, but not yet in the preserve, is counted in this measure. Data adequacy may improve in the future if more stringent protocols are put in place to comprehensively monitor overflights.

Frequency

Annually – every fiscal year data for this measure will be entered into the WCMD.

Significant Change

Linear regression analysis, $\alpha = 0.05$, for all data 1990-present is used to determine if any site has a significant trend. At this time there is no statistically significant trend in the data (p-value = 0.62).

Table 21. Legacy data, hours of fixed-wing aircraft flight time

Fiscal year	Estimated number of hours*
1990	562
1991	509
1992	321
1993	298
1994	317
1995	354
1996	265
1997	240
1998	231
1999	251
2000	228
2001	250
2002	281
2003	217
2004	263
2005	174
2006	170
2007	212
2008	175
2009	231
2010	714
2011	644
2012	559
2013	451
2014	305

* Data from 1990-2008 were calculated based on the assumption that 40% of WEAR flight hours occurred in the Noatak (based on professional judgement). Data from 2009-2014 were calculated based on the assumption that 70% of flight hours occurred in the Noatak due to the addition of ARCN flight hours, which are not otherwise accounted for in this reporting.

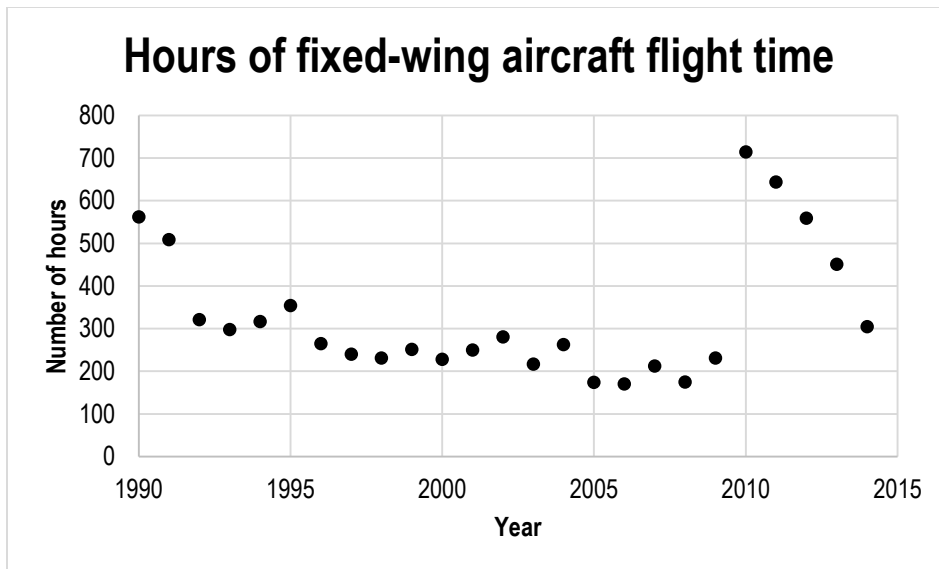


Figure 5. Hours of fixed-wing aircraft flight time legacy data.



NPS Super Cub plane on a gravel bar in Noatak Wilderness. Photo by Charles Olin, NPS.

Undeveloped Quality

Use of motor vehicles, motorized equipment, or mechanical transport

3-7: Miles of administrative snowmachine use

Wilderness character monitoring baseline	Trend since wilderness designation
Baseline data value: 528 miles Year of data: 2014 (fiscal year)	 Condition: Good Trend: Upward Confidence: Medium

Background & Context

Under ANILCA, snowmachines are allowed in Alaskan wilderness areas and are used as one of the primary modes of access in the winter months. Although both administrators and the public use snowmachines in the wilderness, the majority of use generally comes from local residents and occurs within approximately 50 miles of Kotzebue and the village of Noatak. In the Noatak, most snowmachine use occurs in the lands eligible for designation as wilderness because this area is closer to Kotzebue and other villages. Limited snowmachine use occurs in the federally designated portion of the Noatak Wilderness due to the area's remoteness.

Administrative snowmachine use is strongly influenced by changing budgets and personnel. In years where more staff have experience working with snowmachines and budgets are more flexible, considerably more administratively-authorized snowmachine use occurs. In addition, the reality that administrative use is distributed across all four parklands means that only approximately one third of administratively-authorized snowmachine use out of Kotzebue goes into the Noatak National Preserve and Wilderness.

Measure Description & Collection Protocol

This measure monitors the number of miles traveled by administrative and other administratively-authorized snowmachines in the Noatak Wilderness. All miles of administratively-authorized, non-emergency snowmachine travel are counted here and may include backcountry patrols, law enforcement patrols, researcher use, or any other use conducted by the NPS. Snowmachine use by private individuals is not counted here as this use cannot be reliably monitored at this time. If use levels by other users becomes available (through acoustic monitoring or other methods) it will be included in this measure and noted in the WCMD.

Miles are used as the unit of monitoring because they allow accurate monitoring of use levels without requiring careful documentation of use-days, which can be difficult to quantify for extended projects using multiple snowmachines and spanning multiple parklands. As of 2014, administrative and authorized snowmachine use is particularly low following years of low budgets and minimal backcountry staff.

To obtain data for this measure, project leaders for each Division (including, but not limited to the Law Enforcement, Cultural Resources, and Natural Resources Divisions) must be contacted to obtain an estimate of the number of miles traveled in the Noatak Wilderness each fiscal year. In addition, the preserve Research Coordinator should be consulted to obtain an estimate of miles traveled by

authorized researchers. Mileage estimates should include all trips authorized by WEAR and trips for which WEAR paid the fuel costs. This measure is based on the fiscal year to allow for continuous winter reporting. The estimated mileages of each Division are summed to attain the total number of miles, this total is entered into the WCMD. Over time, an increase in the number of hours of administrative snowmachine use would indicate a downward trend for this measure.

Data Source

Project leaders for each Division must be consulted for their estimate of use.

Data Adequacy

Medium – data quantity and quality are partial and medium, respectively, because the mileage is an estimate and it can be tough to differentiate mileage traveled at which park unit, as well as account for time spent traveling to the parklands.

Frequency

Annually – every fiscal year data for this measure will be entered into the WCMD.

Significant Change

Linear regression analysis, $\alpha = 0.05$, for all data available is used to determine if any site has a significant trend. At this time there is a statistically significant improving trend in the measure (p-value = 0.000).

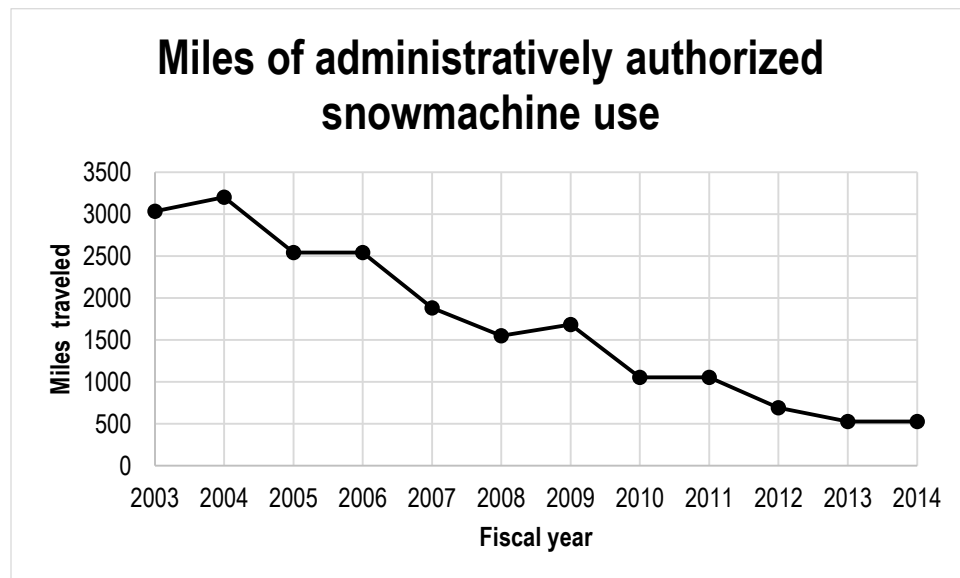


Figure 6. Miles of administratively authorized snowmachine use over time.

Solitude or Primitive and Unconfined Recreation Quality

Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation.

Opportunities for solitude or primitive and unconfined recreation can be difficult to find as modernization and civilization continue to expand. Managers cannot guarantee or require that visitors experience solitude or a primitive and unconfined type of recreation. Still, managers must protect and uphold the opportunity to have these experiences, even if not all visitors choose to partake in them. The Solitude or Primitive and Unconfined Recreation Quality focuses on the tangible aspects of the setting that affect the visitor experience, and not on the subjective nature of the visitor experience itself. Many intangible aspects of wilderness recreation (challenge, self-reliance, self-discovery, etc.) are not monitored under this quality, but are still integral to the wilderness experience.

Table 22. Measures of the Solitude or Primitive and Unconfined Recreation Quality used to monitor the Noatak Wilderness

Indicator	Measure	Frequency	Data Adequacy	Significant Change	Baseline Value
Remoteness from sights and sounds of human activity <i>inside</i> the wilderness	4-1: Number of visitors	1 year	Low	p-value ≤ 0.05	512 visitors
	4-2: Number of researcher-days	1 year	Medium	p-value ≤ 0.05	487 days
Remoteness from sights and sounds of human activity <i>outside</i> the wilderness	4-3: Average number of aircraft overflights	1 year	Low	p-value ≤ 0.05	0.5 overflights per day
Facilities that decrease self-reliant recreation	4-4: Number of aircraft landing sites	5 years	High	Any	83 landing sites
Management restrictions on visitor behavior	4-5: Index of management restrictions	5 years	High	Any	7



Unnamed creek in the DeLong Mountains. Photo by Nyssa Landres, NPS.

Solitude Or Primitive And Unconfined Recreation Quality

Remoteness from sights and sounds of human activity *inside* the wilderness

4-1: Number of visitors

Wilderness character monitoring baseline

Baseline data value: 512 visitors
Year of data: 2014 (fiscal year)

Trend since wilderness designation



Condition: Good
Trend: Stable
Confidence: Low

Background & Context

Opportunities for solitude in the Noatak Wilderness are unparalleled. The expectation in the Noatak is often one of complete solitude, where seeing any other visitor, even when crossing hundreds of miles, can significantly affect the experience. In comparison to the millions of acres that make up the wilderness, the number of visitors often seems small, yet the number of visitors to the Noatak Wilderness has a significant bearing on the opportunities for solitude available inside the Noatak. It is notable that for many Alaskans encountering other visitors in the bush is a positive experience – a chance to talk with other people after long spells of being alone or with a small group. While this dynamic is rare in wilderness areas in the continental U.S., it lives on in this remote Alaskan preserve.



Hiker in Siniktanneyak Mountains in Noatak Wilderness. Photo by Adrienne Lindholm, NPS.

Visitors to the Noatak Wilderness typically arrive via concessionaires permitted by the preserve with Commercial Use Agreements (CUA[s]). Given the remoteness of the Noatak Wilderness, most non-local visitors use airplanes or boats operated by these CUA holders to access the wilderness. CUA holders provide a wide range of activities including air taxis, backpacking guides, boating trips, transport, photography, and sportfishing. Local visitors may also access the Noatak Wilderness by private airplane, boat, or snowmachine, but due to monitoring methods in place as of 2014, local visitors are not counted in this measure at this time.

Measure Description & Collection Protocol

This measure monitors the number of visitors to the Noatak Wilderness documented via CUA agreements. At the end of the fiscal year, all CUA holders operating within the Noatak National Preserve and Wilderness must provide a report to the NPS that includes the number of visitors they

took into the preserve and wilderness. To obtain data for this measure, the number of visitors reported across all CUA holders operating in the Noatak Wilderness is counted, and the total number of visitors is reported in the WCMD. Over time, a decrease in the number of visitors would indicate an upward trend in this measure.

Data Source

CUA annual reports collected by the Concessions Department; access is controlled and may be gained by contacting Concessions Department personnel.

Data Adequacy

Low – data quantity is partial because local and private users are unaccounted for at this time. Data quality is medium because the data available are self-reported.

Frequency

Annually – every fiscal year data for this measure will be entered into the WCMD.

Significant Change

Linear regression analysis, $\alpha = 0.05$, for all data available is used to determine if any site has a significant trend. At this time no statistically significant trend can be determined as there are not yet five data points.



Maiyumerak Mountains, Noatak National Preserve. Photo by Ken Hill, NPS.

Unconfined Recreation Quality

Remoteness from sights and sounds of human activity *inside* the wilderness

4-2: Number of researcher-days

Wilderness character monitoring baseline

Baseline data value: 487 days
Year of data: 2014 (calendar year)

Trend since wilderness designation



Condition: Good
Trend: Stable
Confidence: Medium

Background & Context

Research opportunities in the Noatak Wilderness are extensive and research is one of the primary uses of the area. Both the establishing legislation of the preserve and the area's designation as a United Nations Biosphere Reserve, which was established in 1976, affirm the exceptional value of research in the Noatak. One of the fundamental roles wilderness serves nationwide is as a natural laboratory for ecosystem change and processes. The value of research and monitoring in wilderness has been documented by Graber (2002), McCool and Cole (2000), Parsons (2000), and others, establishing that wilderness provides one of the premier environments to understand the natural processes and long-term change of natural environments (Six et al. 2000), the effects of global climate change (Graumlich 2000), and other anthropogenic threats (for example, Duriscoe 2001).

Research is a fundamental component of the Noatak Wilderness. At the same time, research effects the remoteness of the area by bringing increased sights and sounds of people into the wilderness. Like any other visitor group, effects from groups of researchers arise from the presence of the people themselves and if not managed properly can result in evidence left behind after the project, such as social trails or trampled vegetation, caused by concentrated, albeit temporary, use.

The majority of research projects in the Noatak Wilderness are conducted by the NPS itself, namely by ARCN or preserve staff (Hasselbach 2010). However, non-NPS projects, while fewer in number, have often been the largest projects in terms of number of field days and/or size of crews. NPS and non-NPS research use are combined into a single measure here because they have comparable effects on wilderness character.



Vegetation research near Primus Creek.
Photo by Nyssa Landres, NPS.

Measure Description & Collection Protocol

This measure monitors the number of researcher-days, as determined from data provided via the NPS-WEAR compliance process. The reality of variable weather conditions and changing plans makes monitoring the actual number of days spent in the field problematic. As a result, this measure focuses on the number of field-days approved in advance by the compliance team. The preserve Research Coordinator keeps track of researchers' proposed project dates and the number of individuals involved.

To calculate the data value, the number of field days per project are first multiplied by the number of participating individuals to attain the number of researcher-days per project. This number is then summed for all projects within a calendar year, and entered into the WCMD. For example, a crew with 8 days in the field for a 3 person crew, would contribute a value of 24 to the total number of researcher-days reported. The final number of researcher-days occurring in a one year period is reported in the WCMD. Over time, a decrease in the number of researcher-days would indicate an upward trend for this measure.

Data Source

Compliance documentation collected by preserve Research Coordinator.

Data Adequacy

Medium – data quantity is complete because data are available for all research projects via the compliance and permitting process. Data quality is medium because the numbers reported are based on the project proposal approved by the compliance team, which may not reflect the actual number of days spent in the field or the number of individuals involved.

Frequency

Annually – every calendar year data for this measure will be entered into the WCMD.

Significant Change

Linear regression analysis, $\alpha = 0.05$, for all data available is used to determine if any site has a significant trend. At this time no statistically significant trend can be determined as there are not yet five data points.

Table 23. Legacy data, number of researcher-days

Year	Researcher-days*
2011	864 days
2012	456 days
2013	563 days
2014	487 days

* The total number of days spent in the field by all researchers (NPS and non-NPS) in NOAT (e.g., a 4 day project by a team of 3 people equals 12 'researcher days').

Solitude Or Primitive And Unconfined Recreation Quality

Remoteness from sights and sounds of human activity *outside* the wilderness

4-3: Average number of aircraft overflights

Wilderness character monitoring baseline	Trend since wilderness designation	
Baseline data value: 0.5 overflights per day Year of data: 2014 (calendar year)		Condition: Good Trend: Stable Confidence: Low

Background & Context

Aircraft are one of most common impacts to the outstanding opportunities for solitude within the Noatak Wilderness. Frequently crossing the airspace above the Noatak Wilderness, aircraft correspondingly affect the opportunities for solitude and remoteness experienced inside the wilderness. Across the Noatak, amounts of aircraft overflights are highly variable. Some areas that serve as aircraft access routes in poor weather (often low elevation routes through the mountains), experience much higher levels of traffic are seen than in other areas. Conversely, areas on the edge of the Noatak experience much less air traffic. Across this range of overflight density, the Noatak still generally maintains a very high degree of solitude. In aggregate, the extent of these overflights provide a glimpse into how opportunities for visitors to experience solitude and remoteness may be changing over time.

Measure Description & Collection Protocol

This measure monitors the average number of aircraft overflights that are counted per day in the backcountry during the calendar year. Overflights are tracked as part of law enforcement and wilderness stewardship backcountry trips, and when possible, natural and cultural resource trips as well. The number of overflights observed are available to the Chief Ranger either in trip reports by rangers or in data reported by the Division leads when asked.

For the purpose of this measure, “overflights” are considered any instance when low-flying aircraft (excluding jets) are observed or heard. Aircraft are counted similarly regardless of who is operating the aircraft and the purpose of their mission. For example, a concessionaire aircraft, private aircraft, or preserve aircraft are all counted the same: as one overflight per plane observed or heard. To calculate the value reported for this measure, data are compiled for a single calendar year and the total count of overflights is divided by the number of days that data collection occurred. This average number of overflights per day is entered into the WCMD. Over time, a decrease in the average number of aircraft overflights would indicate an upward trend for this measure.

Data Source

Chief Ranger; backcountry trip reports.

Data Adequacy

Low – data quantity is partial because data are based off a small sample size. Data quality is medium because reporting may be incomplete.

Frequency

Annually – every calendar year data for this measure will be entered into the WCMD.

Significant Change

Linear regression analysis, $\alpha = 0.05$, for all data available is used to determine if any site has a significant trend. At this time no statistically significant trend can be determined as there are not yet five data points.



Alpine lake in the Baird Mountains. Photo by Ken Hill, NPS.

Unconfined Recreation Quality

Facilities that decrease self-reliant recreation

4-4: Number of aircraft landing sites

Wilderness character monitoring baseline	Trend since wilderness designation
Baseline data value: 83 landing sites Years of data: 2010-2014 (calendar years)	 Condition: Good Trend: Stable Confidence: High

Background & Context

Aircraft landing sites are one of the only ways to access the Noatak Wilderness. The landing sites in the Noatak Wilderness are a loosely documented set of locations, known almost exclusively by local pilots, that act as portals by allowing people to access the wilderness without needing to travel hundreds of miles by boat, snow machine, or foot. Landing sites are counted here as facilities that decrease self-reliant recreation because the access they provide diminishes opportunities for primitive recreation. While landing strips in the Noatak Wilderness are not “hardened” or formally recognized by the preserve, and often shift from year to year as gravel bars are re-distributed by the river, their prevalence is important to monitor.

Measure Description & Collection Protocol

This measure counts the total number of regularly used landing sites in the Noatak Wilderness that are accessed by fixed-wing aircraft. Many sites in the preserve could serve as landing sites, so to more accurately monitor the sites, this measure counts only those landing sites that are commonly used.

For upland sites to be counted they must allow access by wheeled plane, have a history of use *or* have been illegally modified so as to create a viable landing site. For gravel bar sites to be counted they must allow access via wheeled plane, and have been consistently located and used at least once in the past five calendar year monitoring period. Gravel bars that are re-distributed every year or few years create some ambiguity in monitoring, however, by assessing these sites based on whether or not they used within the monitoring period, regardless of aircraft type (e.g, Scout, Super Cub, Cessna 185, or Cessna 206), this ambiguity is reduced to an acceptable level. For float plane sites to be counted they must be consistently used within the monitoring period. While these definitions still allow some subjective assessment, the intent is to provide guidance that ensures the most consistent and reliable monitoring possible. A full list of landing sites currently assessed as part of this measure is available in WEAR documentation.

These criteria and specifications are intended to further verify the intent of this measure: to quantify the number of sites being used, not the number of sites that could be used. Landing sites that are in use indicates to what extent people are not taking advantage of opportunities for primitive recreation. The total number of landing sites meeting the criteria above are reported in the WCMD. Over time, a decrease in the total number of landing sites would indicate an upward trend for this measure.

Definitions

Landing site – a landing area used by wheeled plane or float planes. The term is inclusive of all upland sites, gravel bars, and lakes with viable landing for aircraft.

Landing strip or airstrip – a visible, marked, or known aircraft landing area. Airstrips may be marked, or unmarked but recognizable because they have been cleared of vegetation or other obstructions” (36 CFR 13.1). Landing strips for wheeled aircraft are typically 1000 feet long, exhibit wheel tracks down their length, and have disturbed or absent vegetation (depending on use levels).

Data Source

Chief Ranger and Backcountry or Law Enforcement Rangers.

Data Adequacy

High – data quantity and quality are partial and high, respectively, because sites that facilitate extensive access and are frequently used are documented, and only those that are infrequently used may be absent.

Frequency

Every 5 calendar years data for this measure will be entered into the WCMD.

Significant Change

Any change is considered significant for this measure.



Landing strip in the Noatak Wilderness. Photo NPS.

Table 24. Index for scoring management restrictions

Category	Score	Type of restriction
Campfires	0	No regulation
	1	Designated sites, or requirements for ash disposal
	2	Total prohibition
Camping	0	No restrictions
	1	Mandatory setbacks, designated sites
	2	Assigned sites
Fees	0	No fees
	1	Fees charged of selected user type
	2	Fees charged of all visitors
Permits	0	No permit or registration
	1	Voluntary self-registration
	2	Mandatory, non-limiting permit or registration
	3	Mandatory; use limited
Human waste	0	No regulation
	3	Pack out required
Length of stay	0	No restriction on length of stay
	1	Length of stay limited
Group size limit	0	No restriction
	1	Group size limits in place
Caches	0	No requirements
	1	Some requirements for storage in place
	2	Caches prohibited
Area closure	0	No restrictions
	1	Area closed for specific purposes, times of year, or locations
	2	Area closed to use

Unconfined Recreation Quality

Management restrictions on visitor behavior

4-5: Index of management restrictions

Wilderness character monitoring baseline	Trend since wilderness designation
Baseline data value: 7 Years of data: 2010-2014 (fiscal years)	 Condition: Good Trend: Stable Confidence: High

Background & Context

Visitor opportunities for primitive and unconfined recreation are significantly affected by the number and type of regulations in place. Currently, there are few restrictions placed on visitor behavior in the Noatak Wilderness. Those restrictions that are in place have been deemed necessary to protect other qualities of wilderness character.

Measure Description & Collection Protocol

This measure scores restrictions to visitor behavior based on their severity and geographic extent. Regulation categories are adapted from the FS Technical Guide (p. 219) and are each assigned a severity score based on Table 24, with more extensive restrictions weighted more heavily.

These scores are then weighted as follows to reflect their geographic coverage:

This final score for all regulation categories are summed and this number is reported in the WCMD. Over time, a decrease in the index value for this measure would indicate an upward trend for this measure.

Data Source

Superintendent's compendium, available on shared drive and online at:
http://www.nps.gov/akso/management/current_compendiums.cfm (accessed July 2014).

Data Adequacy

High – data quantity and quality are complete and high, respectively, because restrictions are formally and completely available with full documentation.

Frequency

Every 5 fiscal years data for this measure will be entered into the WCMD.

Significant Change

Any change is considered significant for this measure.

Table 24. Restrictions on visitor behavior, calculation of 2014 baseline value

Type of regulation	Score	Geographic weight	Total score
Campfires	0	0	0
Camping	0	0	0
Fees	0	0	0
Permits	0	0	0
Human waste	0	0	0
Length of stay	1	2	2
Group size limit	1	2	2
Caches	1	2	2
Area closure	1	1	1
Total index score:			7

Other Features of Value Quality

Wilderness may also contain other tangible features of scientific, educational, scenic, or historical value.

Wilderness may possess physical, site-specific features of value that are integral to wilderness character and make the area's meaning and significance as wilderness clearer and more distinct. Use of this quality is not required, and if no site-specific features are identified, then this quality is not used. The primary challenge with this quality lies in determining which features are truly essential to the character of a particular wilderness. This determination of which features are truly essential to the character of a particular wilderness is made at the local unit level based on guidance in Keeping It Wild 2. Features included in the Other Features of Value Quality may also be counted under other qualities if relevant. For example, a building in the wilderness area that is on the National Register of Historic Places could add value to wilderness character under the Other Features of Value Quality for its historic or cultural significance, but as a structure in wilderness it would also be counted in the Undeveloped Quality.

Table 25. Other Features of Value Quality used to monitor the Noatak Wilderness

Indicator	Measure	Frequency	Data Adequacy	Significant Change	Baseline Value
Deterioration or loss of integral cultural features	5-1: Percent of impacted and threatened cultural resource sites	5 years	Medium	≥10%	33%



Archeological investigation in the Noatak Wilderness. Photo by Scott Shirar, NPS.

Other Features Of Value

Deterioration or loss of integral cultural features

5-1: Percent of impacted and threatened cultural resource sites

Wilderness character monitoring baseline	Trend since wilderness designation
Baseline data value: 33 percent Years of data: 2010-2014 (calendar years)	 Condition: Warrants some concern Trend: Downward Confidence: Medium

Background & Context

The Noatak is part of the ancestral home of the Iñupiat people and countless cultural and archeological resources are found within the wilderness. With artifacts extending back thousands of years, the Noatak Wilderness contains archeological and cultural evidence from some of the first peoples to cross into the North American continent across the Beringia – the land bridge that connected Asia and North America 13,000 years ago. Today, archeological evidence of these ancient peoples can be found in stone tools, depressions left by house pits, cairns, ancient fire pits, and other artifacts. These resources are considered invaluable to the wilderness character of the Noatak, and loss of these resources degrades wilderness character. Today, these resources face threats from natural disturbance such as erosion, wildfire, floods, and animal digging, as well as human-caused disturbance such as looting, digging catholes, and other visitor and authorized uses.

Due to the immense size of the Noatak Wilderness, it is estimated that less than 1% of the entire wilderness has been surveyed for archeological and cultural resources (Holt, personal communication). As a result, any reporting on the status of cultural resources in the wilderness is necessarily limited in scope, and it is acknowledged that this measure only address a small subset of the resource.

Measure Description & Collection Protocol

This measure monitors the number of sites surveyed in the past five years that were assessed as being impacted or threatened from human or natural causes. During cultural resource fieldwork to re-survey previously documented sites or establish baseline information for sites, professional judgment is used in accordance with the National Historic Preservation Act of 1966 and the Archeological Resource Protection Act of 1979 to assess sites for entry into the Archeological Sites Management Information System (ASMIS) database. Data for this measure is drawn from records in ASMIS.

A percent is used to report this measure because the number of sites surveyed each year, and every five years, can vary widely. Likewise, many of the sites documented in the Noatak Wilderness are not monitored every year. By focusing wilderness character monitoring on sites updated in the past five years and using a percentage to document change, this measure reflects only current information and is not skewed by the amount of staff effort in any given monitoring interval.

Cultural Resources Division staff must be contacted to obtain data reported in ASMIS. The query from ASMIS should reflect the number of sites surveyed in the past five calendar years (including both initial surveys and re-surveys) and report the disturbances that threaten, or have already

impacted, the sites. From this query, the percent of sites that are impacted or threatened can be calculated. This percentage is reported in the WCMD. Over time, a decline in the percent of impacted and threatened sites would indicate an upward trend for this measure.

Data Source

ASMIS database; accessed by contacting preserve Cultural Resources Division staff.

Data Adequacy

Medium – data quantity is medium due to the large number of sites that need to be surveyed and the lack of resources and capacity to do so. Data quality is high because those sites that are surveyed use reliable and accurate methodology.

Frequency

Every 5 calendar years data for this measure will be entered into the WCMD.

Significant Change

Change of 10% or greater is considered significant for this measure.



Nigu River area. Photo by Nyssa Landres, NPS.

Measures suggested for future use

The measures in this section were determined to be highly significant to wilderness character, but were not included because no data was available at the time the baseline was established. If data become available for any of these measures such that they are viable to include as a wilderness character monitoring measure, it is recommended that they be incorporated into this monitoring framework. For the measures described below, the fields of Data Source, Data Adequacy, Data Frequency, and Significant Change were omitted as they are dependent on aspects of the data that are unknown at this point.

Extent of impacted viewshedBackground & Context

A viewshed unaffected by vestiges of modern society is one of the key elements that define Alaskan wilderness. Remote vistas with no permanent evidence of modern human activity are common here and are a desired feature of Alaskan conservation areas. Impacts to the viewshed of the Noatak Wilderness significantly affect visitors' perceived remoteness from the sights and sounds. With minimal human-made developments affecting the viewshed of the Noatak, it can be particularly unexpected to come across these impacts and correspondingly, any given development may have a disproportionate impact to visitor experience and wilderness resources than may occur in other, less remote, wilderness areas.

It is also important to note that developments that affect viewshed are considered to be modern, permanent, developments. While a fish-camp is unlikely to be considered within this evaluation, developments such as scientific instrumentation, ranger stations, and historic structures are all included. The inclusion of these developments is not to say that they do not have value or only negatively affect wilderness resources and character. Conversely, many of these developments contribute positively to wilderness resources and character in various ways. However, the developments are monitored here because of their effects to the viewshed of Noatak Wilderness.

Measure Description & Collection Protocol

This measure monitors the percent of the Noatak Wilderness with a viewshed impacted from anthropogenic sources. Data are obtained through analyses conducted with technical assistance from the NPS Air Resource Division, Visual Resource Specialists. The percent of the Noatak which experiences an impacted viewshed is reported in the WCMD. Over time, an increase in the number of acres with an impacted viewshed would indicate a downward trend in wilderness character.

Note: as of March 2015 viewshed calculations have not been conducted and this measure has been entered into the WCMD in "inactive" status. As data become available, the measure's status should be changed to "active" and baseline data should be entered.

Definitions

Viewshed – the area of land, water, or other environment that is visible from a particular vantage point.

Soundscape

Background and context

The opportunity to experience natural sounds unimpaired by anthropogenic sources is extremely important to wilderness character. The value of natural soundscapes has been affirmed in the 2006 NPS Management Policies, which require the NPS to preserve the natural soundscapes of parks to the greatest extent possible and protect natural soundscapes from degradation due to noise. Adverse effects to natural soundscapes may occur through the frequency, magnitude, or duration of anthropogenic sounds (Fristrup & Mennitt 2012).

The natural soundscape preserved in the Noatak Wilderness is one with relatively few anthropogenic influences. However, motorized use via aircraft, motorboat, and snowmachine are the most common means of access into the Noatak Wilderness, all of which significantly affect the natural soundscape. While these uses are allowed in the Noatak Wilderness under ANILCA, their effects on natural soundscapes still have a large impact on wilderness character and are therefore important to monitor.

Measure Description & Collection Protocol

This measure monitors the percentage of time when anthropogenic sounds are above ambient sound levels in the Noatak Wilderness. Two sites – one in the eastern half of the Preserve and one in the western half – will be monitored within each five-year monitoring period and processed according to Natural Sounds Program protocol (Natural Sounds Division 2013). It is the goal that sites in the western and eastern halves of the preserve will each be monitored three times over the five-year monitoring period: in the summer, fall, and winter. If only some, but not all, of the desired data collection occurs, a note should be made in the WCMD. This data collection effort is intended to collaborate with existing trips and backcountry operations by preserve personnel.

Once the percent time when anthropogenic sounds audible over ambient natural sounds is calculated for all six samples, the average across all six is taken and evaluated within the standards described in Table 27 (next page). The level of use descriptor from that table is entered into the WCMD and the individual data points should be entered into the Notes section. Over time, an increasing percentage of time when anthropogenic sounds are audible would indicate a downward trend for this measure.

Note: as of March 2015 this measure has been entered into the WCMD in “inactive” status. As data become available, the measure’s status should be changed to “active” and baseline data should be entered.

Table 26. Evaluating natural soundscape – adapted from Denali Backcountry Management Plan, pp. 48 (NPS 2006).

Descriptor	Description and standard
Very high	Natural sounds are often interrupted by motorized noise, including loud noise. Motorized use may be audible up to 50% of any hour, and there may be up to 50 motorized noise intrusions per day that exceed natural ambient sound. Motorized noise does not exceed 60dBA.
High	Natural sounds are frequently interrupted by motorized noise, include some loud noise. Motorized use may be audible up to 25% of any hour, and there may be as many as 25 motorized noise intrusions per day that exceed natural ambient sound. Motorized noise does not exceed 60dBA.
Medium	Natural sounds predominate in this area, but there are infrequent motorized intrusions, a few of which may be loud. Motorized noise may be audible up to 15% of any hour, and there may be as many as 10 motorized noise intrusions per day that exceed natural ambient sound. Motorized noise does not exceed 40dBA.
Low	Natural sounds predominate in this area and motorized noise intrusions are very rare and usually faint. Motorized noise may be audible up to 5% of any hour, and there may be as many as 1 motorized noise intrusions each day that exceed natural ambient sound. Motorized noise does not exceed 40dBA.

Note: “Audible” means audibility to a person of normal hearing. Maximum sound levels assume the measurement device is more than 50 feet from the noise source. For comparison, 40dBA is the overall sound level inside a typical residential home. 70dBA is the sound level of a vacuum cleaner as perceived by the user.

Definitions

Soundscape – acoustic resources in a given area or landscape. These sounds may include wildlife, waterfalls, wind, rain, and historic and cultural sounds, as well as sounds from anthropogenic sources, such as aircraft or human voices.

Night sky illuminationBackground & Context

Light pollution is caused by modern human civilization and reflects the extent and type of human activity occurring near a wilderness area. There are two types of light pollution: sky glow and glare (Duriscoe 2001). Sky glow refers to the amount of ambient light visible in the night sky and results from anthropogenic illumination of areas near the wilderness. Glare is caused by lights shining directly into wilderness, which given the remoteness of the Noatak Wilderness, is of less concern. As a result, only sky glow is used for wilderness character monitoring because glare is not possible to monitor at this time.

Measure Description & Collection Protocol

This measure tracks the percentage of the wilderness area that is “minimally impacted” by light pollution. Using field data collected following the protocol developed by the Night Skies Division, hemispherical images of the night sky are taken in the wilderness, then analyzed to compare the level of artificial light to natural levels of sky glow. From this calculation, the NPS Night Skies Team obtains a ratio of how much an area exceeds natural light levels. Specific protocols are available in Night Skies Program Documentation (Duriscoe 2007; Duriscoe 2013). Areas where the ratio is 0.3 or less are considered “minimally impacted” – that is, the ratio of artificial light to natural light should be no more than 30%. A ratio of 2.0 represents “moderately impacted” night skies, and anything over 2.0 is “severely impacted” by wilderness standards (Duriscoe, unpublished data). The percentage of wilderness with “minimally impacted” levels of sky glow is reported in the WCMD. Over time, an increase in the percentage of area minimally impacted by light pollution would indicate an upward trend in wilderness character for this measure.

Note: as of March 2015 this measure has been entered into the WCMD in “inactive” status. As data become available, the measure’s status should be changed to “active” and baseline data should be entered.

Definitions

Light pollution – brightening of the night sky that inhibits the observation of stars and planets, caused by anthropogenic sources, such as street lights.

Caribou jawbone near Nigu River in the Noatak Wilderness. Photo by Peter Landres.

Measures not used for wilderness character monitoring

The measures described below were considered as measures for wilderness character but were ultimately not used. The measure and the reason for its exclusion are described in this section.

Untrammeled Quality

Actions authorized by the federal land manager that intentionally manipulate the biophysical environment

Wildlife hunting regulations

Background & Context

Wildlife hunting regulations are a direct, significant, and intentional manipulation of the earth and its community of life. While an individual hunter may not have this intention, the intent of wildlife hunting regulations is to manipulate wildlife populations for a specified purpose, be it preserving “the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal communities and ecosystems in which they occur” (NPS 2006), or “providing for high levels of human harvest of selected moose, caribou, and potentially, deer populations” (Hilderbrand et al. 2013, summarizing AS 16.05.255).

ADF&G coordinates hunting regulations for non-subsistence uses by local and non-local hunters across the state of Alaska. The Federal Subsistence Board (FSB) coordinates all subsistence hunting regulations. Both agencies work in coordination with one another and with local and non-local users to develop these regulations, which apply on federal lands including the Noatak National Preserve and Wilderness.

Measure Description

This measure monitors wildlife regulations that apply to General Management Unit (GMU) 23 for certain species (listed below) based on regulations by the State of Alaska and the FSB. Regulations promulgated by the State of Alaska (and accepted by the NPS – if the regulations are rejected on NPS lands, the regulations are not counted here), as well as regulations promulgated by the FSB for these species are summed to calculate the total number of regulations reported.

Wildlife hunting regulations that apply within the Noatak Wilderness for the following species are counted: moose, caribou, wolf, wolverine, black bear, and brown bear. These species were selected because they are iconic to the Noatak Wilderness, have population levels which are most subject to change, and for which hunting is more highly regulated. If all applicable regulations applicable to the Noatak were counted under this measure (including regulations pertaining to trapping, waterfowl, and small mammals), the sheer magnitude of regulations would result in this measure becoming less indicative of wilderness character. Therefore, only regulations for these six species are included. Regulations are counted for all user groups, including residents, nonresidents, both residents and nonresidents, and subsistence users.

Rationale for exclusion

This measure was excluded because a trend cannot be accurately or appropriately assigned to this measure. No viable counting methods were successfully devised to resolve the issue. A trend cannot be assigned because an increasing number of regulations does not necessarily correlate with an

upward or downward trend in wilderness character. For instance, more regulations may be put in place to preserve populations (e.g., increasing restrictions on the timing of the hunt, gender of animal, age of animal, etc.), whereas more regulations may also be put in place to liberalize hunting activities (e.g., increasing the length of the open season, allowing more animals to be taken, etc.). As a result, upward or downward trends in wilderness character cannot be determined based on the number of regulations.

Evaluating regulations from other approaches (e.g., professional judgment on the impact to wilderness character) introduces a very high degree of subjectivity given that experts on this topic can have very different opinions.

Area covered by active thaw slumpsBackground & Context

Permafrost underlies the majority of the Noatak Wilderness (NPS 1987). Climate change however, has the potential to change permafrost dynamics in the arctic and climate change has been cited as a cause of recent increases in thawing Alaskan permafrost (Jorgenson et al. 2006). When the underlying permafrost melts, the surface of the ground can slump and change shape. Two kinds of permafrost thaw features that are of particular interest in the Noatak Wilderness are: active-layer detachments (ALD) and retrogressive thaw slumps (RTS). Depending on their location, these thaw slumps can result in increases in soil erosion, changes in water chemistry, and can also release greenhouse gases that had been previously trapped in the soil, (Swanson 2012; Crosby 2009; Kokelj et al. 2005; Balser et al. 2007; French 2007).



Retrogressive thaw slump on the Noatak River. Photo by Dave Swanson, NPS.

Measure Description

This measure monitors the area known to be covered by active thaw slumps in the Noatak, including both ALD and RTS types. Area is used as a measure because the proportion of the affected area within the large area of the Noatak is relatively small.

The results from the ARCN Vital Sign on Permafrost are used to provide data for this measure and the total area covered by thaw slumps – as calculated by ARCN – is entered into the WCMD. These measurements are recorded in the WCMD in accordance with how ARCN collects and reports its data. If methodological changes occur, these changes must be noted in the WCMD. As of 2014, thaw slump data is collected via satellite images, that are first analyzed to identify bare ground, and then analyzed to exclude bare soil that is not a thaw slump. The total area can then be calculated and summed to attain the data value. Further detail on this methodology can be found in “Mapping of Erosion Features Related to Thaw of Permafrost in the Noatak National Preserve, Alaska” (Swanson 2012).

Definitions

Active layer detachment (ALD) – ALD are small landslides that occur on vegetated slopes where a surface layer slides as a unit to a wrinkled mass on the foot slope. The slide leaves an elongated region of bare soil exposed on a slope.

Retrogressive thaw slumps (RTS) – RTS occur where a cut-bank advances into undisturbed, ice-rich, permafrost ground. As soil thaws in the steep bank, soil falls or slumps onto an adjacent, gentler slope and is transported away by water, erosion, or sliding (Burn and Lewkowicz 1990).

Current status

Table 27. Detailed data, area covered by thaw slumps*

Type of slump	Number found	Hectares covered
ALD	848	103
RTS	276	90
Total value entered into WCMD: 193 ha		

*Data published in Swanson 2012

Rationale for exclusion

This measure was excluded because changing permafrost structure cannot necessarily be correlated with upward or downward trends in wilderness character. While changing permafrost and thaw slumps significantly affect the character of the Noatak Wilderness and represent a distinct change since its establishment in 1980, changing permafrost conditions cannot be said to “improve” or “degrade” the Noatak Wilderness. Simply, these changing conditions only represent a “change” from the status quo.

Since there is no known “natural” or “correct” extent of thaw slumps in the Noatak against which changing and current conditions can be compared, any trend assigned would necessarily be based on an arbitrary point in time. If such a trend were assigned, it would not inform wilderness character monitoring.

ShrubificationBackground & Context

The arctic tundra that predominates in the Noatak Wilderness is characterized by low-growing lichens, mosses, herbs, and sedges, which are resilient in this arctic environment underlain by permafrost, with frequent harsh weather and limited nutrient availability. In a changing climate, arctic vegetation is predicted to undergo large-scale shifts in composition (Hinzman et al. 2005; Walker et al. 2003). One shift already documented in arctic biomes is increased cover by shrub species – a change predicted to continue into the future if current warming trends continue (Tape et al. 2006; Myers-Smith et al. 2011). Likewise, low-shrub environments may transition to tall-shrub environments (Myers-Smith et al. 2011). This transition to increased shrub cover is referred to as “shrubification.”

These changes are already beginning to appear in the Noatak Wilderness. In comparing aerial photographs from the 1980s to photos from 2010, Swanson (2013) showed that lowland areas are already experiencing shrubification. Some of the most common vegetation shifts in the Noatak National Preserve and other arctic parklands over the past thirty years have included shrub encroachment on tundra, shrub increase due to floodplain succession, and tree increase due to post-fire succession. As of 2014, the majority of documented vegetation change in the Noatak region has been concentrated in lowlands areas, especially below 1,000 feet in elevation.

Measure Description

This measure monitors shrubification by tracking the percent of area in the Noatak with vegetation composition transitioning to increased shrub cover. This measure reflects data collected by ARCN as part of the Terrestrial Landscape Patterns and Dynamics, and Terrestrial Vegetation and Soils Vital Signs. These Vital Signs monitor both on-the-ground vegetation plots and aerial photography. This measure primarily uses aerial photography data to account for large scale landscape changes in vegetation cover, while the results of on-the-ground vegetation plot sampling serve as secondary information sources. Data for this measure is based on results from the ARCN Vital Sign of Terrestrial Landscape Patterns and Dynamics, which is used to derive the percent of area in the Noatak that has transitioned to increased shrub cover. The percent of area reported in the WCMD is based on how ARCN collects and reports Vital Sign data. Any changes made in ARCN’s data collection or analysis processes must be noted in the WCMD.

Rationale for exclusion

This measure was excluded because changing shrub extent cannot necessarily be correlated with upward or downward trends in wilderness character. Shrubs encroaching into the tundra landscapes that typify the Noatak Wilderness will significantly affect the area’s wilderness character and this change also represents a distinct change since its establishment in 1980. However, increased shrubification cannot be said to cause an upward or downward trend in wilderness character the Noatak Wilderness. Simply, these changing conditions represent a “change” from the status quo.

Since there is no known “natural” or “correct” extent of shrubs in the Noatak against which changing and current conditions can be compared, any trend assigned would necessarily be based on an arbitrary point in time. If such a trend was assigned, it would not inform wilderness character monitoring.

Conclusions

The Noatak Wilderness is a profound landscape surrounded by similarly vast expanses of wild lands. While boundaries in this region may appear arbitrary, the Noatak Wilderness is a place where a wild landscape has been maintained for millennia and is recognized for its intact natural systems and ecology. Distant from most modern technologies, population centers, and access provided by roads, the Noatak has escaped many of the influences facing wilderness areas across the NWPS. Some modern influences however, have caused changes affecting the wilderness character of the Noatak.

While the Noatak remains an incredible and intact wilderness area, its wilderness character has trended downward over the past 35 years. Since the designation of the Noatak Wilderness in 1980, many changes have come to the region. Local villages have become increasingly reliant on gasoline and motorized transportation, extractive mineral developments have been established, practice of some traditional lifeways has changed, the regional population has expanded, and new technologies are readily available to visitors, administrators, and researchers alike.

To more provide a comprehensive understanding of how the Noatak's wilderness character has changed since 1980, a summary of the trend for each quality of wilderness character is provided below. Trends in the qualities are based on the trends in the measures selected in this report. Since 2014 is the baseline year for wilderness character monitoring in the Noatak Wilderness, professional judgement was used to determine the current trend of the measures when data was lacking. The trends in the qualities described below therefore only reflect what is presumed to have happened since the area's designation as wilderness in 1980 and this baseline assessment in 2014. The information is intended to supplement the wilderness character monitoring baseline established in this report and to help prevent shifting baselines in relation to wilderness character.

Untrammelled Quality

The trend in the Untrammelled Quality has been stable since 1980 (Table 29). This is because virtually no trammeling actions have occurred since then. One of the exceptions to this is wildfire suppression, but suppression activities take place infrequently enough that they have not affected the trend in this quality. Likewise, wildlife collaring activities have occurred, but infrequently enough so as to maintain a stable trend for this quality. In short, the Untrammelled Quality of the Noatak has remained virtually unchanged since its wilderness designation in that the earth and its community of life in the Noatak Wilderness is essentially uncontrolled and unmanipulated by human actions.

Many reasons can be cited as to why so few trammeling actions have been taken, ranging from exorbitant cost to logistical difficulties. The important reality, however, is that managers have predominantly decided to not act. In a world where the intentional influence of human actions on biophysical communities is prevalent, the lack of trammeling in the Noatak Wilderness is an important achievement. As a result, the Noatak maintains a truly untrammelled wilderness character.

Table 28. Trends in the Untrammelled Quality of the Noatak Wilderness

Indicator	Measure	Trend since 1980
Actions authorized by the federal land manager that intentionally manipulate the biophysical environment	1-1: Number of actions that manipulate wildlife or vegetation	
	1-2: Percent of wildfires suppressed	
Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment	1-3: Number of unauthorized actions that manipulate plants, wildlife, insects, fish, pathogens, soil, water, or fire	

Natural Quality

Effects of humans on the natural environment have increased since 1980, resulting in a downward trend in the Natural Quality of the Noatak Wilderness (Table 30). One of the most dramatic drivers of change occurring in the Noatak is climate change. The effects of climate change, however, are not reflected as part of wilderness character monitoring. Instead, wilderness character monitoring endeavors to focus on direct human-caused threats effecting the natural environment in ways that natural change would not, based on guidance in *Keeping It Wild 2* (pp. 31 and 69-74 in April 15, 2015 draft).

The increasingly global effects of human activities, resulting in impacts to the natural environment come from a combination of global and regional sources. For instance, as seen as in mercury levels found in fish samples from Burial Lake, indicating high mercury methylation and bioaccumulation (Landers et al. 2008). Impacts from local sources can be seen in new technologies that have enabled activities and developments in the Northwest Alaskan that were previously infeasible. Many of the downward trends in measures used to monitor the Natural Quality reflect these changes.

Table 29. Trends in the Natural Quality of the Noatak Wilderness

Indicator	Measure	Trend since 1980
Plants	2-1: Number of non-native plant species	
Animals	2-2: Number of human-wildlife incidents	
Air and water	2-3: Acidifying and fertilizing pollutants	
Ecological processes	2-4: Extent of landscape connectivity	

A lack of comprehensive natural resource research and data availability is directly related to the extent to which the Noatak Wilderness is still somewhat “unknown.” This “unknown” can be an exciting component of this remote wilderness area and contributes to its wilderness character. However, the limits of our knowledge for monitoring purposes also affects our ability to understand how humans may be influencing natural systems over time.

Undeveloped Quality

Since 1980, the Undeveloped Quality of the Noatak Wilderness has had an “offsetting stable” trend, wherein there are an equal number of upward- and downward-trending measures (trend assessment based on guidance *Keeping It Wild* 2). This “offsetting stable” trend is the result of an upward trend in motorized use and mechanical transport, stable trend in the acres of inholdings, and downward trend in non-recreational installations (Table 31).

Table 30. Trends in the Undeveloped Quality of the Noatak Wilderness

Indicator	Measure	Trend since 1980
Presence of non-recreational structures, installations, and developments	3-1: Number of sub-surface installations	
	3-2: Number of above-ground developments	
	3-3: Weight of abandoned debris	
Presence of inholdings	3-4: Acres of inholdings	
Use of motor vehicles, motorized equipment, or mechanical transport	3-5: Number of helicopter supported projects	
	3-6: Number of hours of airplane flight time	
	3-7: Miles of administrative snowmachine use	

One primary source of new installations in wilderness is research activities, in particular, increasing use of sub-surface site markers. The majority of new above-ground developments since 1980 are research instrumentation. It also important to note that all six administrative and shelter structures currently in the wilderness were present prior to 1980. Research activities should be examined for their effects on wilderness character and stewardship, while recognizing that research is a fundamental purpose of the Noatak Wilderness.

Motorized use authorized by the preserve has had an upward trend since 1980, with less motorized use, as assessed by the measures used in wilderness character monitoring. One contributing factor to the declines may be decreases in federal budgets, which have limited personnel and time that can be spent using in the field and consequently, using motorized transport. The methods of access to the Noatak, however, have remained essentially unchanged since 1980 with almost all access provided by fixed-wing aircraft or helicopter.

Solitude or Primitive and Unconfined Recreation Quality

The trend in the Solitude or Primitive and Unconfined Recreation Quality has been stable since 1980 (Table 32). Due in part to its remoteness from population centers, many concerns that other wilderness areas face relating to recreation simply aren't as prominent of issues here. The remoteness of the Noatak Wilderness from the sights and sounds of human activity has remained relatively constant. Perhaps the most notable changes to the remoteness of the Noatak would be seen in soundscape and night sky illumination, both of which are likely experiencing downward trends but lack data to quantify trends at this time.

Opportunities for primitive and unconfined recreation have likewise remained essentially unchanged since 1980. With few changes to affect how people interact with this landscape, visitors are still able to explore the Noatak Wilderness in the same ways as they did 35 years ago.

Table 31. Trends in the Solitude or Primitive and Unconfined Recreation Quality of the Noatak Wilderness

Indicator	Measure	Trend since 1980
Remoteness from sights and sounds of human activity <i>inside</i> the wilderness	4-1: Number of visitors	
	4-2: Number of researcher-days	
Remoteness from sights and sounds of human activity <i>outside</i> the wilderness	4-3: Average number of aircraft overflights	
Facilities that decrease self-reliant recreation	4-4: Number of landing sites	
Management restrictions on visitor behavior	4-5: Index of management restrictions	

Other Features of Value Quality

The Other Features of Value Quality has trended downward since 1980 (Table 33). Cultural resources face constant threats from natural and human sources and can be difficult to preserve. Erosion and degradation threaten the integrity of sites in the Noatak Wilderness, as does resource attrition from visitor activity. As a vital part of the wilderness character of this area and as a finite

resource that cannot be restored, this downward trend and the current condition of threatened sites is of concern.

Table 32. Trends in the Other Features of Value Quality of the Noatak Wilderness

Indicator	Measure	Trend since 1980
Loss of integral cultural features	5-1: Percent of impacted and threatened cultural resource sites	

Looking Ahead

The future of the Noatak Wilderness is uncertain. Climate change has the potential to dramatically alter the ecology of the Noatak we see today. In a few hundred years, the entire landscape may look dramatically different, with spruce forests reaching farther north and new topography forming from thermokarst features. Despite the changes that will result from climate change, the Noatak Wilderness will remain protected and its unique wilderness character will endure.

Regional developments also stand to significantly affect the Noatak Wilderness and are increasingly encroaching in areas adjacent to the Noatak. Proposed developments in the Ambler Mining District, as well as other mineral development areas, will affect the area's remoteness and naturalness. Changing technologies also have strong potential to allow new activities to occur in the Noatak – for instance, new access enabled by more powerful and fuel-efficient snowmachines.

Despite these changes, the Noatak retains its primeval character. Even with new technologies, traditional skills and knowledge are often vital to survive in the Noatak, even for a short time. With its sheer size, intact natural systems, and remoteness, the incredible wilderness character of the Noatak must be preserved into the future.



Shadows of clouds in Noatak Valley. Photo by Ken Hill, NPS.

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Appendix A – Organizational framework of wilderness character monitoring

An excerpt from Keeping It Wild 2 (Landres et al. in press, pp. 13-14 in April 15, 2015 draft)

This interagency monitoring strategy is organized around a hierarchical framework that divides wilderness character into successively finer elements. These elements, starting from wilderness character, are:

- *Qualities.* Qualities are the primary elements of wilderness character that link directly to the statutory language of the 1964 Wilderness Act. The same set of qualities applies nationwide to all wildernesses managed by all agencies. In this framework, the Untrammeled, Natural, Undeveloped, and Solitude or Primitive and Unconfined Recreation Qualities are all necessary to assess trend in wilderness character and each wilderness would report the trend in each of these qualities. Where other features of value exist in and are integral to a wilderness, the Other Features of Value Quality would also be reported.
- *Monitoring questions.* Monitoring questions capture essential components of each quality that are significantly different from one another and address particular management questions and goals. The same set of monitoring questions applies nationwide to all wildernesses, although some agencies do not use these questions and instead go directly from qualities to indicators.
- *Indicators.* Indicators are distinct and important elements under each monitoring question. In nearly all cases there is more than one indicator under a monitoring question. Each wilderness and agency would be responsible for reporting the trend in all indicators. The same set of indicators applies nationwide to all wildernesses managed by all agencies.
- *Measures.* Measures are the specific elements under each indicator on which data are collected to assess trend in an indicator. Each agency is responsible for determining how their measures will be selected (that is, whether by a national or regional team, or by each wilderness). Examples of measures for each indicator are given in the chapters that describe each quality in detail.

This hierarchical framework allows managers to look at the overall trend in wilderness character and drill down through the various levels to understand how this trend was derived, including how change in an individual measure contributes to the overall trend in wilderness character.

Appendix B – Priority ranking of all measures considered

Use the criteria and ranking guide below to create an overall score for each measure. If the combined score for criteria A and B is ≤ 2, STOP and do not score criteria C and D. Those measures with the highest overall scores should be the highest priority for assessing trends in wilderness character.

Table B1. Priority ranking for untrammelled quality

Potential Measure	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility	Overall Score	Included?	Comments
Indicator: Actions authorized by the federal land manager that intentionally manipulate the biophysical environment Measure: Number of actions to manipulate wildlife or vegetation	3	3	3	1	10	✓	
Indicator: Actions authorized by the federal land manager that intentionally manipulate the biophysical environment Measure: Number of actions to manipulate plants, pathogens, soil, water	3	1	3	1	8	×	Very broad measure and few actions to manipulate these resources occur. When prioritizing measures, this measure had a lower score than other options.
Indicator: Actions authorized by the federal land manager that intentionally manipulate the biophysical environment Measure: Percent of fires suppressed	3	2	3	1	9	✓	
Indicator: Actions authorized by the federal land manager that intentionally manipulate the biophysical environment Measure: Number of fuel reduction efforts	2	2	1	1	6	×	Efforts are not conducted in a quantifiable or systematic way, making monitoring unreliable and infeasible at this time.
Indicator: Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment Measure: Number of illegal wood cutting incidents	2	3	1	0	6	×	Difficult to monitor; more relevant to other wilderness areas in WEAR (i.e. CAKR and KOVA); difficult to quantify relative to the amount of time spent patrolling/searching.
Indicator: Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment Measure: Number of illegal mining activities	2	3	1	0	6	×	Difficult to accurately monitor; relatively infrequent; difficult to quantify relative to the amount of time spent searching.
Indicator: Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment Measure: Poaching incidents	-	-	-	-	-	×	Poaching is not a trammeling action as its intent is not to manipulate the biophysical environment.

- A.** Level of significance (the measure is highly relevant to the quality and indicator of wilderness character, and is highly useful for managing the wilderness):
High = 3 points, Medium = 2 points, Low = 1 point
- B.** Level of vulnerability (the measure is an attribute of wilderness character currently at risk, or might likely be at risk over the next 10-15 years):
High = 3 points, Medium = 2 points, Low = 1 point
- C.** Degree of reliability (the measure can be monitored accurately with a high degree of confidence, and would yield the same result if measured by different people at different times):
High = 3 points, Medium = 2 points, Low = 1 point
- D.** Degree of feasibility (the measure is related to an existing effort or could be monitored without significant additional effort):
High = 1 point, Low = 0 point (if 0 is given, do not use the measure)

Table B1 (continued). Priority ranking for untrammeled quality

Potential Measure	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility	Overall Score	Included?	Comments
Indicator: Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment Measure: Number of fuel spills	2	3	1	0	6	×	Difficult/infeasible to monitor at this time.
Indicator: Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment Measure: DLPs	-	-	-	-	-	×	Incorporated in Animals indicator as “Number of human-wildlife incidents.”
Indicator: Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment Measure: Number of liberalizing actions by Board of Game, Federal Subsistence Board, etc.	3	3	3	0	9	×	Variation of measure as “Wildlife hunting regulations” included as “Measure not used” due to the inability to assess trends.
Indicator: Actions not authorized by the federal land manager that intentionally manipulate the biophysical environment Measure: Number of actions to manipulate plants, pathogens, soil, water	3	3	2	1	9	✓	

- A.** Level of significance (the measure is highly relevant to the quality and indicator of wilderness character, and is highly useful for managing the wilderness):
High = 3 points, Medium = 2 points, Low = 1 point
- B.** Level of vulnerability (the measure is an attribute of wilderness character currently at risk, or might likely be at risk over the next 10-15 years):
High = 3 points, Medium = 2 points, Low = 1 point
- C.** Degree of reliability (the measure can be monitored accurately with a high degree of confidence, and would yield the same result if measured by different people at different times):
High = 3 points, Medium = 2 points, Low = 1 point
- D.** Degree of feasibility (the measure is related to an existing effort or could be monitored without significant additional effort):
High = 1 point, Low = 0 point (if 0 is given, do not use the measure)

Table B2. Priority ranking for natural quality

Potential Measure	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility	Overall Score	Included?	Comments
Indicator: Plants Measure: Composition of terrestrial vegetation and soils	3	3	2	0	8	✖	Variation of measure as “Shrubification” included as “Measure not used” due to inability to assess trends.
Indicator: Plants Measure: Number and distribution of non-indigenous species	3	3	2	1	9	✓	Variation of this measure used: “Number of non-native species.”
Indicator: Animals Measure: Abundance/distribution of brown bears	-	-	-	-	-	✖	Monitoring guidance changed - abundance/distribution measures are inappropriate to monitor the Natural Quality.
Indicator: Animals Measure: Abundance/distribution/health of caribou	-	-	-	-	-	✖	Monitoring guidance changed - abundance/distribution measures are inappropriate to monitor the Natural Quality.
Indicator: Animals Measure: Abundance, distribution, health of char, lake trout, and dolly varden	-	-	-	-	-	✖	Monitoring guidance changed - abundance/distribution measures are inappropriate to monitor the Natural Quality.
Indicator: Animals Measure: Predator species	3	3	1	0	7	✖	Insufficient data; infeasible to monitor at this time.
Indicator: Animals Measure: Number of human-wildlife incidents	3	3	1	1	8	✓	
Indicator: Air and water Measure: Wet and dry deposition	3	3	2	1	9	✓	Variation of this measure used: “Acidifying and fertilizing pollutants.”
Indicator: Air and water Measure: River erosion and ice damming	2	3	1	0	6	✖	Insufficient data; infeasible to monitor at this time.
Indicator: Air and water Measure: Number of lakes created and drying	2	3	2	0	7	✖	Infeasible to assess trends.
Indicator: Ecosystem processes Measure: Number of thermokarst features	3	3	2	0	8	✖	Variation of measure as “Area covered by active thaw slumps” included as “Measure not used” due to inability to assess trends.
Indicator: Ecosystem processes Measure: Permafrost	3	3	2	0	8	✖	Variation of this measure as “Area covered by active thaw slumps” included as “Measure not used” due to inability to monitor trends.

- A.** Level of significance (the measure is highly relevant to the quality and indicator of wilderness character, and is highly useful for managing the wilderness):
High = 3 points, Medium = 2 points, Low = 1 point
- B.** Level of vulnerability (the measure is an attribute of wilderness character currently at risk, or might likely be at risk over the next 10-15 years):
High = 3 points, Medium = 2 points, Low = 1 point
- C.** Degree of reliability (the measure can be monitored accurately with a high degree of confidence, and would yield the same result if measured by different people at different times):
High = 3 points, Medium = 2 points, Low = 1 point
- D.** Degree of feasibility (the measure is related to an existing effort or could be monitored without significant additional effort):
High = 1 point, Low = 0 point (if 0 is given, do not use the measure)

Table B2 (continued). Priority ranking for natural quality

Potential Measure	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility	Overall Score	Included?	Comments
Indicator: Ecosystem processes Measure: Mean annual temp and precipitation	1	2	2	0	5	✖	Changes in mean annual temp and precip do not inform wilderness character monitoring; infeasible to assess trends.
Indicator: Ecosystem processes Measure: Fire extent and severity	2	3	2	1	8	✖	Measure pertaining to fire already used in Untrammeled Quality.
Indicator: Ecosystem processes Measure: Extent of landscape connectivity	3	3	2	1	9	✓	

- A.** Level of significance (the measure is highly relevant to the quality and indicator of wilderness character, and is highly useful for managing the wilderness):
High = 3 points, Medium = 2 points, Low = 1 point
- B.** Level of vulnerability (the measure is an attribute of wilderness character currently at risk, or might likely be at risk over the next 10-15 years):
High = 3 points, Medium = 2 points, Low = 1 point
- C.** Degree of reliability (the measure can be monitored accurately with a high degree of confidence, and would yield the same result if measured by different people at different times):
High = 3 points, Medium = 2 points, Low = 1 point
- D.** Degree of feasibility (the measure is related to an existing effort or could be monitored without significant additional effort):
High = 1 point, Low = 0 point (if 0 is given, do not use the measure)

Table B3. Priority ranking for undeveloped quality

Potential Measure	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility	Overall Score	Included?	Comments
Indicator: Presence of non-recreational structures, installations, or developments Measure: Number of permanent non-recreational structures, installations, and developments	3	2	3	1	9	✓	Variation of this measure used; divided into of “number of above-ground developments” and “number of sub-surface installations.”
Indicator: Presence of non-recreational structures, installations, or developments Measure: Number of temporary non-recreational structures, installations, and developments	3	3	3	1	10	✓	Variation of this measure used; divided into of “number of above-ground developments” and “number of sub-surface installations.”
Indicator: Presence of non-recreational structures, installations, or developments Measure: Number of sites of abandoned equipment and debris	3	3	2	1	9	✓	Variation of this measure used: “Weight of abandoned debris.”
Indicator: Presence of inholdings Measure: Ratio of inholdings with structures to inholdings without structures	2	1	2	1	6	✖	Development occurs at a low rate; more relevant for other WEAR wilderness areas with more, easily accessible inholdings that are more likely to be developed.
Indicator: Presence of inholdings Measure: Number of newly approved inholdings	2	1	3	1	7	✓	Variation of this measure used: “Acres of inholdings.”
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: Number of hours of non-emergency NPS helicopter use	3	3	2	1	9	✓	Variation of this measure used: “Number of helicopter supported projects.”
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: Number of hours of admin snowmobile and ATV use	2	2	2	1	7	✖	Less significant to NOAT than other parks, also less vulnerable due to distance to NOAT.
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: Number of hours of motorboat use	3	3	1	0	7	✖	Not feasible to accurately monitor at this time.
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: Number of hours permitted of all motorized use	2	2	3	1	8	✖	Very broad and doesn’t specifically inform aspects of wilderness character.

- A.** Level of significance (the measure is highly relevant to the quality and indicator of wilderness character, and is highly useful for managing the wilderness):
High = 3 points, Medium = 2 points, Low = 1 point
- B.** Level of vulnerability (the measure is an attribute of wilderness character currently at risk, or might likely be at risk over the next 10-15 years):
High = 3 points, Medium = 2 points, Low = 1 point
- C.** Degree of reliability (the measure can be monitored accurately with a high degree of confidence, and would yield the same result if measured by different people at different times):
High = 3 points, Medium = 2 points, Low = 1 point
- D.** Degree of feasibility (the measure is related to an existing effort or could be monitored without significant additional effort):
High = 1 point, Low = 0 point (if 0 is given, do not use the measure)

Table B3 (continued). Priority ranking for undeveloped quality

Potential Measure	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility	Overall Score	Included?	Comments
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: Number of unauthorized ATV incidents, suction dredges, and other uses that occur	3	2	1	0	6	✖	Not feasible to accurately monitor at this time.
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: Number of hours of NPS airplane use	3	2	2	1	8	✓	Variation of this measure used: "Hours of fixed-wing aircraft flight time"

- A.** Level of significance (the measure is highly relevant to the quality and indicator of wilderness character, and is highly useful for managing the wilderness):
High = 3 points, Medium = 2 points, Low = 1 point
- B.** Level of vulnerability (the measure is an attribute of wilderness character currently at risk, or might likely be at risk over the next 10-15 years):
High = 3 points, Medium = 2 points, Low = 1 point
- C.** Degree of reliability (the measure can be monitored accurately with a high degree of confidence, and would yield the same result if measured by different people at different times):
High = 3 points, Medium = 2 points, Low = 1 point
- D.** Degree of feasibility (the measure is related to an existing effort or could be monitored without significant additional effort):
High = 1 point, Low = 0 point (if 0 is given, do not use the measure)

Table B4. Priority ranking for solitude or primitive and unconfirmed recreation quality

Potential Measure	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility	Overall Score	Included?	Comments
Indicator: Remoteness from sights and sounds of human activity <i>inside</i> the wilderness Measure: Number and condition of campsites	2	2	2	1	7	✖	No data available at this time and evaluated to be less reliable and less significant than other measures of this indicator.
Indicator: Remoteness from sights and sounds of human activity <i>inside</i> the wilderness Measure: Estimates of use in the Noatak River corridor	3	2	2	1	8	✓	Variation of this measure used: "Number of visitors" and includes visitors in all areas of the wilderness.
Indicator: Remoteness from sights and sounds of human activity <i>inside</i> the wilderness Measure: Density and condition of use at drop-off sites	3	2	1	0	6	✖	Not feasible to accurately monitor at this time.
Indicator: Remoteness from sights and sounds of human activity <i>inside</i> the wilderness Measure: Estimates of use outside of river corridor	3	2	1	0	6	✖	Not feasible to accurately monitor at this time.
Indicator: Remoteness from sights and sounds of human activity <i>inside</i> the wilderness Measure: Research activity	3	2	2	1	8	✓	Variation of this measure used: "Number of researcher-days" and includes researchers in all areas of the wilderness.
Indicator: Remoteness from sights and sounds of human activity <i>outside</i> the wilderness Measure: Overflights	3	2	2	1	8	✓	Variation of this measure used: "Average number of aircraft overflights."
Indicator: Remoteness from sights and sounds of human activity <i>outside</i> the wilderness Measure: Soundscape	3	3	3	0	9	✖	Used in "Measures suggested for future use" pending available data.
Indicator: Remoteness from sights and sounds of human activity <i>outside</i> the wilderness Measure: Viewshed	3	3	3	0	9	✖	Used in "Measures suggested for future use" pending available data.
Indicator: Remoteness from sights and sounds of human activity <i>outside</i> the wilderness Measure: Nightsky	3	3	3	0	9	✖	Used in "Measures suggested for future use" pending available data.

- A.** Level of significance (the measure is highly relevant to the quality and indicator of wilderness character, and is highly useful for managing the wilderness):
High = 3 points, Medium = 2 points, Low = 1 point
- B.** Level of vulnerability (the measure is an attribute of wilderness character currently at risk, or might likely be at risk over the next 10-15 years):
High = 3 points, Medium = 2 points, Low = 1 point
- C.** Degree of reliability (the measure can be monitored accurately with a high degree of confidence, and would yield the same result if measured by different people at different times):
High = 3 points, Medium = 2 points, Low = 1 point
- D.** Degree of feasibility (the measure is related to an existing effort or could be monitored without significant additional effort):
High = 1 point, Low = 0 point (if 0 is given, do not use the measure)

Table B4 (continued). Priority ranking for solitude or primitive and unconfirmed recreation quality

Potential Measure	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility	Overall Score	Included?	Comments
Indicator: Remoteness from sights and sounds of human activity <i>outside</i> the wilderness Measure: Estimate of area in park affected by extraction activity (e.g., Red Dog and Omar)	2	3	2	1	8	✖	Less reliable and feasible than other options.
Indicator: Remoteness from sights and sounds of human activity <i>outside</i> the wilderness Measure: Estimate of park area affected by roads	2	3	2	1	8	✖	Less reliable and feasible than other options.
Indicator: Facilities that decrease self-reliant recreation Measure: Number of agency-provided recreation facilities	3	1	3	1	8	✖	Less vulnerable than other possible measures
Indicator: Facilities that decrease self-reliant recreation Measure: Number of user-created recreation facilities	1	2	3	1	7	✖	User created “facilities” are rare and any that are found would be removed by WEAR.
Indicator: Facilities that decrease self-reliant recreation Measure: Number of landing strips	3	3	3	1	10	✓	Variation of this measure used: “Number of aircraft landing sites.”
Indicator: Management restrictions on visitor behavior Measure: Number of restrictions on visitor behavior	3	2	3	1	9	✓	Variation of this measure used: “Index of management restrictions.”

- A.** Level of significance (the measure is highly relevant to the quality and indicator of wilderness character, and is highly useful for managing the wilderness):
High = 3 points, Medium = 2 points, Low = 1 point
- B.** Level of vulnerability (the measure is an attribute of wilderness character currently at risk, or might likely be at risk over the next 10-15 years):
High = 3 points, Medium = 2 points, Low = 1 point
- C.** Degree of reliability (the measure can be monitored accurately with a high degree of confidence, and would yield the same result if measured by different people at different times):
High = 3 points, Medium = 2 points, Low = 1 point
- D.** Degree of feasibility (the measure is related to an existing effort or could be monitored without significant additional effort):
High = 1 point, Low = 0 point (if 0 is given, do not use the measure)

Table B5. Priority ranking for other features quality

Potential Measure	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility	Overall Score	Included?	Comments
Indicator: Deterioration or loss of integral cultural features Measure: Number of unauthorized actions that result in disturbances to cultural resources (looting, trespass activities, non-compliance with NHPA)	3	2	1	0	6	✖	
Indicator: Deterioration or loss of integral cultural features Measure: Number of authorized actions that result in disturbances to cultural resources [visitor and commercial use (catholes, trampling, hearths, aircraft landings, etc.); findings of adverse effect for projects and operations]	2	2	3	1	8	✖	
Indicator: Deterioration or loss of integral cultural features Measure: Number of naturally caused disturbances (erosion, animal digging, floods, rising sea levels, fires, tree throws)	3	3	2	1	9	✓	Variation of this measure used: "Percent of impacted and threatened cultural resource sites."

- A.** Level of significance (the measure is highly relevant to the quality and indicator of wilderness character, and is highly useful for managing the wilderness):
High = 3 points, Medium = 2 points, Low = 1 point
- B.** Level of vulnerability (the measure is an attribute of wilderness character currently at risk, or might likely be at risk over the next 10-15 years):
High = 3 points, Medium = 2 points, Low = 1 point
- C.** Degree of reliability (the measure can be monitored accurately with a high degree of confidence, and would yield the same result if measured by different people at different times):
High = 3 points, Medium = 2 points, Low = 1 point
- D.** Degree of feasibility (the measure is related to an existing effort or could be monitored without significant additional effort):
High = 1 point, Low = 0 point (if 0 is given, do not use the measure)

Appendix C – What is a trammeling action?

An excerpt from Keeping It Wild 2 (Landres et al. in press, pp. 63-66 in April 15, 2015 draft)

This appendix provides guidelines and examples to clarify what is and is not a trammeling action. These are intended to capture about 90% of the cases and provide sufficient guidance for local staff to figure out the novel and rarer cases as they occur. A trammeling action is defined as an action that intentionally manipulates “the earth and its community of life” inside a designated wilderness or inside an area that by agency policy is managed as wilderness.

The following terms and phrases clarify this definition above:

- **Intentional:** done on purpose; deliberate; willful.
- **Manipulation:** an action that alters, hinders, restricts, controls, or manipulates “the earth and its community of life” including the type, amount, or distribution of plants, animals, or physical resources.
- **Intentional manipulation:** an action that purposefully alters, hinders, restricts, controls, or manipulates “the earth and its community of life.”

Two concepts are crucial for understanding what is and is not a trammeling action: restraint and intention. Restraining our power to manipulate or control the earth and its community of life is at the core of the Untrammelled Quality of wilderness character. Trammeling actions occur when opportunities for restraint are ignored or bypassed; when there is no opportunity for restraint, there is no opportunity to trammel. Wilderness legislation and policies mandate that managers exercise restraint when authorizing actions that interfere with or control wilderness ecological systems. While other agencies, organizations, and the public are not beholden to these same restrictions, activities that have not been authorized by the federal land manager and that manipulate the wilderness environment are counted as trammeling actions.

The second concept central to the idea of trammeling is intentionality. Actions that deliberately interfere with, manage, or control an aspect of wilderness ecological systems are intentional and clear instances of trammeling. As explained in the chapter on the Untrammelled Quality, intentional actions are counted as a trammeling regardless of the magnitude of their effects (including areal extent, intensity, frequency, and duration). For pragmatic reasons, however, some actions are not monitored if they fall below a minimum practical threshold of scale and scope (for example, hand pulling a few individual noxious plants). Much more complex and nuanced is determining whether to include actions whose purpose is not to manipulate the earth and its community of life, but some manipulation of the environment is required to produce the desired outcome. These types of actions can be confusing because the biophysical environment is intentionally manipulated even though it is not the purpose behind the action. In general, when such actions have substantial and foreseeable effects on the wilderness ecosystem, they are counted as a trammeling.

The following sections describe three types of activities: those that *are* trammeling actions, those that are *not* trammeling actions, and those that *may be* trammeling actions. Following these sections, a flowchart provides general guidance for making these determinations.

Activities that are trammeling actions

There are two broad classes of trammeling actions: those that are authorized by the federal wilderness manager, and those that are not. Three subclasses under each of these reflect whether the action is taken on a biological resource, on a physical resource, or on a resource outside the wilderness with the intent to manipulate biophysical resources within the wilderness.

Agency authorized trammeling actions. These are actions that are authorized by the federal wilderness manager as well as actions by other agencies, organizations, or individuals that have been approved or permitted by the federal land manager.

1. Actions taken inside the wilderness on a *biological* resource to intentionally affect “the earth and its community of life.” Examples include:
 - a. Removing or killing indigenous or non-indigenous vegetation or fish and wildlife.
 - b. Adding or restoring indigenous or non-indigenous vegetation or fish and wildlife.
 - c. Using chemicals or biocontrol agents to control indigenous or non-indigenous vegetation or fish and wildlife.
 - d. Collecting, capturing, or releasing plants and animals under a research permit.
 - e. Enclosing or excluding fish and wildlife from an area.
2. Actions taken inside the wilderness on a *physical* resource or natural process to intentionally affect “the earth and its community of life.” Examples include:
 - a. Suppressing naturally-ignited fire.
 - b. Lighting fire (under management prescription) for any purpose.
 - c. Constructing or maintaining a dam, water diversion, guzzler, or other persistent installation intended to continuously alter wilderness hydrology; each agency will need to determine their counting rules for monitoring such installations.
 - d. Adding acid-buffering limestone to water to neutralize the effects of acid deposition.
3. Actions taken *outside* the wilderness on a physical or biological resource or process to intentionally affect “the earth and its community of life” inside a wilderness. Examples include:
 - a. Cloud seeding to intentionally increase precipitation inside the wilderness.
 - b. Damming a river outside a wilderness to intentionally alter the hydrology inside the wilderness.
 - c. Killing fish and wildlife outside the wilderness, or planting or stocking fish or wildlife outside the wilderness, to intentionally affect the population or distribution of this species inside the wilderness.

Unauthorized trammeling actions. These are citable or other actions taken by other agencies, organizations, or individuals that have not been authorized, approved, or permitted by the federal wilderness land manager.

1. Actions taken inside the wilderness on a *biological* resource to intentionally affect “the earth and its community of life.” Examples include:
 - a. Adding or removing plants or fish and wildlife.
 - b. Other direct manipulation of plants or fish and wildlife.
 - c. Indirect manipulation of fish and wildlife, such as changing hunting regulations with the goal of decreasing predator populations within the wilderness.
2. Actions taken inside the wilderness on a *physical* resource or natural process to intentionally affect “the earth and its community of life.” Examples include:
 - a. Setting arson fire.
 - b. Modifying water resources to provide water for wildlife, or otherwise store water or alter the timing of water flow.
3. Actions taken *outside* the wilderness on a physical or biological resource to intentionally affect “the earth and its community of life” inside a wilderness. Examples include:
 - a. Releasing or killing species outside of the wilderness with the intention to affect populations whose ranges expand into the wilderness.

In some situations, staff may assume that they do not have the opportunity for restraint because an action is required to comply with other laws or agency policies, or to protect human life or property. Examples of such situations include restoring habitat for a listed endangered species, spraying herbicides to eradicate an invasive non-indigenous plant that is degrading wildlife habitat, transplanting an extirpated species back into the wilderness, or suppressing a naturally-ignited fire. These are still considered trammeling actions because even in these situations staff are deciding to take action as well as deciding the type and intensity of action.

Activities that are not trammeling actions

Actions for which there is no opportunity for managerial or individual restraint are not considered a trammeling. For example, climate change, air pollutants wafting into a wilderness, and the presence of non-indigenous species that naturally dispersed into a wilderness are not intentional decisions or actions, and therefore do not provide an opportunity for management restraint. Accidental unauthorized actions, such as escaped campfires and oils spills, similarly lack an opportunity to restrain our power over the landscape. Past actions that manipulated the biophysical environment before the area was designated as wilderness are not considered a trammeling because the provisions of the 1964 Wilderness Act did not apply to the area prior to designation.

Another group of examples that are not a trammeling encompass those small-scale actions with no intent to manipulate the earth and its community of life, such as installing meteorological or other science instrumentation, landing a helicopter for search and rescue operations, and removing trash. Camping violations, unauthorized motorized incursions, and other illegal activities that are not

intended to manipulate the biophysical environment are also not counted as trammeling actions; legality is irrelevant in determining whether an action is a trammeling.

Hunting, for sport or subsistence, has provoked an enormous amount of discussion about whether it degrades the Untrammelled Quality. The consensus from the Lessons Learned Workshop was that hunting is generally not a trammeling action because individual hunters are taking individual animals without the intention to manipulate the wildlife population. However, if a state wildlife agency manipulates hunting quotas (or takes other management action) to alter the predator/prey relationship in order to maximize certain hunting opportunities, this manipulation of the “community of life” would degrade the Untrammelled Quality (see above).

Activities that may be trammeling actions

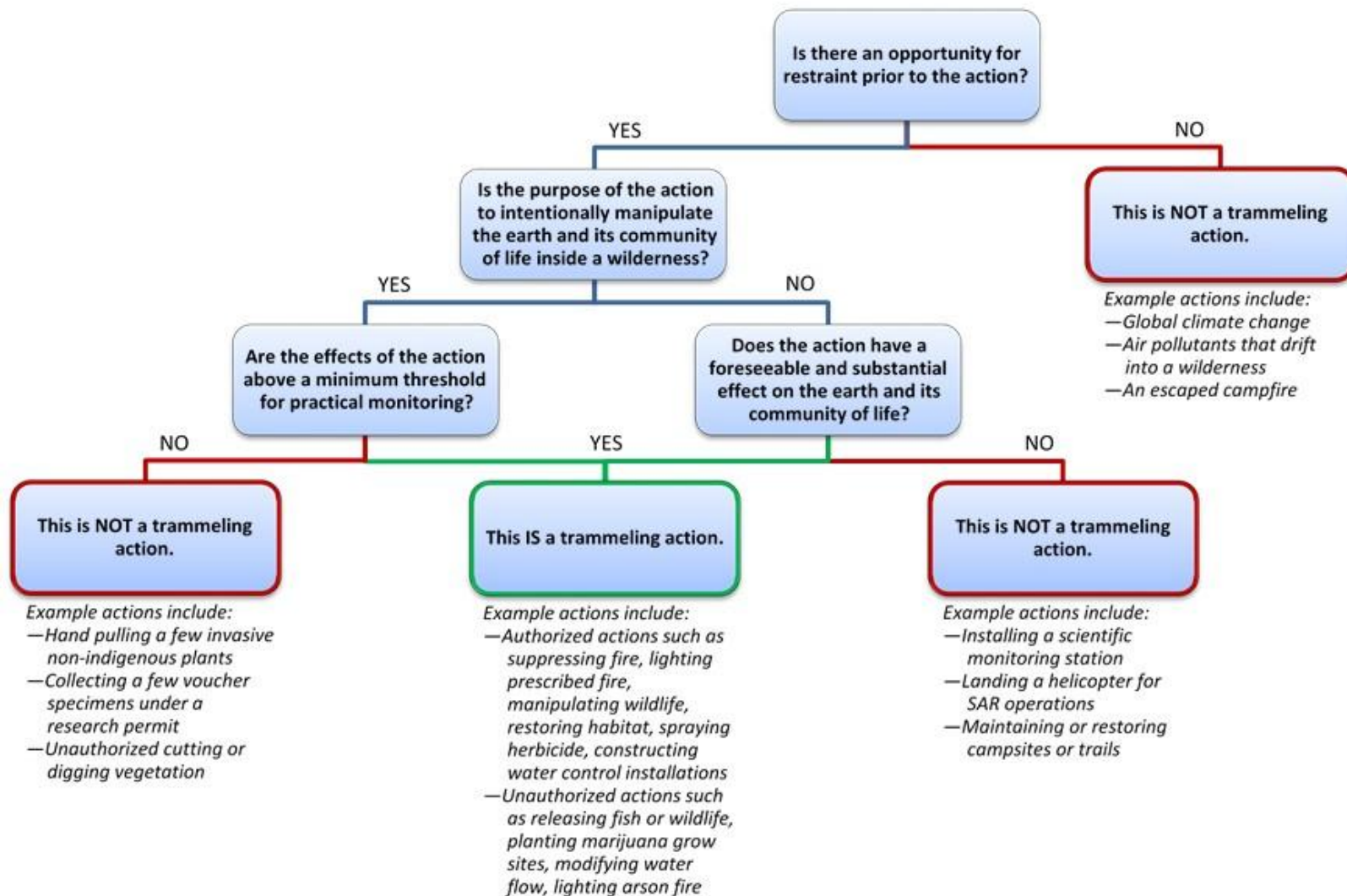
There are two types of actions that may or may not be considered trammeling actions. The first includes intentional manipulations that interfere with or control an aspect of wilderness ecosystems but are too small in scale or scope to be practically monitored. The second type encompasses those nuanced cases where the primary purpose of the action is not to manipulate the ecosystem but a foreseeable and substantial effect on the earth and its community is required to achieve this purpose. As shown in Table 11 below, several hypothetical situations illustrate how an action may or may not be a trammeling depending on the extent of the action and its effects. Each bullet in the table presents a situation where the action being taken likely would, or would not, be considered a trammeling.

Table C1. Examples of actions that likely are not, and likely are trammeling actions based on the scale and scope of the action and its effects on the earth and its community of life.

Action	Likely Not a Trammeling	Likely a Trammeling
Treating non-indigenous invasive plants	Hand pulling a small area of non-indigenous invasive plants	Spraying herbicide
Permitting scientific activities	- Installing research plot monumentation, such as rebar stakes or nails - Installing most scientific instrumentation - Collecting a limited number of voucher specimens with no impact on species distribution or abundance	- Installing enclosures or exclosures - Installing instrumentation that disrupts the movement or behavior of plants, or fish and wildlife - Capturing, collaring, and releasing wildlife
Building system trail	- Routing a trail around a rock slide - Building a bridge across a stream to prevent stream bank erosion - Installing a small section of corduroy across a wet area - Installing in waterbars or building rock-cribbing	- Routing a trail through an area of sensitive alpine butterfly habitat - Building a large amount of trail to go around a section of river or cliff - Building a trail that requires extensive earth movement or tree cutting
Obliterating non-system trail	Piling vegetation or rocks at the beginning and end of trail sections that cut a switchback	Obliterating a large section of non-system trail that requires extensive earth movement
Restoring campsites	- Restoring a single, isolated campsite - Restoring a number of campsites that don't require disrupting the soil or vegetation in the surrounding area	Restoring a number of campsites that requires moving a significant amount of soil or number of plants in the surrounding area
Removing hazard trees	Removing one or a few hazard trees that threaten designated campsites or that are along a trail	Removing all of the hazard trees over a large area

Flowchart

The flowchart below is intended to provide general guidelines to help agency staff determine when an action should be considered a trammeling. The first question asks if there is an opportunity for restraint, and is placed first to help avoid confusing those actions that are beyond the scope of management control, or are unauthorized accidents, from actions that managers or others do have an opportunity to influence. Political considerations are not a factor in determining whether or not there is an opportunity for restraint. The second question examines the intentionality of the action and whether the purpose is to manipulate the earth and its community of life. If there is a clear intent to manipulate, then the action is counted as a trammeling unless it does not meet a minimum threshold for practicable monitoring. If the purpose of the activity is not to manipulate the ecological system, the action is nonetheless considered a trammeling if it results in foreseeable and substantial effects to the wilderness ecosystem.



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