

ARCTIC NATIONAL WILDLIFE REFUGE

Arctic Refuge Wilderness

A Report on Wilderness Character Monitoring

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U.S. FISH AND WILDLIFE SERVICE

This report is part of a national initiative to establish baseline wilderness character for all the National Wildlife Refuges with designated wilderness. The measures for each wilderness were developed with refuge staff and reviewed at the national level.



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INTRODUCTION

The Wilderness Act of 1964 was established to protect natural lands from the seemingly endless threat of “expanding settlement and growing mechanization.”² The primary mandate of the Wilderness Act, Section 4(b), states that “each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area.” Today, many wilderness field and program managers perceive steady erosion in wilderness character caused by widespread threats³, but lack a consistent definition of wilderness character and the means to measure its loss, preservation or the unintended impacts of their stewardship.

In 2006, an Interagency Wilderness Character Monitoring Team (IWCMT) – representing the Department of the Interior Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey (USGS) and the U.S. Forest Service (USFS) from the Department of Agriculture – was established to promote wilderness stewardship and develop a standard definition of wilderness character and strategy for monitoring trends in wilderness character. The IWCMT identified 5 qualities of wilderness character based on the language of the Wilderness Act²:

Untrammeled

“An area where the earth and its community of life are untrammeled by man”

Undeveloped

“An area of undeveloped Federal land ... without permanent improvements or human habitation”

Natural

“Protected and managed so as to preserve its natural conditions”

Solitude or Primitive and Unconfined Recreation

“Has outstanding opportunities for solitude or a primitive and unconfined type of recreation”

Other Features of Value

“May also contain ecological, geological, or other features of scientific, educational, scenic, or historical value”

² 1964. Wilderness Act.

³ Cole, D.N. 2002. Ecological impacts of wilderness recreation and their management. *In* Wilderness Management: Stewardship and Protection of Resources and Values (J.C. Hendee and C.P. Dawson, editors). Third Edition. Golden, CO: Fulcrum Publishing: 413-459.

Cole, D.N.; Landres, P.B. 1996. Threats to wilderness ecosystems: impacts and research needs. *Ecological Applications* 6:168-184.

Hendee, J.C; Dawson, C.P. 2001. Stewardship to address the threats to wilderness resources and values. *International Journal of Wilderness* 7(3):4-9.

Landres P.; Marsh, S.; Merigliano, L.; Ritter, D.; Norman, A. 1998. Boundary effects on national forest wildernesses and other natural areas. *In* Stewardship Across Boundaries (R.L. Knight and P.B. Landres, editors). Washington, DC: Island Press: 117-139.

³ Landres, P.; Barns, C.; Dennis, J.G.; Devine, T.; Geissler, P.; McCasland, C.S.; Merigliano, L.; Seastrand, J.; Swain, R. 2008. Keeping it Wild: An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System. 81 pages. USDA Forest Service, Rocky Mountain Research Station General Technical Report RMRS-GTR-212, Fort Collins, CO.

These qualities apply to all designated wilderness areas – regardless of their size, location, administering agency, or other unique place-specific attributes – because they are based on the legal definition of wilderness. In addition to the five tangible qualities there are also important intangible aspects of wilderness character that would be difficult or even impossible to quantify or monitor. These intangible aspects are diverse and 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.

Wilderness character may be either preserved or degraded by the actions or inaction of managers. The challenge of wilderness stewardship is that decisions and actions taken to protect one aspect of wilderness character may diminish another aspect. Furthermore, the accumulated result of seemingly small decisions and actions may cause a significant gain or loss of wilderness character over time. Because of this complexity, preserving wilderness character requires that managers document decisions and any associated impacts.

In 2008, the IWCMT published an interagency strategy for monitoring trends in wilderness character across the National Wilderness Preservation System titled *Keeping it Wild*. The framework is based on the qualities of wilderness character defined above. Each quality is divided into a hierarchical set of monitoring questions, indicators, and measures to assess trends in wilderness character. While the qualities, monitoring questions and indicators are nationally consistent, measures are specific and sometimes unique to individual wilderness areas (Figure 1).

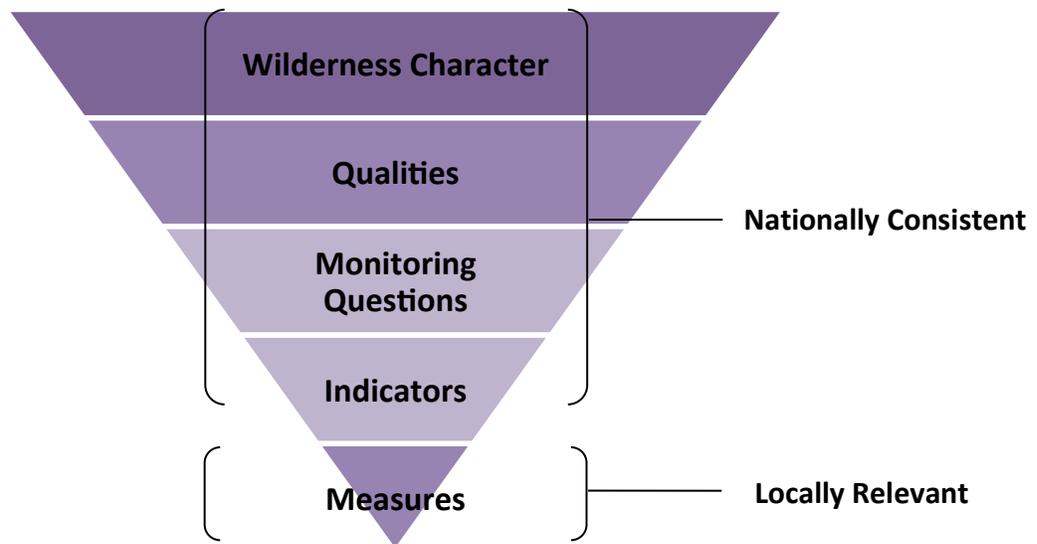


Figure 1. *Keeping it Wild* Hierarchical Framework

This approach 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 regional and national information to evaluate policy effectiveness;
- Communicates a positive and tangible vision for what wilderness is within the agency and with the public;
- Allows managers to understand consequences of decisions and actions in wilderness;
- Evaluates and documents the effects of actions taken inside the wilderness and effects from threats outside the wilderness
- Provides invaluable information for planning;
- Synthesizes data into a single, holistic assessment of wilderness character;
- Guards against legal vulnerability;
- Improves on-the-ground wilderness stewardship.

Under this monitoring strategy, wilderness character in a particular wilderness cannot, and will not, be compared to that of another wilderness. Each wilderness is unique in its legislative and administrative direction, and in its social and biophysical setting. Therefore, comparing wilderness character among different wildernesses is inappropriate. The purpose of this monitoring strategy is to offer a consistent means for documenting trends in wilderness character and wilderness management within a wilderness, not across wildernesses. This strategy has proved to be an effective tool for wilderness managers with limited resources.

The following report establishes a baseline condition and monitoring strategy for the Arctic National Wildlife Refuge wilderness based the interagency strategy outlined in *Keeping It Wild*. A Wilderness Character Monitoring Database (WCMD) accompanies this document including entries for all measures and baseline data specific to this refuge.



A view of the Brooks Range Mountains in the Arctic Refuge Wilderness (USFWS).

HISTORICAL AND ADMINISTRATIVE SETTING OF THE ARCTIC REFUGE WILDERNESS

History of establishing the wilderness

The Arctic Refuge Wilderness was designated in 1980 by provisions in the Alaska National Interest Lands Conservation Act (ANILCA). The act expanded the original Arctic National Wildlife Range and renamed it the Arctic National Wildlife Refuge. At 8 million acres, Arctic Refuge Wilderness is the second largest wilderness area in the United States (Figure 2). Within the vast 19 million acre Arctic Refuge, designated wilderness comprises more than 40% by area (Figure 3).

The legislative history of Arctic Refuge Wilderness begins with the movement to establish the original Arctic Wildlife Range. In the mid-1950s, national and Alaskan conservationists and sportsmen embarked on a long, hard-fought campaign to preserve the northeast corner of Alaska, initially referred to as “The Last Great Wilderness.”⁴ Concerned by the rapid loss of wildlands in the lower 48 states following World War II, proponents sought to establish a vast ecosystem-scale conservation unit, intended to be unprecedented not only in size, but also in the range of values and opportunities its preservation would perpetuate.

Olaus and Margaret Murie of the Wilderness Society, and other leaders of the effort, decided that status as a national wildlife range, administered by the FWS, would be most politically feasible and most likely to protect the area’s special values and opportunities. In 1957, the Fairbanks-based Tanana Valley Sportsmen’s Association petitioned the US Department of the Interior to establish the Arctic Range. Their proposal requested perpetuation of the area’s “primeval features,” “maintenance of undisturbed ecological conditions,” and “preservation of wilderness conditions.”⁵ Innumerable conservation, civic, scientific, and sportsmen’s organizations joined in lobbying for the area’s preservation.

Although there was widespread support for the proposal, there were many opponents as well, and the issue was hotly debated in Alaska and elsewhere. The Alaska Department of Mines, the Anchorage Chamber of Commerce, and both of Alaska’s senators were among those that voiced their opposition. Critics argued the proposal would hinder development of the area and limit game management options, among other concerns.

However on December 6, 1960, the Eisenhower administration established the 8.9-million-acre Arctic National Wildlife Range through Public Land Order 2214. Its brief statement of purpose proclaimed that the Range was established “to preserve unique wildlife, wilderness, and recreational values.” Never before had a wildlife range or refuge been established to “preserve . . . values.”⁶ Setting aside Arctic Wildlife Range was an important milestone for the wilderness movement and provided momentum for the passage of the Wilderness Act in 1964. Although designated wilderness was not

⁴ Collins, G., and L. Sumner. 1953. Northeast Alaska: The Last Great Wilderness. *Sierra Club Bulletin*, October 1953.

⁵ Tanana Valley Sportsmen’s Association. 1959. Statement submitted to U.S. Congress, Senate, Committee on Interstate and Foreign Commerce, Subcommittee on Merchant Marine and Fisheries, Hearings, S. 1899, A Bill to Authorize the Establishment of the Arctic Wildlife Range, Alaska, 86th Congress, 1st session, Part 2, 29 October 1959. Washington, D.C.: GPO, 1960: 293-296.

⁶ Kaye, R. 2006. *Last Great Wilderness: The campaign to establish the arctic national wildlife refuge*. University of Alaska Press, Fairbanks, Alaska, USA.

established in what would become Arctic Refuge until ANILCA was passed in 1980, the area was managed to preserve wilderness values. The Arctic National Wildlife Refuge Wilderness was renamed the Mollie Beattie Wilderness in 1996 after the first woman director of the US Fish and Wildlife Service.

In the 1960's the Arctic Wildlife Range received few visitors, and the refuge was not even staffed until 1969. Visitation increased in the 1970s because of increased international attention after oil was discovered in Prudhoe Bay in 1968 and the beginning of commercial air taxi service. Since then an increasing number of commercial air taxis and guides, as well as road access from the Dalton Highway have allowed greater access to the refuge. Today, people from around Alaska, the nation, and the world visit Arctic Refuge. Visitors participate in a variety of activities, such as river floating, hiking, backpacking, camping, long-distance expeditions, mountaineering, dogsledding, berry picking, wildlife observation, and photography. Hunting is also a popular activity on the refuge. Most recreational hunters visit the Refuge to hunt Dall's sheep, caribou, moose, and/or brown bears.

Visitors may experience wilderness qualities and opportunities that are unique relative to most protected areas in North America. With relatively few visitors for its vast area the refuge provides the possibility to travel and explore the Arctic environment for days or weeks without seeing another person. The wilderness allows the unique opportunity to plan multiday expedition trips and remain entirely inside designated wilderness. Arctic Refuge Wilderness is a place where people may experience and appreciate remarkable scenery, diverse wildlife resources, remoteness, and vast wilderness.⁷

Refuge purposes

Section 302.(7) (B) of ANILCA states that the purposes of Arctic Refuge are:

(i) to conserve fish and wildlife populations and habitats in their natural diversity including, but not limited to, the Porcupine caribou herd (including participation in coordinated ecological studies and management of this herd and the Western Arctic caribou herd), polar bears, grizzly bears muskox, Dall's sheep, wolves, wolverines, snow geese, peregrine falcons and other migratory birds and Arctic char and grayling;

(ii) to fulfill the international treaty obligations of the United States with respect to fish and wildlife and their habitats;

(iii) to provide, in a manner consistent with the purposes set forth in subparagraphs (i) and (ii), the opportunity for continued subsistence uses by local residents; and

(iv) to ensure, to the maximum extent practicable and in a manner consistent with the purposes set forth in paragraph (i), water quality and necessary water quantity within the refuge.

The purpose of congressionally designated wilderness as defined by the Wilderness Act of 1964 (16 U.S.C. 1131-1136), Section 2(a):

⁷ Christensen Research. 2009. Arctic National Wildlife Refuge visitors study: the characteristics, experiences, and preferences of Refuge visitors. Christensen Research, U. S. Fish and Wildlife Service, and The Aldo Leopold Wilderness Research Institute, Missoula, Montana, USA.

“For this purpose there is hereby established a National Wilderness Preservation System to be composed of federally owned areas designated by the Congress as “wilderness areas,” and these shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness...”

Special access and access to inholdings in the Arctic Refuge Wilderness is required by section 1110 (a) of ANILCA:

(a) Notwithstanding any other provision of this Act or other law, the Secretary shall permit, on conservation system units national recreation areas, and national conservation areas, and those public lands designated as wilderness study, the use of snowmachines (during periods of adequate snow cover, or frozen river conditions in the case of wild and scenic rivers), motorboats, airplanes, and non- motorized surface transportation methods for traditional activities (where such activities are permitted by this Act or other law) and for travel to and from villages and homesites. Such use shall be subject to reasonable regulations by the Secretary to protect the natural and other values of the conservation system units, national recreation areas, and national conservation areas, and shall not be prohibited unless, after notice and hearing in the vicinity of the affected unit or area, the Secretary finds that such use would be detrimental to the resource values of the unit or area. Nothing in this section shall be construed as prohibiting the use of other methods of transportation for such travel and activities on conservation system lands where such use is permitted by this Act or other law.

BIOPHYSICAL SETTING OF THE ARCTIC REFUGE WILDERNESS

Geographic setting

Arctic Refuge lies across the spine of the Brooks Range Mountains in the northeast corner of Alaska (Figure 2). The refuge spans roughly 200 miles north to south from the Beaufort Sea to the Porcupine and Chandalar Rivers, and 180 miles east to west, at its greatest extent, from Canada to the Sagavanirktok River drainage near the Dalton Highway. The designated wilderness extends west from the Canadian border about 120 miles (Figure 3). In the northeast, the wilderness extends all the way to the Arctic Ocean for approximately 30 miles of coastline. Further west beyond those 30 miles, the coastal plain is not designated wilderness. This undesignated area is referred to as the 1002 area after a special ANILCA provision. The 1002 area is managed as wilderness until it is officially designated by congress or opened for oil and gas development.

The Brooks Range represents the northernmost extension of the Rocky Mountains. The range consists of a wide belt of mountain ridges, several of which are named, that arc gently east to west across the Refuge. The long, central, northeast-trending crest of the Philip Smith Mountains (one of the several named Brooks Range ridges) forms the continental drainage divide. The Arctic Ocean receives rivers on the north side of the Brooks, while the southern side flows out to the Pacific Ocean via the Yukon River. Mountain summits in the Philip Smith Mountains are generally from 4,000 to 6,000 ft; 7,000 to 8,000 ft in the Franklin Mountains; and 8,000 to 9,000 ft in the Romanzof Mountains. The four

highest peaks in the Brooks Range are found in the Romanzof Mountains, the highest being 9,050 ft Mount Isto.

The Brooks Range was extensively glaciated during the Pleistocene epoch, but today only small, scattered alpine glaciers persist above 6,000 ft in the Philip Smith, Franklin and Romanzof Mountains. The Romanzof Mountains glaciers covered over 140 mi² in 1956 but have been losing mass since the late 19th century and many glaciers are expected to disappear in the next 50 years.⁸ Glacier studies began on the Refuge in 1957 on McCall Glacier near Mt. Hubley, which has the longest history of research of any U.S. Arctic glacier.⁹ McCall Glacier has retreated more than 2,600 ft since the late 1800s.¹⁰ Currently, glacier melt water contributes considerably to the summer flow of several North Slope rivers, particularly the Hulahula, Jago, and Okpilak Rivers and the glaciers loss is expected to have a strong influence on downstream ecosystems.¹¹



A mountain glacier in Arctic National Wildlife Refuge (USFWS).

⁸ Nolan, M., R. Churchwell, J. Adams, J. McClelland, K.D. Tape, S. Kendall, A. Powell, K. Dunton, D. Payer, and P. Martin. 2011. Predicting the impact of glacier loss on fish, birds, floodplains, and estuaries in the Arctic National Wildlife Refuge. Pages 49-54 in C.N. Medley, G. Patterson, and M.J. Parker, eds. Proceedings of the Fourth Interagency Conference on Research in the Watersheds. USGS. Scientific Investigations Report 2011-5169.

⁹ Weller, G., M. Nolan, G. Wendler, C. Benson, K. Echelmeyer, and N. Untersteiner. 2007. InfoNorth: Fifty years of McCall glacier research: From the international geophysical year 1957–58 to the international polar year 2007–08. *Arctic* 60:101-110.

¹⁰ Nolan, M., A. Arendt, B. Rabus, and L. Hinzman. 2005. Volume change of McCall glacier, arctic Alaska, USA, 1956-2003. *Annals of Glaciology* 42:409-416.

¹¹ Nolan, M., R. Churchwell, J. Adams, J. McClelland, K.D. Tape, S. Kendall, A. Powell, K. Dunton, D. Payer, and P. Martin. 2011. Predicting the impact of glacier loss on fish, birds, floodplains, and estuaries in the Arctic National Wildlife Refuge. Pages 49-54 in C.N. Medley, G. Patterson, and M.J. Parker, eds. Proceedings of the Fourth Interagency Conference on Research in the Watersheds. USGS. Scientific Investigations Report 2011-5169.

The glacier history of Arctic Refuge Wilderness is still manifested in breathtaking rivers and valleys that draw many visitors to experience them through recreational float trips. The headwaters of several major rivers can be found in the wilderness high in the Brooks Range flowing out both north and south. The Sheenjek, the East Fork of the Chandalar, and Colleen Rivers flow south from the Brooks Range until they meet the Porcupine or Yukon Rivers. On the north side, the Kongakut, Jago, Okpilak, and Hulahula Rivers flow to the Arctic Ocean. On either side of the range, the initial course of each river is situated in scenic glacier-carved valleys. The valleys are perfect U-shapes with wide floors that abruptly meet the steep, sharp ramparts of the valley walls. The walls are bare exposed rock that dramatically present the uplifted, tilted, folded and faulted geology of the Brooks Range Mountains. Along the course of each of the main rivers smaller streams flow out through notches cut in the steep valley walls to meet the main rivers, but not before they drop their sediment in huge radial-shaped alluvial fans on the valley bottom.



Sheenjek River valley in Arctic Refuge Wilderness (USFWS)

After several days of floating further downstream on either the North Slope and south of the Brooks, visitors almost abruptly depart the mountainous Brooks Range. Downstream from the North Slope the highlands give way to a great expanse of tundra and low hills before reaching the Arctic Ocean. On the south side some rounded hills persist as well but along with open tundra spruce trees have colonized the valleys in the wilderness area. Although they share similar features, each major river valley that begins in the Brooks Range Mountains has its own unique character and all offer amazing wilderness landscapes to explore.

Ecological setting

Arctic Refuge Wilderness contains a unique juxtaposition of ecosystems compared to the rest of northern Alaska. The southern portions of the Arctic Refuge border the Yukon Flats, which have the highest summer temperatures in Alaska. In contrast, the northern portion of the refuge, along the Beaufort Sea, experiences some of the coldest summer temperatures. North of the Brooks Range, the Beaufort Sea Coastal Plain and Brooks Range Foothills ecoregions are treeless tundra, composed mainly of hardy dwarf shrubs, sedges, and mosses. Within the Brooks Range Mountains, barren rock and sparse, dry alpine tundra predominate. Mountain valleys contain moist tundra and, along river courses, areas of shrub willow thickets. South of the Brooks Range mountains, the biological environment is more complex. Spruce forests are widespread in the lowlands south of the wilderness area, but spruce woodlands also extend far into the valleys inside the wilderness area. Open tundra is present throughout the wilderness as well and covers vast expanses of uplands on the south side. Dense shrub thickets occur on floodplains, near treeline, and on glacial moraines. Treeless bogs and muskeg areas are found mostly along major river floodplains. Wilderness designation clearly befits this landscape filled with diverse wild ecosystems, punctuated by the Brooks Range divide, cold waters of the Arctic Ocean and the extreme temperatures of interior Alaska.

The variety of unaltered habitats in Arctic Refuge Wilderness supports a great diversity of high-interest arctic and subarctic wildlife, including whales, seals, polar and brown bears, wolves, wolverines, muskoxen, moose, Dall's sheep, and wide-ranging caribou. The huge migrations and concentrated calving of the Porcupine Caribou herd is iconic of the wilderness. The Porcupine Caribou herd ranges across an astounding 130,000 square mi of wildlands in the US and Canada. Their calving grounds on the coastal plain of Arctic Refuge makes it one of the most important areas for the herd. Besides being known for large charismatic mammals, Arctic Refuge also supports 42 species of fish and 201 species of birds, of which 109 are known to breed in the Refuge.

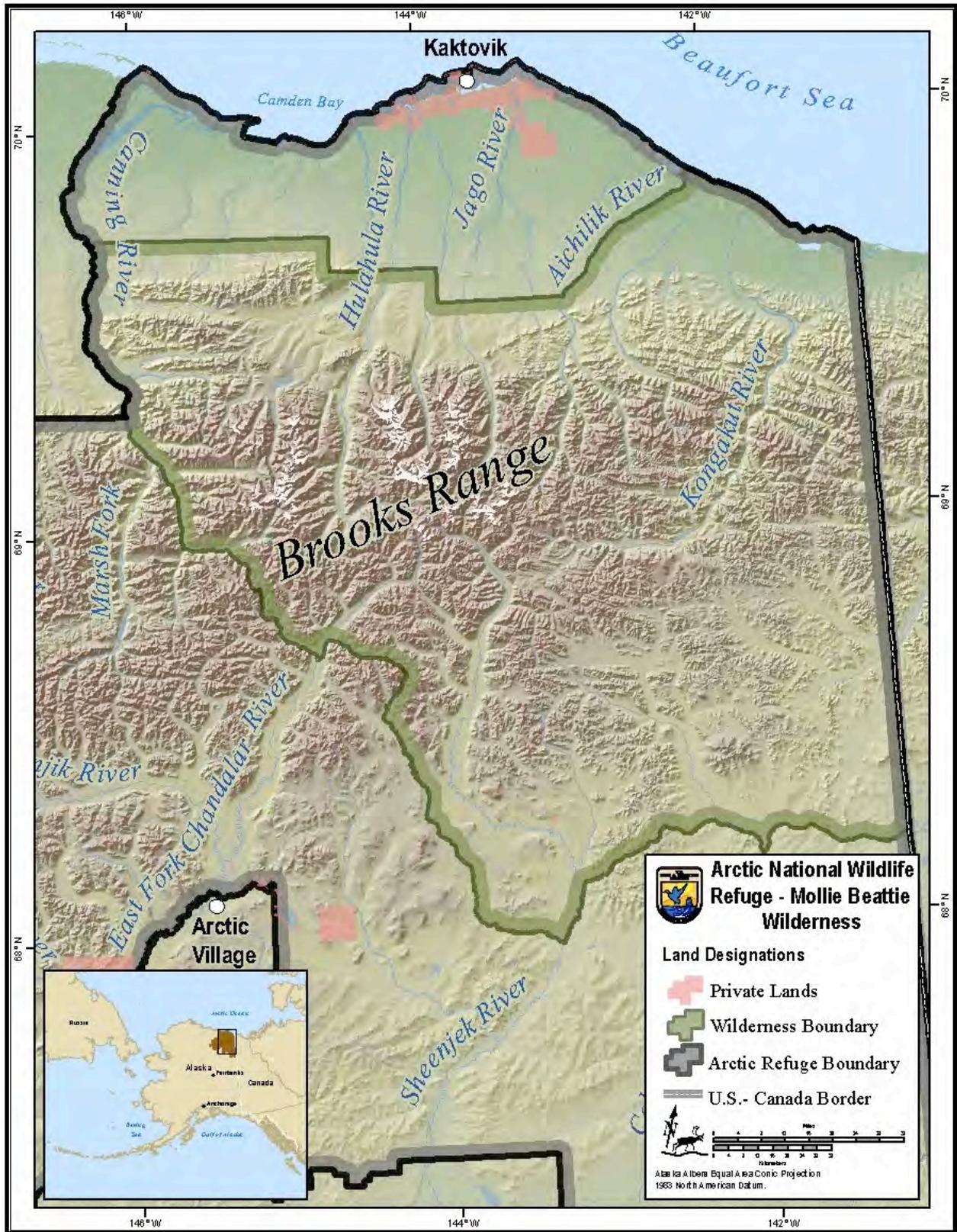


Figure 3. Arctic Refuge Wilderness with major rivers shown.

DOCUMENTS CONSULTED

Kaye, Roger. 2006. *Last Great Wilderness*. University of Alaska Press, Fairbanks, AK.

Landres et al. 2008. *Keeping It Wild: An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System*. USDA Forest Service.

Landres et al. 2009. *Technical Guide for Monitoring Selected Conditions Related to Wilderness Character*. USDA Forest Service.

US Fish and Wildlife Service. 2013. *Arctic National Wildlife Refuge: Revised Comprehensive Conservation Plan - DRAFT*.

US Fish and Wildlife Service. 1973. *Arctic National Wildlife Range, Alaska Wilderness Study Report*.

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PROCESS USED FOR IDENTIFYING MEASURES

The process to identify measures began with a review of the Arctic Refuge Comprehensive Conservation Plan (CCP) and annual narratives. These documents provided an understanding of the unique values of the Arctic Refuge Wilderness and provided some details on active projects that could provide data for measures. In the process of this initial work, a list of measures was developed from the Excel document “Potential Measures for FWS WCM—2013.xlsx,” which was part of the electronic resources provided to Wilderness Fellows at training. This list of generic measures was whittled down and amended for the first draft of measures for the wilderness character monitoring program at Arctic.

Once this initial draft of measures was created, staff meetings were organized to discuss potential measures for each of the five wilderness character monitoring qualities. Each meeting began with a short presentation on the quality and tips for choosing measures. Following the presentation the potential measures were discussed and new measures and data sources were brainstormed. After each meeting, minutes were generated based on staff discussion and the potential measure list was refined based on staff consensus. Also following each staff meeting, particular staff members were sometimes consulted based on their area of expertise to further develop measure descriptions and collection protocol. The measures for some qualities could not be resolved in a single meeting so follow up discussions were held. At all times in the process an up to date list of potential measures and meeting minutes were available on the refuge’s shared drive for staff to review.

After potential measures for every quality had been discussed, staff filled out a survey where they scored each potential measure based on significance, vulnerability, reliability and feasibility. All staff surveys were averaged together to provide a collective ranking of all potential measures (See Appendix A). The collective ranking was used as a tool in one final meeting with all staff to finalize the list of measures. During the final meeting, staff went through every measure, made adjustments to measure names or descriptions and decided which measures would stay in the active list of measures for the final report. In this way staff discussed every measure at least twice and the best attempt was made to reach consensus on measures that would be ideal to represent the wilderness character of the Arctic Refuge Wilderness and provide useful information to managers.

WILDERNESS CHARACTER MONITORING MEASURES

This section describes in detail the measures chosen to monitor the Arctic Refuge Wilderness. Background information, collection protocol, baseline data, and the data source are described for each measure. Additional details such as frequency, significant change, weight, condition of baseline data (good, caution, or poor), and data adequacy are also addressed. The frequency of a measure is how often the data are collected and entered into the Wilderness Character Monitoring Database (WCMD), usually every one or five years. The significant change tells how much a measure's data must change from a previous data entry to suggest a change in trend of wilderness character for that measure. A measure's weight tells how important that measure is relative to the other measures within a particular indicator. The sum of the weights of each measure within an indicator equals 100%. Baseline data represent the current condition of the measure: whether the data reflects a good or poor condition of wilderness character, or indicates that while the effect is neither good nor poor, there is concern about what these data say about the wilderness' character. In most cases the frequency, significant change, weight, and baseline condition for each measure were assigned by the wilderness fellow and approved by the wildlife refuge specialist and/or deputy project leader.

Data adequacy is defined as the reliability of the data to assess trends in the measure. The intention behind evaluating data adequacy is to understand where improvements in data collection need to be made and not to evaluate how well an individual measure represents a particular aspect of wilderness character. For example, if the data indicate a degrading trend in a particular indicator and the data adequacy is deemed "low," this would suggest that the trend be interpreted conservatively, not discounted entirely, and that greater efforts be expended in future years to acquire more or better data.

To determine the data adequacy of each measure for this report, two related but distinct aspects of data adequacy are subjectively evaluated: 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. Data quantity and quality are subjectively evaluated for each measure according to categories found in Tables 1 and 2 below.

Each wilderness character monitoring measure for Arctic Refuge Wilderness has an Excel file where data will be recorded before updating the WCMD MS Access database. The Excel file that belongs to each measure is set up to calculate index values (if required) or simply act as the repository for data. The Excel files are kept together in the wilderness character monitoring folder on the Arctic NWR shared drive at T:\Administration\Management\Wilderness\Wilderness Character Monitoring. The electronic path to each measure's Excel file is found under the header, "Data Collection File" in the measure definitions below.

Table 1. Data Quantity	
Complete	This category indicates a high degree of confidence that all data records have been gathered. For example, to assess the occurrence of nonindigenous invasive plants, a complete inventory of the wilderness was conducted or all likely sites were visited.
Partial	This category indicates that some data are available, but the data are generally considered incomplete (such as with sampling). For example, to assess the occurrence of nonindigenous invasive plants, a partial inventory was conducted or a sampling of sites was conducted where these plants are likely to occur.
Insufficient	This category indicates even less data records have been gathered or perhaps this measure is not dependent on actual field data. For example, no inventory for nonindigenous invasive plants has been conducted, and visitor use was not assessed anywhere.

Table 2. Data Quality	
High	This category indicates a high degree of confidence that the quality of the data can reliably assess trends in the measure. For example, data on the occurrence of nonindigenous invasive plants is from ground-based inventories conducted by qualified personnel; for visitor use, data would come from visitor permit data.
Moderate	This category indicates a moderate degree of confidence about the quality of the data. For example, data on invasive plants could come from national or regional databases; for visitor use, data could come from direct visitor contacts.
Low	This category indicates a low degree of confidence about the quality of the data. For example, data on invasive plants and visitor use could come from professional judgment.

1. UNTRAMMELED QUALITY

Table 3. Untrammeled Quality

Wilderness is essentially unhindered and free from modern human control or manipulation.

Monitoring Question	Indicator	Measure	Frequency, Data Adequacy	Baseline Value	Condition, Weight
What are the trends in actions that control or manipulate the “earth and its community of life” inside wilderness?	Actions authorized by the Federal land manager that manipulate the biophysical environment	1.1 Number of actions to manipulate plant, wildlife, insects, fish, pathogens, soil, water	1 year, High	0	Good, 34%
		1.2 Index of suppression or control taken on naturally ignited wildfires	1 year, High	0	Good, 33%
		1.3 Number of research, survey, and monitoring projects that manipulate plants, wildlife or habitat	1 year, High	0	Good, 33%
	Actions <u>not</u> authorized by the Federal manager that manipulate the biophysical environment	1.4 Number of unauthorized actions to manipulate plant, wildlife, insects, fish, pathogens, soil, water, or fire	1 year, Low	0	Good, 50%
		1.5 Number of hunting regulations with clear intent to manipulate predator populations inside wilderness	1 year, High	0	Good, 50%



A lone grizzly bear smells the air and checks its surroundings as it travels up a sunny hillside in the Arctic Refuge Wilderness (Photo: USFWS).

Measure: 1.1 Number of actions to manipulate plants, wildlife, insects, or fish**Background & Context**

There are currently no actions taken by refuge staff to manipulate the ecosystem in the wilderness or anywhere in the refuge, except for limited wildfire suppression. No foreseeable reasons exist for staff to take additional actions that manipulate the earth or community of life. Should the FWS decide to aggressively manage the effects of climate change or manipulate the ecosystem for some other reason, future managers should carefully weigh actions that degrade the untrammelled quality. Possible trammeling actions include, prescribed burns, invasive species control, or plant seeding.

In the past the FWS also authorized predator control and culling actions for a variety of reasons. Should refuge staff revert to these management methods, potentially to manage the effects of climate change, staff should monitor these trammeling actions in this measure.

Measure Description & Collection Protocol

This measure is a simple count of actions authorized or conducted by refuge staff that manipulates plant, wildlife, insects or fish in the Arctic Refuge Wilderness. Note that wildfire suppression is monitored in measure 1.2 rather than this measure. Biological staff or the refuge manager should be aware of projects that manipulate plants, wildlife, insects or fish and could tally the number of actions. Minimum Requirement Analyses (MRAs) should be consulted if refuge staff are unsure of recent trammeling actions taken in wilderness.

In the future, if an authorized trammeling occurs a criterion may need to be created to standardize what constitutes “one” action. For example, starting multiple prescribed burns at various locations in the wilderness would count as multiple actions rather than just one

collective action. The method for determining what constitutes “one” action should be created by staff and kept standard if and when trammeling actions ever occur. Record the number of actions in this measure’s data collection Excel file and in the WCMD MS Access Database

Definitions

- *Authorized action: an action that is conducted or approved by Arctic Refuge staff*

Data Source

Refuge manager, biological staff or MRAs

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\1 Untrammelled Quality\1.1 Number of actions to manipulate plants, wildlife, insects, or fish.xls

Data Adequacy

High

Data Quantity: *Complete*, Data Quality: *High*

Frequency

1 Year

Baseline Value

0*

*Throughout this report “0” will always mean “zero,” and missing data will be indicated with “N/A.” Also, all baseline data presented are for the year 2013 unless otherwise noted.

Significant Change

Any change would be significant

Measure: 1.2 Index of fire management actions in wilderness**Background & Context**

The Arctic Refuge Wilderness are classified for “Limited” fire protection. Limited protection means that the standard response to a fire is *monitoring*. Suppression action is typically only taken on fires that may threaten allotments inside the refuge and wilderness area. The suppression actions taken on these fires would fall into 3 categories that include, point protection, partial suppression and full suppression. Point protection would take place on or in the vicinity of an allotment to allow the fire to burn around, but not inside an allotment, to the extent possible and safe for the fire crew. Partial suppression would be a more aggressive attack near an allotment, but likely on refuge land with a goal to partially halt a fire that would burn in the direction of an allotment. Full suppression is the most aggressive and would aim to fully suppress and put out a fire burning near an allotment.

For each of the three suppression types, smokejumpers or helitack crews are mobilized to take various suppression actions such as, saw lines, burn outs, hose lays and water application, or direct attack of the fire, as in stomping out a slow burning tundra fire. Extensive digging of fire lines is not a method typically employed by fire crews in Alaska. The baseline value for 2013, is 0, because no fires occurred in the wilderness in 2013. Wildfires in the wilderness are not very common but have occurred in the past.

Measure Description & Collection Protocol

This measure is an index score based on the actions taken on fires inside the wilderness area. Data for this measure are collected by consulting the Refuge Fire Management Officer for a count of fires that burned inside the wilderness in the past year. If any fires occurred, more details on the actions taken should be collected and the Fire Management

Officer can assign a score for the suppression action taken on each fire from the index (Table 4).

Once this information is collected, these data should be recorded in the Excel file called “1.2 Index of fire management actions in wilderness.xls” Each year has a column to tally fires by each management type taken and automatically generate the overall index score. The index score should be entered into the WCMD MS Access Database.

Definitions

- *Smokejumper crew: a wildland firefighter crew that parachutes into the backcountry to combat wildfires*
- *Helitack crew: a wildland firefighter crew that is deployed to remote areas by helicopter*
- *Monitoring: the standard fire protection plan for Arctic NWR that normally includes one observation overflight per week.*
- *Allotment: lands held privately by Alaska Natives*

Data Source

Refuge Fire Management Officer
If the Fire Management Officer is unavailable, the Alaska Interagency Coordination Center Online GIS Map can be consulted.
http://afsmaps.blm.gov/imf_fire/imf.jsp?site=fire

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\1 Untrammeled Quality\1.2 Index of fire management actions in wilderness.xls

Data Adequacy

High

Data Quantity: *Complete*, Data Quality: *High*

Frequency

1 year

Significant Change

Any change in this index in a given monitoring cycle should degrade or improve this measure. Any suppression actions taken beyond *monitoring* would degrade the untrammelled quality.

Baseline Value

There were no fires in 2013 for the baseline year so it scored "0."

Table 4 Scoring index for management actions taken on fires that occur within wilderness

Management Action	Description	Score
Monitoring	No control action taken. Only monitoring with approximately one overflight per week.	0
Point Protection	Suppression inside or in the close vicinity of an allotment that aims to cause a fire to burn around, but not on an allotment to the extent possible and safe for wildland fire personnel.	3
Partial Suppression	More aggressive suppression that takes place on wilderness lands near an allotment with a goal of partially halting or deflecting a fire that would threaten an allotment.	6
Full Suppression	The most aggressive suppression that aims to fully suppress and put out a fire on wilderness land.	10

Measure: 1.3 Number of research, survey, and monitoring projects that manipulate plants, wildlife or habitat**Background & Context**

Arctic Refuge offers unique opportunities for research in an unaltered arctic environment. Research and monitoring may have positive effects on refuge management practices or even be beneficial for another quality of wilderness character. However, research activities conducted inside the Arctic Refuge Wilderness could degrade the untrammeled quality of wilderness character depending on the methods and actions taken by researchers.

Research projects that are considered a trammeling may include research that disturbs the ground surface, uses exclusion fences, alters vegetation exceptionally, or research that handles, tranquilizes, or collars wildlife. Any other actions taken for a research project that somehow manipulate populations, or processes in the wilderness would degrade the untrammeled quality.

A single trammeling action conducted alone for a research project may be considered insignificant compared to the large scale of wilderness in Arctic Refuge. However, the sum of multiple small actions can threaten the untrammeled quality of wilderness. If there are any questions about trammeling actions, consult the document "*What is a Trammeling Action*" found in Appendix E.

Measure Description & Collection Protocol

This measure is a count of the number of research projects conducted by refuge staff or

non-staff researchers that manipulate wildlife, plants or habitat in wilderness. Unit biologists and refuge staff responsible for issuing permits should be consulted for this measure. A staff person should count the number of research projects that included a trammeling action from Special Use Permits (SUPs) and MRAs. Record a brief description in this measure's data collection Excel file and record the total number of projects in the WCMD MS Access Database.

Data Source

SUPs and MRAs

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\1 Untrammeled Quality\1.3 Number of research, survey, and monitoring projects.xls

Data Adequacy

High

Data Quantity: *Complete*, Data Quality: *High*

Frequency

1 Year

Baseline Value

0

Significant Change

Any change would be significant

1. UNTRAMMELED QUALITY

INDICATOR: Actions NOT authorized by the federal land manager that manipulate the biophysical environment

Measure: 1.4 Number of unauthorized actions to manipulate plant, wildlife, insects, fish, pathogens, soil, water, or fire

Background & Context

Unauthorized trammeling actions are not approved by Arctic Refuge management. Although staff do not believe any unauthorized trammeling actions have occurred in wilderness recently, this could change in the future. Unauthorized actions could be conducted by visitors, unapproved researchers, state agencies or other federal agencies. Some potential unauthorized actions that manipulate the environment include, human-ignited fires and the introduction of non-native species.

If the Alaska Department of Fish and Game (ADFG) or other government agencies conduct predator control or animal culling inside the wilderness without refuge management consent, an unauthorized trammeling will have occurred and should be counted in this measure. To determine if a particular unauthorized action degrades the untrammeled quality of wilderness consult the “*What is a Trammeling Action*” document found in Appendix E.

Measure Description & Collection Protocol

This measure is a count of unauthorized actions inside wilderness that manipulate the biophysical environment. Data for this measure comes from several sources including, (1) citations issued by refuge law enforcement officers for violations that manipulate the biophysical environment; (2) staff knowledge of known or suspected unauthorized trammeling actions; and (3) publications by state or federal agencies documenting unauthorized trammeling actions.

As with measure 1.1, if trammeling actions begin to occur regularly a criterion may need to be created to standardize what constitutes “one” action. The method for determining

what constitutes “one” action should be created by staff and kept standard if and when trammeling actions ever occur. Record the number of actions and a description of actions in this measure’s data collection Excel file, but only record the total number of trammeling actions during the 1 year monitoring cycle in the WCMD MS Access Database.

Definitions

- *Unauthorized Action: an action not approved by Arctic Refuge management that could be conducted by visitors, state agencies or other federal agencies.*

Data Source

Refuge manager, law enforcement citation records, ADFG publications

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\1 Untrammeled Quality\1.4 Unauthorized manipulations.xls

Data Adequacy

Low

Data Quantity: *Incomplete*, Data Quality: *Low*
Data quantity and quality are *incomplete* and *low*, respectively because staff do not have the ability to closely track violations in the large refuge.

Frequency

1 year

Baseline Value

0

Significant Change

Any change would be significant

Measure: 1.5 Number of hunting regulations with clear intent to manipulate predator populations inside wilderness

Background & Context

Intensive management may take the form of lethal predator control but it may also include hunting regulations that encourage the taking of predators such as wolf, grizzly bear and black bear. Examples of hunting regulations that promote predator removal may include: increased bag limits; extended seasons; eased permit requirements; or economic incentives for predator species hunting. These hunting regulations sometimes have the stated intent to decrease predator populations in order to increase ungulate or other game animal populations. When the manipulative intent of a hunting regulation is obvious it should be counted as a degradation of the untrammelled quality of wilderness character.

Measure Description & Collection Protocol

Staff already monitor proposed regulations that affect the refuge. For this measure, staff will more closely monitor and count the hunting regulations made by either state or federal regulatory bodies that have the stated purpose to manipulate predator populations with the goal of changing game animal populations. It applies for regulations in Alaska game management units (GMU) 25A and 26C, which cover the wilderness.

Hunting regulation changes can be made either by the Alaska Board of Game or the Federal Subsistence Board. In each regulatory body, proposals are accepted from the public and considered by the board annually. If a new regulation does not adequately explain its intent, the proposal that corresponds with the regulation can be consulted to examine its rational. If the proposal shows intent to manipulate, it can be counted.

However, a regulation should only be counted if it is abundantly clear that the intent of the regulation is to manipulate predator and game populations for a management goal. The regulation cannot be counted in this measure if the intent to manipulate is not clearly stated by the regulatory body or the associated proposal. If there is doubt then it should not be counted.

For example, if hunting regulations were amended to lengthen the wolf hunting season and the stated purpose of the change was to decrease wolf numbers and increase the Caribou population, this is a clear trammeling and should be counted. However, if the wolf hunting season was lengthen and the stated intent of the change was to make the wolf season better coincide with sheep hunting season then it should not be counted. The intent to manipulate is not clear.

Record the number and description of regulations that are considered a trammeling in measure's data collection Excel file, but only record the total number in the WCMD MS Access Database.

Definitions

- *Alaska Board of Game: is a state regulatory body appointed by the governor of Alaska to conserve and develop Alaska's wildlife resources. The board takes proposals for hunting, fishing and trapping regulation changes from the public and considers and enacts regulation changes*
- *Federal Subsistence Board: is a federal regulatory body that manages and regulates subsistence activities on federal land in Alaska. The board takes recommendations on regulation changes from Regional Advisory Councils (RACs) and enacts those changes unless they lack evidence or are damaging to subsistence activities or resources.*

Data Source

The refuge wilderness specialist or a biologist who is knowledgeable in hunting regulation changes should be consulted for this measure. The published federal subsistence board and AK board of game hunting regulation amendments and proposals will also need to be consulted to check the stated intent of each regulation change.

The changes made annually by the Alaska Board of Game are available, along with the written proposals, online at:

<http://www.adfg.alaska.gov/index.cfm?adfg=gameboard.main>

Proposed changes to the Federal Subsistence regulations are published by region at http://www.doi.gov/subsistence/library/meeting_books/index.cfm. Consult the North Slope and Eastern Interior RAC Meeting notes.

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\1 Untrammeeed Quality\1.5 Number of hunting regulations with clear intent to manipulate.xls

Data Adequacy

High

Data Quantity: *Complete*, Data Quality: *Medium*

Frequency

1 year

Baseline Value

0

Significant Change

Any change would be significant

2. NATURAL QUALITY

Table 5. Natural Quality

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

Monitoring Question	Indicator	Measure	Frequency, Data Adequacy	Baseline Value	Condition, Weight
What are the trends in terrestrial, aquatic, and atmospheric natural resources inside wilderness?	Plant and animal species and communities	2.1 Number of non-native plants, animals and pathogen species	5 years, Low	0	Good, 100%
	Physical resources				
	Biophysical processes	2.2 Vegetation greenness and length of growing season indicator of climate change	1 year, High	0.32	Good, 100%



Caribou and wolf tracks in Arctic National Wildlife Refuge (USFWS).



Muskox can still be found in Arctic National Wildlife Refuge. During the long Arctic winter Muskoxen reduce their activity and movements to conserve energy (USFWS).¹¹

¹¹ Reynolds, P.E. 1998a. Ecology of a reestablished population of muskoxen in northeastern Alaska. Dissertation. University of Alaska-Fairbanks. 105 pp.

Measure: 2.1 Number of non-native plant, animal and pathogen species**Background & Context**

As of 2013, there are no documented non-native species present in the Arctic Refuge Wilderness. A future occurrence of non-native species in the wilderness area is possible. Any visits to the wilderness area by refuge staff in the future should include observations for non-native species, especially if they are discovered elsewhere in Arctic Refuge.

Measure Description & Collection Protocol

This measure is a simple count of non-native plant, animal or pathogen species found in the wilderness. The species count can come from three sources including, (1) staff observation, (2) findings at long-term ecological monitoring plots in wilderness, or (3) the Alaska Natural Heritage Program's Alaska Exotic Plants Information Clearinghouse (AKEPIC). The AKEPIC provides an online GIS map of locations where non-natives have become established in Alaska. Each of these sources should be checked to see if any non-native species have been found inside the Arctic Refuge Wilderness. The AKEPIC map can be found at this URL: <http://aknhp.uaa.alaska.edu/maps/akepic/>.

The number of non-native species found, and their names should be recorded in this measure's data collection Excel file. However, only the total number of non-native species should be entered into the WCMD MS Access Database.

Definitions

- *Non-Native Species: a species that is not native to Alaska, although plant species common to Beringia can be considered native for this measure.*

Data Source

Refuge biological staff, and the AKEPIC online GIS map of non-native plant species.

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\2 Natural Quality\2.1 Number of non-native plants, animals and pathogen species.xls

Data Adequacy

Medium

Data Quantity: *Partial*, Data Quality: *Moderate*
The data quantity and quality is partial because there is no practical way to monitor every acre of Arctic Refuge for non-native species.

Frequency

5 years

Baseline Value

0

Significant Change

Any change would be significant

Measure: 2.2 Vegetation greenness and length of growing season indicator of climate change

Background & Context

Vegetation communities are expected to change as a result of a warming climate in the arctic. This could be expressed in species changes or growth pattern changes such as increased greenness or length of growing season. The trend in these vegetation characteristics provides a climate change indicator that is more sensitive to long-term shifts rather than short-term weather or climate cycles.

Measure Description & Collection Protocol

This measure uses two satellite remote sensing data products publically available from the Geographic Information Network of Alaska (GINA), which is run by the University of Alaska. The first data set is a measure of annual peak greenness from a Normalized Difference Vegetation Index (NDVI). The second data set is the annual length of the growing season. Vegetation ecologists commonly use these two remote sensing data types when monitoring vegetation change.

The two data sets should be downloaded from GINA's GIS server and then clipped to the wilderness area in ArcGIS. The average annual value of annual peak greenness and length of growing season should be found for the wilderness and entered into this measure's Excel data file. In the Excel file a regression analysis of both data set will yield two p-values

to test if a significant trend exists. A significant change in this measure occurs if the p-value for either regression equals 0.1 or less. Only enter the more significant p-value into the WCMD MS Access Database. Additional detailed data collection and processing instructions can be found in Appendix D.

Baseline Value

Max Greenness p-value = 0.85

Length of Growing Season p-value = 0.32

Data Source

GINA NDVI maps

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\2 Natural Quality\2.2 Vegetation greenness and length of growing season indicator of climate change.xlsx

Data Adequacy

High

Data Quantity: *Complete*, Data Quality: *High*

Frequency

1 year

Significant Change

Significant change occurs if a trend with a p-value <0.10 is recorded for either data set.

3. UNDEVELOPED QUALITY

Table 6. Undeveloped Quality

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

Monitoring Question	Indicator	Measure	Frequency, Data Adequacy	Baseline Value	Condition, Weight
What are the trends in non-recreational development and mechanization inside wilderness?	Non-recreational installations, structures, developments	3.1 Index of authorized physical structures, installations, or developments	5 years, High	7	Good, 50%
		3.2 Index of Collars, and both visible and not visible transmitters in the wilderness	5 years, Low	8.6	Good, 50%
	Inholdings	3.3 Index of inholdings within wilderness	5 years, High	42	Good, 100%
	Use of motor vehicles, motorized equipment, and mechanical transport	3.4 # of authorized helicopter uses	1 year, Medium	2	Good, 25%
		3.5 Air Taxi and Transporter fixed wing aircraft use	1 year, Medium	103 (2009)	Good, 25%
		3.6 # of fixed wing aircraft landing sites	1 year, Medium	30	Good, 25%
		3.7 Authorized motor and mechanical use	1 year, Medium	1	Good, 25%



Collared caribou (USFWS).



Structures in Arctic Refuge Wilderness (USFWS).

3. UNDEVELOPED QUALITY

Non-recreational installations, structures and developments

Measure: 3.1 Index of authorized physical structures, installations, or developments

Background & Context

Physical structures, installations and developments in wilderness degrade the undeveloped quality of wilderness character. There are several administrative structures inside the Arctic Refuge Wilderness from before wilderness designation and a few scientific installations. The number and type of authorized installations may change over time so it is important to monitor.

Measure Description & Collection Protocol

For this measure an index is used because authorized structures such as buildings and weather stations should not be equally weighted (Table 7). Authorized developments that are not primarily for a recreation purpose are monitored under this measure, whereas developments for a recreation purpose are monitored under the solitude or primitive and unconfined recreation quality. This index should be expanded when new types of installations occur. Note that this measure does not include wildlife collars or transmitters, which are counted in measure 3.2.

Data Source

SUPs, and MRAs

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\3 Undeveloped Quality\3.1 Authorized Installations.xls

Data Adequacy

High
Data Quantity: *Complete*, Data Quality: *High*

Frequency

5 years

Baseline Value

0.01

Significant Change

Changes to the overall index score of 0.5 or greater is significant. Minor changes in the number of small installations have a negligible effect on wilderness character

Table 7. 2013 Index for authorized physical developments

Authorized Installation	# present or potentially in Wilderness	Weight	Index value
Administrative Structure	4	x1	4
Permitted Structure	0	x1	0
Weather Station	1	x0.5	0.5
Tent Platform type structure	1	x0.5	0.5
		*	
		INDEX TOTAL:	5

*Future installations could be weighted relative to their impact to the undeveloped quality compared to the structures currently listed.

Measure: 3.2 Index of Collars, and both visible and not visible transmitters in the wilderness

Background & Context

The GPS collars, radio collars and external or internal transmitters installed on or inside wildlife to track their movements are installations that degrade the undeveloped quality of wilderness character. Although this research may be important for understanding and protecting various aspects of the natural quality of wilderness character, because these devices are installations the trend in their use should be monitored.

Measure Description & Collection Protocol

This measure is an index of the collars and visible and not visible transmitters installed on wildlife found inside the Arctic Refuge Wilderness. These collars or transmitters can either be installed on or inside terrestrial or aquatic wildlife. An index is used because some of the tracked species are transient and only inhabit the wilderness seasonally. A refuge biologist can provide the number of collared or transmitter monitored animals that are inside wilderness. Biological staff can also estimate the percentage of time each species are located in the wilderness so the number of collars or transmitters can be weighted appropriately in the index.

The data collection Excel file for this measure is set up to calculate the index score. A staff person should include a description of the

collared or transmitter monitored wildlife in the Excel file but only enter the overall index score into the WCMD MS Access Database.

Data Source

Biological staff

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\3 Undeveloped Quality\ 3.2 Index of Collars, and both visible and not visible transmitters in the wilderness.xls

Data Adequacy

Low

Data Quantity: *Complete*, Data Quality: *Moderate*

The data quality is *moderate* because the index requires some estimation for index weighting transient collared or transmitter monitored species.

Frequency

5 years

Baseline Value

8.6

Significant Change

A change greater than 50% of the 2013 baseline is significant.

Table 8. 2013 Index for collars and both visible and not visible transmitters in wilderness

Species	# present in Wilderness*	Fraction of time in Wilderness	Index value
Caribou	86	x0.1	8.6
	0	x0.X*	0
Index Total:			0

*Staff should estimate a weight for future species based on time in wilderness.

Measure: 3.3 Index of inholdings within wilderness**Background & Context**

Certain lands within the boundaries of the Arctic Refuge Wilderness are allotments that are privately held by Alaska Natives. Since inholdings within designated wilderness are not subject to the same management rules, these lands can be developed for various purposes at the landowner's discretion, and thereby can have an impact on the surrounding wilderness. The undeveloped quality is degraded if the number and impact of inholdings increases. As of 2013, there are 38 inholdings, and 4 structures on inholdings, within the borders of the Arctic Refuge Wilderness.

Measure Description & Collection Protocol

This measure is an index value for inholdings that includes the number of inholdings, and the number of structures. In the index, structures are score as 1, and each inholding also counts as 1. The collection protocol for this measure includes asking the refuge manager if any changes in inholding land status have occurred and if any new structures have been built. Refuge pilots and the fire management officer should be asked about new structures on inholdings. Once this information is collected, data should be recorded in the Excel file called "3.3 Inholding DATA.xls." Each year (2013, 2018, 2023, etc.) have their own sheet in the Excel document. The overall index value should be entered into the WCMD MS Access Database.

Definitions

- *Inholding: a private property unit that occurs inside the boundary of a wilderness area*

Data Source

The refuge manager should know about inholding changes and the refuge pilots, fire management officer, or fire maps should be consulted for new structures. If changes to the status of lands are unknown, the FWS Lands Mapper, an online GIS tool, can be consulted for information at: <http://ifw7rosde/refstat/>

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\3 Undeveloped Quality\3.3 Index of Inholdings.xlsx

Data Adequacy

High

Data Quantity: *Partial*, Data Quality: *Moderate*
The data quantity is *partial* because it is not completely certain that all inholding structures are inventoried.

Frequency

5 years

Baseline Value

42

(# of inholdings = 38; # of inholding structures = 4)

Significant Change

Any change would be significant

Measure: 3.4 Number of authorized helicopter uses**Background & Context**

Helicopter use in wilderness degrades the undeveloped quality of wilderness character. Helicopters have been used in Arctic Refuge for law enforcement, scientific research and trash removal. Monitoring the number of authorized helicopter uses inside Arctic Refuge Wilderness is the best available way to track this concern. In 2013, there were 2 authorized helicopter uses in wilderness for scientific research. This measure does not include helicopter use by the Alaska State Troopers in wilderness or overflights without landings because they are not authorized by the refuge and cannot be monitored.

Measure Description & Collection Protocol

This measure is a count of the number of helicopter uses that the refuge authorizes through SUPs or for FWS staff. The number of times helicopter use in wilderness is authorized each year should be counted from SUPs and MRAs. Record this number in this measure's

Excel file and in the WCMD MS Access Database.

Data Source

SUPs and MRAs

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\3 Undeveloped Quality\3.4 Number of authorized helicopter uses.xls

Data Adequacy

Medium

Data Quantity: *Complete*, Data Quality: *High*

Frequency

1 year

Baseline Value

2

Significant Change

Any change would be significant

Measure: 3.5 Air Taxi and Transporter fixed wing aircraft use**Background & Context**

Section 1110 of ANILCA provides special provisions that allow the use of snowmachines (during periods of adequate snow cover, or frozen river conditions), motorboats, and airplanes for traditional activities (where such activities are permitted by ANILCA or other law) and for travel to and from villages and homesites. However, the use of these motorized vehicles still degrade wilderness character and it is useful for managers to monitor the trend in their use.

The majority of aircraft use in the Arctic Refuge Wilderness is by air taxi and transporters. Most visitors use these commercial services to access the refuge. This aircraft activity is also easiest to monitor due to client use reports that commercial operators are required to provide to the refuge. There are no means to monitor private aircraft use in the refuge at this time.

Measure Description & Collection Protocol

This measure is a count of the total client drop offs that occur annually in wilderness. The measure uses the Client Use MS Access Database to generate an annual report of drop offs in the Arctic Refuge Wilderness. Rather than attempting to tally the number of flights for each client, the staff person collecting these data should simply count each drop off line in the report and record this number in this measure's Excel file and in the WCMD MS Access Database.

Definitions

- Air taxi: a airplane operator who transports hikers, boaters and other non-hunting clients
- *Transporter: An airplane operator who transport hunters, their gear, meat and trophies, but provide no guiding.*

Data Source

Client Use Report MS Access Database

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\3 Undeveloped Quality\3.5 Air Taxi and Transporter fixed wing aircraft use.xls

Data Adequacy

Medium

Data Quantity: *Complete*, Data Quality: *Moderate*

Data quality is moderate because this measure only counts the number of clients dropped off in wilderness rather than actual number of flights required to drop them off. However, this measure will still address the changing frequency of airplane use in the wilderness.

Frequency

1 year

Baseline Value

103 (2009)

Significant Change

Change greater than 10% would be significant

Measure: 3.6 Number of fixed wing aircraft landing strips**Background & Context**

Although Section 1110 of ANILCA allows the use of aircraft for traditional activities in Alaskan wilderness areas, the use of an aircraft in designated wilderness and the associated impacts of aircraft use (i.e. airstrips) still degrade wilderness character. Additional landing strips in wilderness degrade the undeveloped quality and could have implications for visitor solitude, and the natural quality.

Some aircraft like small two seat Super Cub planes can land in short distances (less than 500ft) and have almost unlimited landing locations in Arctic refuge. Longer landing strips, typically greater than 500ft, that get use by larger four seat aircraft, like the Cessna 185 or 206, are more likely to have visible impacts on the ground surface. A combination of greater aircraft traffic and heavier loads increase the potential for noticeable impacts at these airstrips. Monitoring the trend in the number of these Cessna 185-sized airstrips is important for tracking aircraft use and impacts in the Arctic Refuge Wilderness.

Measure Description & Collection Protocol

This measure is a count of the number of, Cessna 185-sized (greater than 500ft) landing strips in wilderness. A record of landing strip locations and sizes is maintained by refuge pilots and should be sampled for the

wilderness. The count of Cessna 185 landings strips in wilderness should be entered into this measure's Excel data file and the WCMD MS Access Database. If the record of landing strips is not maintained, then at the next monitoring cycle in 5 years this measure should be removed.

Data Source

Refuge Pilots

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\3 Undeveloped Quality\3.6 Number of fixed wing aircraft landing strips.xls

Data Adequacy

Medium

Data Quantity: *Complete*, Data Quality:

Moderate

Data quality is rated *moderate* because the data are based on pilot knowledge and observations.

Frequency

5 year

Baseline Value

30

Significant Change

Change greater than 5% from the 2013 baseline would be significant



A ground view of a backcountry landing strip on a tundra bench adjacent to a river in Arctic Refuge (USFWS).



An aerial view of a backcountry landing strip on an alluvial fan located in Arctic Refuge Wilderness (USFWS).

Measure: 3.7 Authorized motor and mechanical use**Background & Context**

Occasionally Arctic Refuge managers must weigh a request to use motorized or mechanical devices in the wilderness for research, commercial or administrative reasons. In the past, the refuge has received requests to use gas powered generators in wilderness. A trend of increasing use of these devices would indicate degrading wilderness character because they are prohibited by the wilderness act.

Some possible motorized or mechanical devices include, motorized generators, motorized pumps, bicycles, or wheelbarrows. Objects like wrist watches, GPS devices, camping stoves or other mechanical devices not used for transportation are not prohibited by the wilderness act and should not be counted in this measure.

Measure Description & Collection Protocol

This measure is a count of the number of authorizations for motor or mechanical device

use. The number of authorizations can be found by consulting SUP and MRA documents.

Baseline Value

1

Data Source

SUPs and MRAs

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\3 Undeveloped Quality\3.7 Authorized motor and mechanical use.xls

Data Adequacy

Medium

Data Quantity: *Complete*, Data Quality: *High*

Frequency

1 year

Significant Change

Any change would be significant

4. SOLITUDE OR PRIMITIVE AND UNCONFINED RECREATION QUALITY

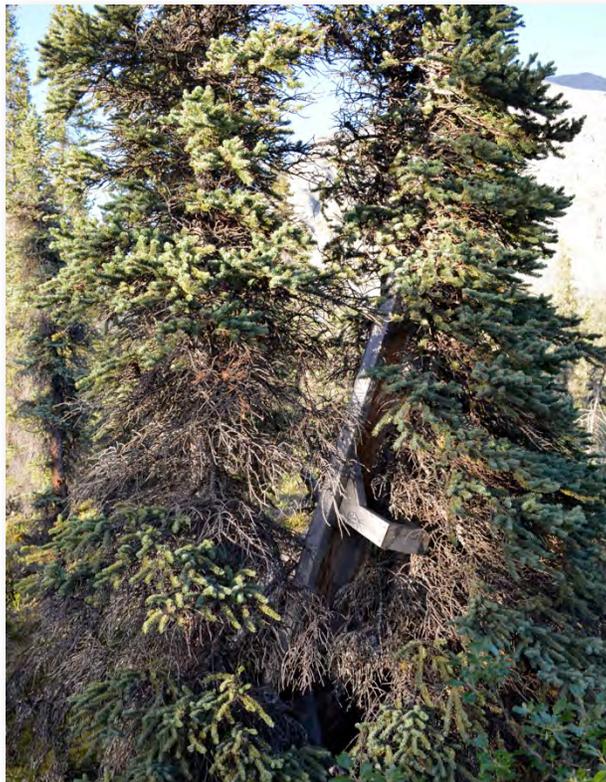
Table 9. Solitude or Primitive and Unconfined Recreation Quality

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

Monitoring Question	Indicator	Measure	Frequency, Data Adequacy	Baseline Value	Condition, Weight
What are the trends for outstanding opportunities for solitude within wilderness?	Remoteness from sights and sounds of people inside the wilderness	4.1 Visitor Study Count of other groups encountered by visitors	5 years, Medium	1.8 (2009)	Good, 15%
		4.2 Visitor Study Count of the # of air planes encountered	5 years, Medium	4.4 (2009)	Good, 14%
		4.3 Visitor Study Count of Evidence of other visitors' impacts	5 years, Medium	1.1 (2009)	Good, 15%
		4.4 Visitor Study Count of encounters with refuge staff or other law enforcement	5 years, Medium	0.4 (2009)	Good, 14%
		4.5 # of abandoned property or trash sites inside the wilderness	5 years, Medium	16	Good, 14%
		4.6 Visitor use days at select high traffic sites	1 Year, High	N/A	Good, 14%
		4.7 # of commercial guides in wilderness	5 Year, High	19	Good, 14%
		Remoteness from occupied and modified areas outside the wilderness	4.8 Viewshed impacts from developed areas outside the wilderness	5 years, Medium	0
What are the trends in outstanding opportunities for primitive and unconfined recreation inside wilderness?	Facilities that decrease self-reliant recreation	4.9 Agency-provided facilities in the wilderness that decrease self-reliant recreation	5 years, High	0	Good, 50%
		4.10 # of sites with obvious visitor created trails in wilderness	5 years, Medium	7	Good, 50%
	Management restrictions on visitor behavior	4.11 Management restrictions on non-commercially guided visitors	5 years, High	0	Good, 100%



Abandoned fuel cans in Arctic Refuge (USFWS).



A bench made from cut boards hidden in a stand of spruce trees in Arctic Refuge Wilderness (USFWS).

Measure: 4.1 Visitor Study count of other groups encountered by visitors**Background & Context**

A unique value of the Arctic Refuge Wilderness is the solitude opportunities in a vast arctic landscape. In the future, increasing visitation to the refuge could affect the high quality opportunities for solitude that visitors currently experience. Managers can make better stewardship decisions with baseline information related to the opportunities for solitude.

Measure Description & Collection Protocol

This measure is the average visitor response to a question posed in a survey for the Arctic Refuge Visitor Study. The question asks visitors how many “other groups did [they] encounter?” Although the Arctic Refuge visitor study did not differentiate between wilderness and non-wilderness, it is still a good representation of solitude in wilderness because visitor management does not differ in either part of the refuge. Measures 4.2, 4.3, and 4.4 also use this Visitor Study as a data source. The refuge plans to conduct the Visitor Study approximately every five years and always include the same survey questions used in these four measures. A staff person should record the average response for this Visitor Study

question in the Excel data file for this measure and in the WCMD MS Access Database.

Data Source

Visitor Study

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.1 4.2 4.3 4.4 Visitor Study DATA.xls

Data Adequacy

Medium

Data Quantity: *Complete*, Data Quality: *Moderate*

The quality is moderate because the data source is based on visitor surveys and does not specify only wilderness visitors’ responses.

Frequency

5 year

Baseline Value

1.8

Significant Change

Change greater than 20% would be significant

Measure: 4.2 Visitor Study count of the # of air planes encountered**Background & Context**

The sights and sounds of people inside wilderness degrades the opportunity for solitude. During the busy summer season, small aircraft regularly fly over and land in Arctic Refuge. The sight, and moreover the sound of aircraft in wilderness degrades the opportunity for visitors to feel remoteness from modern society.

Measure Description & Collection Protocol

This measure uses the average visitor response to the Visitor Study question that asks how many “air planes (not jets) did [they] encounter?” Although the Arctic Refuge visitor study did not differentiate between wilderness and non-wilderness, it is still a good measure of solitude for the wilderness because aircraft use is not managed any differently in either part of the refuge. A staff person should record the average response for this Visitor Study question in the Excel data file for this measure and in the WCMD MS Access Database.

Data Source

Visitor Study

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.1 4.2 4.3 4.4 Visitor Study DATA.xls

Data Adequacy

Medium

Data Quantity: *Complete*, Data Quality: *Moderate*

The quality is moderate because the data source is based on visitor surveys and does not specify only wilderness visitors’ responses.

Frequency

5 year

Baseline Value

4.4

Significant Change

Change greater than 20% would be significant

Measure: 4.3 Visitor Study Count of Evidence of other visitors' impacts**Background & Context**

The evidence of previous visitors inside wilderness degrades the opportunity for solitude. Ideal wilderness is meant to be trail-less, without campsites or improvements where a person can have a totally unique experience with nature. Simple reminders that other modern people have been in a place before you, such as small pieces of trash, can greatly reduce the opportunity to have a remote wilderness experience. The impacts of previous visitors even if they are small and will slowly erode wilderness character overtime.

Measure Description & Collection Protocol

This measure is the average visitor response to the Visitor Study question that asks visitors how many "times did [they] encounter the evidence of other visitors' impacts?" Although the Arctic Refuge visitor study did not differentiate between wilderness and not wilderness, it is still a good representation of solitude in wilderness because visitor management is the same in either part of the refuge. A staff person should record the average response for this Visitor Study question in the Excel data file for this measure and in the WCMD MS Access Database.

Data Source

Visitor Study

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.1 4.2 4.3 4.4 Visitor Study DATA.xls

Data Adequacy

Medium

Data Quantity: *Complete*, Data Quality:

Moderate

The quality is moderate because the data source is based on visitor surveys and does not specify only wilderness visitors' responses.

Frequency

5 years

Baseline Value

1.1

Significant Change

Change greater than 20% would be significant

Measure: 4.4 Visitor Study Count of encounters with refuge staff or other law enforcement

Background & Context

Wilderness is meant to provide the best opportunity for solitude anywhere, and even encounters with refuge staff or non-FWS law enforcement degrade the opportunity to experience that solitude. Although refuge staff or other law enforcement may have important work to do in the refuge, they still degrade the opportunity for visitors to experience a high degree of solitude.

Measure Description & Collection Protocol

This measure is the average visitor response to the visitor study question that asks how many “times did you encounter refuge staff or other law enforcement?” Although the Arctic Refuge visitor study did not differentiate between wilderness and not wilderness, it is still a good representation of solitude in wilderness because refuge staff and other law enforcement agencies roughly work throughout the refuge equally. A staff person should record the average response for this Visitor Study question in the Excel data file for this measure and in the WCMD MS Access Database.

Data Source

Visitor Study

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.1 4.2 4.3 4.4 Visitor Study DATA.xls

Data Adequacy

Medium

Data Quantity: *Complete*, Data Quality:

Moderate

The quality is moderate because the data source is based on visitor surveys and does not specify only wilderness visitors’ responses.

Frequency

1 year

Baseline Value

0.4

Significant Change

Change greater than 20% would be significant

Measure: 4.5 Number of abandoned property or trash sites inside the wilderness**Background & Context**

Since the creation of the Arctic Refuge, abandoned property or trash on refuge lands has been an issue for managers to contend with. According to regulations, property left in the refuge for greater than 365 days becomes abandoned property. Once property becomes abandoned it is synonymous with trash because it is a reminder of humans that does not belong in the refuge. If refuge LE can determine the owner of abandoned property or trash they will pursue those individuals to get the items removed, but if owners cannot be found the responsibility falls to the FWS.

Abandoned property tends to be a problem in Arctic Refuge due to its large size and remoteness, which necessitates access by small aircraft. Since bush planes have a limited range and passenger and cargo capacity, fuel cans, gear or other items are commonly cached at various locations in the refuge to facilitate access. Although these practices are certainly not illegal and typically required for visitors to access Arctic Refuge, invariably some items are forgotten or discarded. Other instances of trash in the refuge are due to poor practices of leave-no-trace principles. Downed aircraft are also counted as trash or abandoned property in this measure. Most modern crashes are promptly removed by the owners of the aircraft but that is not always the case. Several historical downed aircraft are still present in the wilderness.

Measure Description & Collection Protocol

This measure is a count of the number of sites in the wilderness with trash, abandoned

property or downed aircraft. Abandoned property, trash and downed aircraft are monitored in the trash and downed aircraft database. A staff person should inspect the database every 5 years for the number of trash or downed aircraft sites in wilderness. The total number of these sites inside wilderness should then be recorded in this measure's Excel data file and the WCMD MS Access Database.

Data Source

Refuge Trash MS Access Database

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.5 # of abandoned property or trash sites inside the wilderness.xls

Data Adequacy

Medium

Data Quantity: *Partial*, Data Quality: *Moderate*
Data for this measure is partial and moderate because due to the size of Arctic Refuge, a field survey for trash and downed aircraft sites is rarely conducted. Known sites have been reported by visitors or found by staff while they are working in the refuge.

Baseline Value

16

Frequency

5 year

Significant Change

Any change would be significant

Measure: 4.6 Visitor use days at select high traffic sites**Background & Context**

The opportunities for solitude can be degraded by overcrowding and the use impacts of visitors. A count of annual visitor use days at select high traffic sites is the best possible measure to address this concern. Much of the visitor use at these high traffic areas occur during the short arctic summer, but for the purposes of wilderness character monitoring this measure monitors the trend in overall visitor use at each site. Peak use data are too complicated to collect for wilderness character monitoring, but the trend in overall visitor use should correspond to the peak use.

Measure Description & Collection Protocol

This measure is a count of annual visitor use days at select high traffic sites. This measure uses the client use report database which can be queried for activity in the wilderness and provide data on drop offs, pick ups and the number of visitors in each party. From these data a minimum number of visitor use days at particular high use drop off and pick up sites can be found.

To make this count, a staff person should first query the Client Use MS Access Database for an annual report of activity in wilderness. Next, the drop offs or pickups at the following high traffic sites should be highlighted (1) Drain Creek, (2) Caribou Pass, (3) Grassers, (4) Upper Colleen and (5) Canning River Bend (Arc-02). The number of individuals dropped off or picked up at these sites should then be tallied for an estimate of visitor use days. Enter the total number of visitor use days for each site into this measure's Excel data file and find the percent change between the initial data collected for year 2009. If the percent increase in visitor use days for any of the five sites is greater than 10% then a significant change has occurred. Enter percentage value from the site with the

greatest percent increase into the WCM MS Access Database.

It is important to remember that visitor use days collected from the Client Use Database report provides a minimum estimate of the number of visitor use days at these sites because visitors often spend multiple days at put in or take out locations as they wait for clear weather. Also, visitors with their own aircraft are not counted in this measure because no data on these users exists.

Baseline Value

N/A

No baseline value was available at the time of writing this report because the measure is expressed in percent change and only 2009 data were only available due to a database problem.

Data Source

Client Use Database

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.6 Visitor use days at select high traffic sites.xls

Data Adequacy

Medium

Data Quantity: *partial*, Data Quality: *Moderate*
Data quality is moderate and partial because the visitor use days calculated from the client use database only provides a minimum estimate.

Frequency

1 year

Significant Change

Change is significant if the percent change in the sum of user days at any one high traffic sites exceeds 15%.

4. SOLITUDE OR PRIMITIVE AND UNCONFINED RECREATION**Remoteness from sights and sounds of people inside the wilderness**

Measure: 4.7 # of commercial guides in wilderness**Background & Context**

The wilderness act allows some commercial services in designated wilderness such as guides because they help people to access and experience wilderness. As of 2013, there are a variety of permitted guides operating in Arctic Refuge Wilderness who provide hunting, educational, wildlife viewing and hiking or river trip recreation experiences to visitors. Increasing numbers of guides could degrade the opportunities for solitude in wilderness. Monitoring the trend in the number of permits issued to commercial guides to operate in wilderness addresses this concern.

Measure Description & Collection Protocol

This measure is a count of commercial guides operating in wilderness. It includes hunting, recreation, education and wildlife viewing guides who are issued permits to operate in wilderness. If the permit for the guide does not include the wilderness then it should not count it in this measure. A staff person knowledgeable in the permits issued to guides could provide information for this measure but the permit records may need to be checked if staff are unsure of the geographic extent of a guide's permit. Record the number of guides operating in wilderness in this measure's Excel data file and in the WCMD MS Access Database.

Definitions

Commercial guides: commercial service providers that are permitted to operate on refuge land and act as hunting, recreational or educational guides.

Baseline Value

19

Data Source

Permit staff person and permit records

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.7 # of commercial guides in wilderness.xls

Data Adequacy

Medium

Data Quantity: *Complete*, Data Quality: *Moderate*

Transporter reported data are not always complete so the data quality is *moderate*.

Frequency

1 year

Significant Change

Change greater than 20% would be significant

4. SOLITUDE OR PRIMITIVE AND UNCONFINED RECREATION

Remoteness from occupied and modified areas outside the wilderness

Measure: 4.8 Viewshed impacts from developed areas outside the wilderness

Background & Context

Currently there are no viewshed impacts from areas outside the Arctic Refuge Wilderness. Large developments such as wind turbines, oil rigs or roads are most likely to be visible for a long distance and could potentially impact the opportunity for solitude and remoteness inside the wilderness.

Measure Description & Collection Protocol

This measure is a simple count of viewshed impacts that can be seen from the wilderness. Data for viewshed impacts can come from (1) a count of new large developments (i.e. oil and gas developments onshore or off shore, windmills, roads and mines) within 15 miles of Arctic Refuge Wilderness, and (2) from in the field observations by refuge staff. Record the number and description of the viewshed impact in this measure's Excel data file, but only the total number in the WCMD MS Access Database.

Baseline Value

0

Data Source

Refuge staff

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.8 Viewshed impacts from developed areas outside the wilderness DATA.xls

Data Adequacy

Medium

Data Quantity: *Complete*, Data Quality: *Moderate*

The data quality is *moderate* because staff rarely visit the northern border of the wilderness to see new viewshed impacts, however most potential viewshed impacts will likely be from substantial new developments that staff will be aware of.

Frequency

5 years

Significant Change

Any change would be significant



Point Thomson is an oil development west of Arctic Refuge, it is about 30 miles from the wilderness (Photo: USFWS).

Measure: 4.9 Agency-provided facilities in the wilderness that decrease self-reliant recreation**Background & Context**

Recreation facilities decrease the self-reliance aspect of the Opportunities for Solitude or Primitive and Unconfined Recreation quality of wilderness. The FWS provides no facilities in the wilderness or refuge, but could in the future. Facilities provided by a managing agency could include things like improved campsites, bridges, landing site maps or coordinates, signs and trail markers. If the FWS ever formally authorizes one or more landing strips in order to manage airstrip impacts or for safety reasons then this would also count as a facility that decreases self-reliance.

Measure Description & Collection Protocol

This measure is a count of agency-provided facilities that are recreation related. The refuge manager or staff should know if any new facilities have been installed in the refuge and MRAs can be consulted for more detail. Record the number of facilities and short description of the facilities in this measure's data collection Excel file but only record the total number in the WCMD MS Access Database.

Only recreation facilities provided by the FWS should be counted in this measure. Other non-

recreation structures or developments are addressed in measure 3.1 (*Authorized installations in the wilderness*).

Baseline Value

0

Data Source

Refuge Manager, staff and MRAs

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.9 Agency-provided facilities in the wilderness that decrease self-reliant recreation DATA.xls

Data Adequacy

High

Data Quantity: *Complete*, Data Quality: *High*

Frequency

5 years

Significant Change

Any change would be significant

Measure: 4.10 Number of sites with obvious visitor created trails in wilderness**Background & Context**

The FWS does not maintain any trails in the Arctic Refuge Wilderness and staff intend to keep the area trail-less to protect wilderness character. However, there are several locations where visitor created trailing has become an issue. Although human trails may be difficult to differentiate from caribou or bear trails, human created trails are often discernable because they travel directly to and from human points of interest. Some examples could include sites where a trail develops to scout for rapids on a river frequented by visitors or trails that lead away from a heavily used airstrip to view points.

Measure Description & Collection Protocol

This measure is a count of locations where user created trailing is known to occur. Data collection relies on the professional judgment of the staff member most aware of visitor use issues. At the time of writing this report the refuge lacks a systematic program for field monitoring of social trailing, which is why professional judgment was used. The number of sites and the name of the locations should be

recorded in this measure's Excel data file, and the number of sites should be entered into the WCMD MS Access Database.

Baseline Value

7

Data Source

Refuge staff

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.10 # of sites with obvious user created trails in wilderness DATA.xls

Data Adequacy

High

Data Quantity: *Partial*, Data Quality: *Moderate*

Frequency

5 years

Significant Change

Any change would be significant

Measure: 4.11 Management restrictions on non-commercially guided visitors**Background & Context**

There are currently no management restrictions in place for non-commercially guided visitors to the Arctic Refuge Wilderness but that could potentially change in the future. As of 2013, the wilderness area has no closed areas or special visitor use requirements unique to the wilderness area. *Management restrictions on visitor behavior* is an Indicator for the solitude or primitive and unconfined recreation quality because any restrictions that limit the unconfined aspect of recreation in wilderness degrade wilderness character. A measure that tracks management restrictions is therefore important to include. Although unconfined recreation is the ideal, restrictions may become necessary to protect other qualities of wilderness character as visitor use increases. By tracking management restrictions and the measures in the other 4 qualities, managers will be able to see the wilderness character tradeoffs they make.

Measure Description & Collection Protocol

This measure is a count of management restrictions for non-commercially guided visitors to the wilderness area. The refuge manager or visitor outreach staff can provide the data for this measure. The number of management restrictions and their description should be recorded in this measure's Excel data file, and the total number of restrictions should be entered into the WCMD MS Access Database.

Definitions

- Non-commercially guided visitors: visitors who are not guided for recreation or hunting purposes.
- *Restriction: Any permit rules or other requirements and limitations imposed on a visitor to the wilderness area besides State hunting and fishing regulations or other basic regulations already in place in the rest of the refuge. Examples include, but are not limited to, closed wilderness areas, permits, fire restrictions, and limits on group size.*

Baseline Value

0

Data Source

Refuge staff knowledgeable about permit requirements for visitors or closed areas.

Data Collection File

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.11 Management Restrictions DATA.xls

Data Adequacy*High**Data Quantity: Complete, Data Quality: High***Frequency**

5 years

Significant Change

Any change would be significant

OTHER POTENTIAL MEASURES

I. MEASURES SUGGESTED FOR FUTURE USE

These measures could be useful in the future but were not included because they either lack a reliable data source or the concern they address is not especially vulnerable to change today

Undeveloped

Indicator: *Non-recreational structures, installations, or developments*

Measure: 3.X Index of unauthorized physical structures, installations, or developments

Background & Context

This measure is similar to measure 3.1 (*Index of authorized physical developments*) except it applies to user-created structures, installations, and developments that have not been authorized by the Federal land manager (therefore illegal) or those that do not require authorization. Two unauthorized structures currently exist at "Fish Hole 2" in the Arctic Refuge Wilderness, but this number is unlikely to change. Examples could include fences, trails, roads, fixed instrumentation sites, game cameras, trail markers, or sign posts.

Reason Not Used

At the time of writing this report staff did not think unauthorized installations in Arctic Refuge Wilderness was vulnerable for change. Also, when unauthorized structures or other

installations are found on the refuge they are normally removed by staff so they may never accumulate to be recorded in this measure. If unauthorized installations become a problem in the wilderness then this measure could be added to the wilderness character monitoring program.

Measure Description & Collection Protocol

This measure would be a count or weighted index of unauthorized installations in wilderness.

Data Source

Refuge staff

Data Adequacy

Low

Opportunities for solitude or primitive and unconfined recreation

Indicator: *Remoteness from sights and sounds of people inside the wilderness*

Measure: 4.X Campsite condition at heavy use access or take out locations

Background & Context

In several locations in Arctic Refuge Wilderness there appears to be degrading campsite conditions due to repeated visitor use. The majority of campsites that show the impacts of visitor use are located at high traffic put in and take out aircraft landing strips. Impacts include tent rings, fire rings, trailing, and improperly disposed of human waste. At the time of writing this report staff are developing a standardized inventory and monitoring program for the campsites associated with high traffic aircraft landing strips.

Reason Not Used

The program for monitoring and scoring human impacts at campgrounds in the refuge is currently being developed. When a standardized monitoring program is in place, a measure to monitor wilderness campsite conditions could be added to the active list of measures.

Data Source

Campsite Monitoring Program

II. MEASURES NOT USED

These measures were considered for wilderness character monitoring, but are not likely to be used in the future due to considerable challenges developing a measure with reliable data or due to a lack of vulnerability.

Natural

Indicator: *Plant and animal species and communities*

Measure: 2.X Presence of species of particular concern or interest

Background & Context

This measure would be meant to monitor a particular species that contributes to wilderness character and whose population health is a major concern for the FWS. Although this measure could draw on population data, alternatively it could be a simple measure that tracks the overall number of species in the wilderness that have been designated as threatened or endangered species.

Reason Not Used

Polar bears and ice seals were considered for monitoring but ultimately not used because staff were not convinced that these species should represent overall wilderness character because they are marine mammals that only occasionally use designated wilderness. The alternative count of total threatened or endangered species was explored but also could not be developed as satisfactory measure of wilderness character.

Natural

Indicator: *Plant and animal species and communities*

Measure: 2.X Presence of selected species

Background & Context

This measure would be similar to the above measure but applied to any species or group of species that contributes to wilderness character.

Reason Not Used

The measure could not be used because staff could not find a species or group of species with reliable population or presence/absence data

that could represent wilderness character. A measure for the presence/absence of Dall's Sheep in the wilderness was the leading potential measure, but data for Dall's Sheep presence/absence was lacking so the measure could not be used. There was also concern that a single species would not be representative of the status of wilderness character in the vast Arctic Refuge Wilderness.

Natural

Indicator: *Physical resources*

Measure: 2.X Water quality index

Background & Context

The water quality and quantity of the Arctic Refuge Wilderness is important for the ecosystem, subsistence activities and recreation opportunities. Degradation of water quality or reduced flows in Arctic Refuge could degrade the natural quality of wilderness character. Water quality and quantity degradation in the Arctic Refuge could be caused by a changing

climate or the fall out of air pollution from lower latitudes.

Reason Not Used

The monitoring program for water quality in the refuge does not currently lend itself to a simple wilderness character monitoring measure. Water quantity data are available on one river from a USGS gauge station, but the station is not likely to continue operating.

Natural

Indicator: *Physical resources*

Measure: 2.X Air quality

Background & Context

The natural quality of wilderness character is degraded when pollution affects the air quality of designated wilderness. The Arctic seasonally experiences a phenomenon known as Arctic Haze, where a reddish brown haze settles in the air, often in the springtime. Pollution from the mid-latitudes is transported to the higher-latitudes where it persists as a haze because of a lack of precipitation or turbulent air to disperse it.

In addition to global air pollution, new oil and gas, or mining operations west of the wilderness will likely affect the air quality of Arctic Refuge. The refuge is designated by the

EPA with Class II air quality protection, which permits moderate deterioration, associated with well-managed population growth. The Wilderness Act however, requires the FWS to protect and preserve the wilderness character of designated areas, including pristine air quality.

Reason Not Used

A measure was not used for air quality because no air quality monitoring program currently exists in Arctic Refuge. No reliable baseline for air quality is available. The nearest air quality monitoring station, operated by the NPS, is located in Bettles, AK about 200 miles southwest of the wilderness.

Undeveloped

Indicator: *Use of motor vehicles, motorized equipment, or mechanical transport*

Measure: 3.X FWS fixed wing aircraft use

Background & Context

Motor vehicle use in wilderness is prohibited in the wilderness act and use of motorized vehicles in wilderness by the FWS would benefit from monitoring.

Reason Not Used

This measure was not used because the amount of FWS aircraft use in wilderness is minor compared to the aircraft use by visitors and commercial operators in wilderness. The data

collection for FWS aircraft use in wilderness would also require time consuming data processing in GIS software, which would be excessive for a single measure.

Measure Description & Collection Protocol

This measure would have sampled the number of hours of flight time in wilderness by FWS aircraft from the "flight following" GPS data recorded on every FWS flight.

Opportunities for solitude or primitive and unconfined recreation

Indicator: *Remoteness from sights and sounds of people inside the wilderness*

Measure: 4.X Percent of wilderness away from access locations or river travel route

Background & Context

The opportunity for solitude in wilderness is degraded by encounters with other visitors and overflight by aircraft. Some areas in Arctic Refuge Wilderness, along popular boating rivers or near backcountry airstrips receive more visitors and air traffic. The potential for solitude along these popular rivers and airstrips is less. However, in valleys without airstrips and lesser used rivers, the potential for ideal wilderness

solitude is greater. This measure would monitor the percentage of wilderness that remains isolated from major river routes and airstrips.

Reason Not Used

This measure was not used because concerns about solitude were captured in other measures and it would likely prove time consuming for staff to gather these GIS based

data. However, if the refuge ever considered limiting access to certain parts of wilderness to preserve a high quality of wilderness character, this may be a useful exercise to determine the most remote and secluded places in the wilderness. As new airstrips are developed or new rivers become popular for recreation in the future, it is possible that areas in wilderness that provide an opportunity for exceptional solitude may erode.

Measure Description & Collection Protocol

This measure would have developed a map of visitor and aircraft use in the wilderness. GIS software could be used to create buffers around major visitor travel sites, rivers and Cessna 185-sized backcountry airstrips. The areas outside the buffered areas would be considered places where the opportunity for solitude was greatest.

Opportunities for solitude or primitive and unconfined recreation

Indicator: *Remoteness from occupied and modified areas outside the wilderness*

Measure: 4.X Night sky visibility or light pollution

Background & Context

Light pollution and the visibility of lights from within a wilderness degrades visitor opportunities for solitude because they are reminders of modern civilization. Although managers have little ability to control light pollution outside of a refuge, monitoring the severity of light pollution would provide a baseline and inform managers how it affects wilderness character over time.

Reason Not Used

This measure was not used because a feasible method for monitoring light pollution could not be determined. It was highly unlikely that staff would visit the wilderness in the dark winter months to make an assessment of visible lights or overall light pollution. Staff also decided that measure 4.8 (Viewshed impacts from developed areas outside the wilderness) would sufficiently capture the lighted developments that would be counted in this potential measure.

Opportunities for solitude or primitive and unconfined recreation

Indicator: *Remoteness from occupied and modified areas outside the wilderness*

Measure: 4.X Soundscape Point Thomson

Background & Context

Solitude and the sense of isolation from modern developments is degraded by sounds that can travel into designated wilderness. In the Arctic Refuge Wilderness the noise related to oil and gas development outside the wilderness has the potential to degrade wilderness character. A sound study was conducted in the mid 2000's for sounds caused by the oil industry developments at Point Thomson, located about 30 miles northwest of the Arctic Refuge Wilderness. This study collected a baseline of

sound that could potentially be used for wilderness character monitoring.

Reason Not Used

This measure was not used because the baseline study still needs to be analyzed and there is no plans currently to repeat soundscape monitoring near Point Thomson. If the FWS conducts regular soundscape monitoring in the wilderness in the future it could be incorporated into wilderness character monitoring.

Opportunities for solitude or primitive and unconfined recreation

Indicator: *Facilities that decrease self-reliant recreation*

Measure: 4.X # User-created recreation facilities

Background & Context

User-created recreation facilities degrade the opportunities for self-reliant recreation and

solitude. User-created recreation facilities could include campfire rings, tent rings, benches, or trail markers. These facilities are occasionally found in the wilderness often near airstrips or popular river campsites.

Reason Not Used

This measure was not used because user-created recreation facilities were not perceived by staff to be a major problem and also because it would be problematic to monitor. Often

whenever these user-created facilities are found they are removed or broken down by staff and never enter into a database or other reporting system that would allow easy monitoring as a wilderness character measure. If staff find that user-created recreation facilities become more serious threat to wilderness character then a measure could be developed to aid managers and track degradation to wilderness character.

Opportunities for solitude or primitive and unconfined recreation

Indicator: *Management restrictions on visitor behavior*

Measure: 4.X Management restrictions on commercially guided visitors

Background & Context

Management restrictions on visitors degrades the opportunity for an unconfined type of wilderness recreation. There are currently several restrictions applied to visitors who are commercially guided, such as group size limits.

Reason Not Used

This measure was not used because it is not likely that the number of restrictions to change in the future. Staff could not envision any new restrictions so there would be little utility for managers to monitor the number of restrictions on commercially guided visitors.

CONCLUSIONS

The measures selected in this report are the best possible representation of the tangible values of wilderness character for the Arctic Refuge Wilderness. Although measures were constrained by data sources and feasibility, they should prove to be an effective tool for managers. Each measure corresponds to the indicators, monitoring questions and qualities that make up the national framework of wilderness character monitoring and will provide important information on wilderness character to the US Fish and Wildlife Service and the public. By following this monitoring plan, managers will be able to see how the tangible qualities of wilderness character are improving or degrading over time. Additionally, by defining measures for the tangible qualities, managers can see how each quality is related and understand that a decision affecting one quality can affect another quality. For example, a decision to limit public use to protect vegetation improves the natural quality, but degrades the aspect of the opportunities for solitude or primitive and unconfined recreation quality.

The Arctic Refuge Wilderness currently has a high level of wilderness character with limited human influences. If managers continue making decisions as they have in the past, some aspects, such as the untrammelled quality, may remain in an excellent condition well into the future. Unfortunately, refuge managers cannot control some of the major threats to wilderness character, such as developments that will degrade the wilderness air quality and viewshed or the effects of anthropogenic climate change. Other measures require careful vigilance by staff and will likely require difficult decisions if visitation to certain high traffic areas in the wilderness continues to increase. The chosen measures are, however, defined to collect valid trends and provide useful data to inform decisions on those challenges. Numerous measures in this monitoring plan had scores of zero and were collected to document the strong baseline of wilderness character and to ensure that good management decisions continue into the future.

The wilderness character of Arctic Refuge Wilderness also encompasses intangible values, which are not amenable to measurement in this monitoring program, but are equally important as the tangible values. The intangible values include strong symbolic meanings and ideals of humility, restraint, and respect shown by managers and society. The founders of the wilderness movement were acutely aware and concerned about the intangible and symbolic values in their writings about the land that would become Arctic Refuge. In 1959, Olaus Murie wrote:

It is inevitable, if we are to progress as people in the highest sense, that we shall become ever more concerned with the saving of the intangible resources, as embodied in this move to establish the Arctic Wildlife Range¹²

Since its creation the refuge has taken on a number of symbolic meanings. One meaning describes the refuge as a last vestige of America's wild frontier that has vanished elsewhere. Since its designation in 1980, the wilderness has also been made to symbolize questions of energy use and consumption in modern society, as the refuge's 1002 area, located adjacent to the designated wilderness, still waits for congressional action to allow resource development or designate the area as wilderness.¹³ Although these intangible values of wilderness character in the Arctic Refuge Wilderness are difficult to monitor, these values can at least be partly protected by preserving the tangible qualities outlined in this plan. Pervasive in nearly all the symbolic meanings is a sense that the Arctic Refuge and its wilderness is a bequest to future generations.¹⁴ By instituting this long-term monitoring program, managers and the public now have a baseline by which we can gauge if the Arctic Refuge Wilderness that is passed down to those future generations is truly preserved as "The Last Great Wilderness."

¹² Murie, Olaus J. 1959a Testimony before the Merchant Marine and Fisheries Subcommittee on S. 1899, A Bill to Establish the Arctic Range. U.S. Congress, Senate, Committee on Interstate and Foreign Commerce. S. 1899, 86th Congress, 1st session, part 1, 1959 (Washington, D.C.:GPO, 1960) 58-59

¹³ Kaye, R. 2010. Celebrating a wilderness legacy. *International Journal of Wilderness*, 16, 1.

¹⁴ Kaye, R. 2006. *Last Great Wilderness: The campaign to establish the arctic national wildlife refuge*. University of Alaska Press, Fairbanks, Alaska, USA.

APPENDICES

APPENDIX A – Priority ranking of all measures considered

Directions: In each row, write the potential measure in the left column under the appropriate indicator. Add or delete rows as needed. 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.

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 (measures an attribute of wilderness character that currently is at risk, or might likely be at risk over 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)

POTENTIAL MEASURE	Criteria for Prioritizing Potential Measures				OVERALL SCORE	Comments
	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility		
UNTRAMMELED QUALITY						
Indicator: Authorized actions that manipulate the biophysical environment Measure: 1.1 Number of actions to manipulate plant, wildlife, insects, fish, pathogens, soil, water	2.6	1.7	2.8	1.00	8.1	
Indicator: Authorized actions that manipulate the biophysical environment Measure: 1.2 Index of suppression or control taken on naturally ignited wildfires	2.3	2.1	2.8	1.00	8.3	

POTENTIAL MEASURE	Criteria for Prioritizing Potential Measures				OVERALL SCORE	Comments
	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility		
Indicator: Authorized actions that manipulate the biophysical environment Measure: 1.3 Number of research, survey, and monitoring projects that manipulate plants, wildlife or habitat	2.3	1.7	2.8	1.00	7.8	
Indicator: Unauthorized actions that manipulate the biophysical environment Measure: 1.4 Number of unauthorized actions to manipulate plant, wildlife, insects, fish, pathogens, soil, water, or fire	2.3	1.3	1.4	0.57	5.6	
Indicator: Unauthorized actions that manipulate the biophysical environment Measure: 1.5 Number of hunting regulations with clear intent to manipulate predator populations inside wilderness	2.3	2.3	2.1	0.71	7.4	
NATURAL QUALITY						
Indicator: Plant and animal species and communities Measure: 2.1 Number of non-native plants, animals and pathogen species	2.7	2.4	1.7	0.71	7.6	
Indicator: Plant and animal species and communities Measure: 2.X Presence of selected species	2.3	1.9	2.1	0.86	-	Not used
Indicator: Plant and animal species and communities Measure: 2.X Presence of species of particular concern or interest	2.0	1.9	2.3	0.86	7.0	Not used –
Indicator: Physical resources Measure: 2.X Water quality index	2.7	2.0	2.2	1.00	7.9	Not used
Indicator: Physical resources Measure: 2.X Air quality	2.5	2	1	0	-	Not used

POTENTIAL MEASURE	Criteria for Prioritizing Potential Measures				OVERALL SCORE	Comments
	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility		
Indicator: Biophysical processes Measure: 2.3 Vegetation greenness and length of growing season indicator of climate change	2.0	2.0	1.8	0.67	6.5	
UNDEVELOPED QUALITY						
Indicator: Non-recreational structures, installations, or developments Measure: 3.1 Index of authorized physical structures, installations, or developments	2.7	1.9	3.0	1.00	8.6	
Indicator: Non-recreational structures, installations, or developments Measure: 3.2 Index of Collars, and both visible and not visible transmitters in the wilderness	2	2	2	1	7	
Indicator: Non-recreational structures, installations, or developments Measure: 3.X Index of unauthorized physical structures, installations, or developments	2.4	2.0	2.0	0.57	7.0	Not used
Indicator: Inholdings Measure: 3.3 Index of inholdings within wilderness	2.3	2.0	2.9	1.00	8.1	
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: 3.4 # of authorized helicopter uses	2.1	1.9	2.3	0.83	7.2	
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: 3.5 Air Taxi and Transporter fixed wing aircraft use	2.3	2.1	1.7	1.00	7.1	
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: 3.6 # of fixed wing aircraft landing sites	2.1	2.0	1.6	0.57	6.3	

POTENTIAL MEASURE	Criteria for Prioritizing Potential Measures				OVERALL SCORE	Comments
	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility		
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: 3.7 Authorized motor and mechanical use	1.7	1.3	1.8	0.60	5.4	
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: 3.X FWS fixed wing aircraft use	1.6	1.3	2.3	1.00	6.1	Not Used: not a major concern currently
SOLITUDE OR PRIMITIVE AND UNCONFINED RECREATION QUALITY						
Indicator: Remoteness from sights and sounds of people inside the wilderness Measure: 4.1 Visitor Study Count of other groups encountered by visitors	2.7	2.6	2.3	1.00	8.6	
Indicator: Remoteness from sights and sounds of people inside the wilderness Measure: 4.2 Visitor Study Count of the # of air planes encountered	2.6	2.7	2.1	1.00	8.4	
Indicator: Remoteness from sights and sounds of people inside the wilderness Measure: 4.3 Visitor Study Count of Evidence of other visitors' impacts	2.9	2.7	2.4	1.00	9.0	
Indicator: Remoteness from sights and sounds of people inside the wilderness Measure: 4.4 Visitor Study Count of encounters with refuge staff or other law enforcement	2.1	2.0	2.3	1.00	7.5	
Indicator: Remoteness from sights and sounds of people inside the wilderness Measure: 4.5 # of abandoned property or trash sites inside the wilderness	2.7	2.4	1.6	0.71	7.4	

POTENTIAL MEASURE	Criteria for Prioritizing Potential Measures				OVERALL SCORE	Comments
	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility		
Indicator: Remoteness from sights and sounds of people inside the wilderness Measure: 4.6 Visitor use days at select high traffic sites	2.6	2.9	2.4	0.86	8.7	
Indicator: Remoteness from sights and sounds of people inside the wilderness Measure: 4.7 # of commercial guides in wilderness	2.3	2.3	3.0	1.00	8.6	
Indicator: Remoteness from sights and sounds of people inside the wilderness Measure: 4.X Campsite condition at heavy use access or take out locations	2.7	2.7	2.0	0.86	8.3	Not used
Indicator: Remoteness from sights and sounds of people inside the wilderness Measure: 4.X Percent of wilderness away from access locations or river travel routes	2.4	2.3	2.0	0.71	7.4	Not used
Indicator: Remoteness from occupied and modified areas outside the wilderness Measure: 4.8 Viewshed impacts from developed areas outside the wilderness	2.1	1.9	2.7	0.83	7.5	
Indicator: Remoteness from occupied and modified areas outside the wilderness Measure: 4.X Night sky visibility or light pollution	3.0	2.5	3.0	0.33	8.8	Not used
Indicator: Remoteness from occupied and modified areas outside the wilderness Measure: 4.X Soundscape Point Thomson	2.5	2.5	3.0	0.17	8.2	Not used
Indicator: Facilities that decrease self-reliant recreation Measure: 4.9 Agency-provided facilities in the wilderness that decrease self-reliant recreation	2.0	1.7	3.0	1.00	7.7	

POTENTIAL MEASURE	Criteria for Prioritizing Potential Measures				OVERALL SCORE	Comments
	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility		
Indicator: Facilities that decrease self-reliant recreation Measure: 4.10 # of sites with obvious visitor created trails in wilderness	2.4	2.4	2.0	0.71	7.6	
Indicator: Facilities that decrease self-reliant recreation Measure: 4.X # User-created recreation facilities	2.1	1.7	2.0	0.67	6.5	Not used
Indicator: Management restrictions on visitor behavior Measure: 4.11 Management restrictions on non-commercially guided visitors	2.5	2.2	2.5	0.86	8.0	
Indicator: Management restrictions on visitor behavior Measure: 4.X Management restrictions on commercially guided visitors	2.2	2.0	1.8	0.57	6.6	Not used
Other Features Quality (if applicable)						
Indicator: Loss of statutorily protected cultural resources Measure: 5.X Number of authorized removals of cultural resources	2.0	1.7	2.7	0.83	7.2	Not used

APPENDIX B – Summary of effort required for wilderness character monitoring

Quality	Indicator	Measure	Type of Data Source	Time spent gathering data for each measure (in whole hours)	Measure Frequency (years)	Comments
Untrammeled	Authorized actions	1.1 Number of actions to manipulate plant, wildlife, insects, fish, pathogens, soil, water	Staff, MRAs, SUPs	1	1	
Untrammeled	Authorized actions	1.2 Index of suppression or control taken on naturally ignited wildfires	Staff	2	1	
Untrammeled	Authorized actions	1.3 Number of research, survey, and monitoring projects that manipulate plants, wildlife or habitat	Staff, MRAs, SUPs	1	1	
Untrammeled	Unauthorized actions	1.4 Number of unauthorized actions to manipulate plant,	Staff, Computer	1	1	

Quality	Indicator	Measure	Type of Data Source	Time spent gathering data for each measure (in whole hours)	Measure Frequency (years)	Comments
		wildlife, insects, fish, pathogens, soil, water, or fire				
Untrammelled	Unauthorized actions	1.5 Number of hunting regulations with clear intent to manipulate predator populations inside wilderness	Computer	3	1	
Natural	Plant and animal species	2.1 Number of non-native plants, animals and pathogen species	Staff	1	5	
Natural	Biophysical processes	2.3 Vegetation greenness and length of growing season indicator of climate change	Computer	4	1	
Undeveloped	Non-recreational structures, installations,	3.1 Index of authorized physical structures, installations, or	Staff, MRAs, SUPs	2	5	

Quality	Indicator	Measure	Type of Data Source	Time spent gathering data for each measure (in whole hours)	Measure Frequency (years)	Comments
	and developments	developments				
Undeveloped	Non-recreational structures, installations, and developments	3.2 Index of Collars, and both visible and not visible transmitters in the wilderness	Staff, MRAs, SUPs	1	5	
Undeveloped	Inholdings	3.3 Index of inholdings within wilderness	Staff, Computer	1	5	
Undeveloped	Use of motorized or mechanical	3.4 # of authorized helicopter uses	Staff	1	1	
Undeveloped	Use of motorized or mechanical	3.5 Air Taxi and Transporter fixed wing aircraft use	Computer	4	1	
Undeveloped	Use of motorized or mechanical	3.6 # of fixed wing aircraft landing sites	Computer	3	1	
Undeveloped	Use of motorized or mechanical	3.7 Authorized motor and mechanical use	MRAs, SUPs	1	1	

Quality	Indicator	Measure	Type of Data Source	Time spent gathering data for each measure (in whole hours)	Measure Frequency (years)	Comments
Solitude +	Remoteness from inside	4.1 Visitor Study Count of other groups encountered by visitors	Report	0.25	5	
Solitude +	Remoteness from inside	4.2 Visitor Study Count of the # of air planes encountered	Report	0.25	5	
Solitude +	Remoteness from inside	4.3 Visitor Study Count of Evidence of other visitors' impacts	Report	0.25	5	
Solitude +	Remoteness from inside	4.4 Visitor Study Count of encounters with refuge staff or other law enforcement	Report	0.25	5	
Solitude +	Remoteness from inside	4.5 # of abandoned property or trash sites inside the wilderness	Computer	5	5	This measure will take many hours if the trash database isn't kept up to date

Quality	Indicator	Measure	Type of Data Source	Time spent gathering data for each measure (in whole hours)	Measure Frequency (years)	Comments
Solitude +	Remoteness from inside	4.6 Visitor use days at select high traffic sites	Computer	3	1	
Solitude +	Remoteness from inside	4.7 # of commercial guides in wilderness	Computer, Paper	2	5	
Solitude +	Remoteness from outside	4.8 Viewshed impacts from developed areas outside the wilderness	Staff	1	5	
Solitude +	Facilities that decrease self-reliant recreation	4.9 Agency-provided facilities in the wilderness that decrease self-reliant recreation	MRAs	1	5	
Solitude +	Facilities that decrease self-reliant recreation	4.10 # of sites with obvious visitor created trails in wilderness	Professional Judgment	2	5	
Solitude +	Management restrictions	4.11 Management restrictions on non-	Staff	1	5	

Quality	Indicator	Measure	Type of Data Source	Time spent gathering data for each measure (in whole hours)	Measure Frequency (years)	Comments
	on visitor behavior	commercially guided visitors				

Total Time Estimate for data collection by staff

Task	Time Required (hours)	# of measures	Comments
1) Staff prep for WCM data collection	16		Time required for staff person to become familiar with WCM report, electronic files, and WCMD MS Access Database.
2) 1 year frequency measures	24	11 measures	If measures that have data with a 1 year frequency are not collected annually it will likely take several more hours each 5 years to collect all the annual data.
3) 5 year frequency measures	18	14 measures	
4) Trend calculation and reporting	24		
5 Year Total	82	25 measures	Approximately 2 weeks of one staff person's time, 1 to 2 hours of other staff members' time

APPENDIX C – Data sources and protocols for all measures used

Keeping Track of Wilderness Character Monitoring Measures

Measure	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
Untrammelled Quality	
1.1 Number of actions to manipulate plant, wildlife, insects, fish, pathogens, soil, water	<p>Data Source: Refuge manager, biological staff, or SUPs and MRAs</p> <p>Protocol: Ask knowledgeable person if any actions that manipulated plants, wildlife, insects or fish occurred in the last year. If necessary consult any available SUPs or MRAs. Record result in this measure’s Excel file and in the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\1 Untrammelled Quality\1.1 Number of actions to manipulate plants, wildlife, insects, or fish.xls</p>
1.2 Index of suppression or control taken on naturally ignited wildfires	<p>Data Source: Refuge fire management officer, or online at: http://afsmaps.blm.gov/imf_fire/imf.jsp?site=fire if the fire management officer is unavailable.</p> <p>Protocol: Data for this measure are collected by consulting the Refuge Fire Management Officer for a count of fires that burned inside the wilderness in the past year. If any fires occurred, more details on the actions taken should be collected. Have the Fire Management Officer assign a score for the suppression action taken on each fire from the index (Table 4). Once this information is collected, these data should be recorded in the Excel file called “1.2 Index of fire management actions in wilderness.xls” Each year has a column to tally fires by each management type taken and automatically generate the overall index score. The index score should be entered into the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\1 Untrammelled Quality\1.2 Index of fire management actions in wilderness.xls</p>
1.3 Number of research, survey, and monitoring projects that manipulate plants, wildlife or habitat	<p>Data Source: SUPs and MRAs</p> <p>Protocol: Count the number of research projects conducted by refuge staff or non-staff researchers that manipulate wildlife, plants or habitat in wilderness. Unit biologists and refuge staff responsible for issuing permits should be consulted for this measure. A staff person should collect the number of research projects that included a trammeling action and a brief description in this measure’s data collection Excel file and enter the total number of projects into the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\1 Untrammelled Quality\1.3 Number of research, survey, and monitoring projects.xls</p>
1.4 Number of unauthorized actions to manipulate plant, wildlife, insects, fish,	<p>Data Source: Refuge manager, law enforcement citation records, ADFG publications</p> <p>Protocol: This measure is a count of unauthorized actions inside wilderness that manipulate the biophysical environment. Data for this measure comes from several sources including, (1) citations issued by refuge law enforcement officers for violations that manipulate the biophysical environment; (2) staff knowledge of known or suspected unauthorized trammeling actions; and (3) publications by state or federal agencies documenting unauthorized trammeling actions.</p>

Measure	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
pathogens, soil, water, or fire	<p>Record result in this measure's Excel file and in the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\1 Untrammled Quality\1.4 Unauthorized manipulations.xls</p>
1.5 Number of hunting regulations with clear intent to manipulate predator populations inside wilderness	<p>Data Source: The refuge wilderness specialist or a biologist who is knowledgeable in hunting regulation changes should be consulted for this measure. The published federal subsistence board and AK board of game hunting regulation amendments and proposals will also need to be consulted to check the stated intent of each regulation change.</p> <p>The changes made annually by the Alaska Board of Game are available, along with the written proposals, online at: http://www.adfg.alaska.gov/index.cfm?adfg=gameboard.main</p> <p>Proposed changes to the Federal Subsistence regulations are published by region at <http://www.doi.gov/subsistence/library/meeting_books/index.cfm>. Consult the North Slope and Eastern Interior RAC Meeting notes.</p> <p>Protocol: Closely monitor and count the hunting regulations made by either state or federal regulatory bodies that have the stated purpose to manipulate predator populations with the goal of changing game animal populations. The monitoring applies for regulations in Alaska game management units (GMU) 25A and 26C, which cover the wilderness. Record the number and description of regulations that are considered a trammeling in measure's data collection Excel file, but only record the total number in the WCMD MS Access Database. .</p> <p>Data Collection File: T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\1 Untrammled Quality\1.5 Number of hunting regulations with clear intent to manipulate.xls</p>
Natural Quality	
2.1 Number of non-native plants, animals and pathogen species	<p>Data Source: Refuge biological staff, and the AKEPIC online GIS map of non-native plant species at http://aknhp.uaa.alaska.edu/maps/akepic/</p> <p>Protocol: The number of non-native species found, and their names should be recorded in this measure's data collection Excel file. However, only the total number of non-native species should be entered into the WCMD MS Access Database. The species count can come from three sources including, (1) staff observation, (2) findings at long-term ecological monitoring plots in wilderness, or (3) the Alaska Natural Heritage Program's Alaska Exotic Plants Information Clearinghouse (AKEPIC).</p> <p>Data Collection File: T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\2 Natural Quality\2.1 Number of non-native plants, animals and pathogen species.xls</p>
2.2 Vegetation greenness and length of growing season indicator of	<p>Data Source: GINA NDVI maps</p> <p>Protocol: This measure uses two satellite remote sensing data products publically available from the Geographic Information Network of Alaska (GINA), which is run by the University of Alaska. The first data set is a measure of annual peak greenness from a Normalized Difference Vegetation Index (NDVI). The second data set is the annual length of the growing season. Vegetation ecologists commonly use these two remote sensing data types when monitoring vegetation change.</p>

Measure	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
climate change	<p>The two data sets should be downloaded from GINA’s GIS server and then clipped to the wilderness area in ArcGIS. The average annual value of annual peak greenness and length of growing season should be found for the wilderness and entered into this measure’s Excel data file. In the Excel file a regression analysis of both data set will yield two p-values to test if a significant trend exists. A significant change in this measure occurs if the p-value for either regression equals 0.1 or less. Only enter the more significant p-value into the WCMD MS Access Database. Additional detailed data collection and processing instructions can be found in Appendix D.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\2 Natural Quality\2.2 Vegetation greenness and length of growing season indicator of climate change.xlsx</p>
Undeveloped Quality	
3.1 Index of authorized physical structures, installations, or developments	<p>Data Source: SUPs, and MRAs</p> <p>Protocol: For this measure an index is used because authorized structures such as buildings and weather stations should not be equally weighted (Table 7). Authorized developments that are not primarily for a recreation purpose are monitored under this measure, whereas developments for a recreation purpose are monitored under the solitude or primitive and unconfined recreation quality. This index should be expanded when new types of installations occur. Note that this measure does not include wildlife collars or transmitters, which are counted in measure 3.2.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\3 Undeveloped Quality\3.1 Authorized Installations.xls</p>
3.2 Index of Collars, and both visible and not visible transmitters in the wilderness	<p>Data Source: Biological staff</p> <p>Protocol: This measure is an index of the collars and visible and not visible transmitters installed on wildlife found inside the Arctic Refuge Wilderness. These collars or transmitters can either be installed on or inside terrestrial or aquatic wildlife. An index is used because some of the tracked species are transient and only inhabit the wilderness seasonally. A refuge biologist can provide the number of collared or transmitter monitored animals that are inside wilderness. Biological staff can also estimate the percentage of time each species are located in the wilderness so the number of collars or transmitters can be weighted appropriately in the index.</p> <p>The data collection Excel file for this measure is set up to calculate the index score. A staff person should include a description of the collared or transmitter monitored wildlife in the Excel file but only enter the overall index score into the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\3 Undeveloped Quality\ 3.2 Index of Collars, and both visible and not visible transmitters in the wilderness.xls</p>
3.3 Index of inholdings within	<p>Data Source: The refuge manager should know about inholding changes and the refuge pilots, fire management officer, or fire maps should be consulted for new structures. If changes to the status of lands are unknown, the FWS Lands Mapper, an online GIS tool, can be consulted for information at: http://ifw7rosde/refstat/</p>

Measure	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
wilderness	<p>Protocol: Fill out the index value for inholdings, which includes the number of inholdings, and the number of structures. In the index, structures are score as 1, and each inholding also counts as 1. The collection protocol for this measure includes asking the refuge manager if any changes in inholding land status have occurred and if any new structures have been built. Refuge pilots and the fire management officer should be asked about new structures on inholdings. Once this information is collected, data should be recorded in the Excel file called “3.3 Inholding DATA.xls.” Each year (2013, 2018, 2023, etc.) have their own sheet in the Excel document. The overall index value should be entered into the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\3 Undeveloped Quality\3.3 Index of Inholdings.xlsx</p>
3.4 # of authorized helicopter uses	<p>Data Source: SUPs and MRAs</p> <p>Protocol: This measure is a count of the number of helicopter uses that the refuge authorizes through SUPs or for FWS staff. The number of times helicopter use in wilderness is authorized each year should be counted from SUPs and MRAs. Record this number in this measure’s Excel file and in the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\3 Undeveloped Quality\3.4 Number of authorized helicopter uses.xls</p>
3.5 Air Taxi and Transporter fixed wing aircraft use	<p>Data Source: Client Use Report MS Access Database</p> <p>Protocol: This measure is a count of the total client drop offs that occur annually in wilderness. The measure uses the Client Use MS Access Database to generate an annual report of drop offs in the Arctic Refuge Wilderness. Rather than attempting to tally the number of flights for each client, the staff person collecting these data should simply count each drop off line in the report and record this number in this measure’s Excel file and in the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\3 Undeveloped Quality\3.5 Air Taxi and Transporter fixed wing aircraft use.xls</p>
3.6 # of fixed wing aircraft landing sites	<p>Data Source: Refuge Pilots</p> <p>Protocol: This measure is a count of the number of, Cessna 185-sized (greater than 500ft) landing strips in wilderness. A record of landing strip locations and sizes is maintained by refuge pilots and should be sampled for the wilderness. The count of Cessna 185 landings strips in wilderness should be entered into this measure’s Excel data file and the WCMD MS Access Database. If the record of landing strips is not maintained, then at the next monitoring cycle in 5 years this measure should be removed.</p> <p>Data Collection File: T:\\Wilderness\Wilderness Character Monitoring\Wilderness Character Data\3 Undeveloped Quality\3.6 # of landing sites and floatplane lakes used</p>
3.7 Authorized motor and mechanical use	<p>Data Source: SUPs and MRAs</p> <p>Protocol: This measure is a count of the number of authorizations for motor or mechanical device use. The number of authorizations can be found by consulting SUP and MRA documents.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\Wilderness Character Monitoring\WCM Excel Data Files\3 Undeveloped Quality\3.7 Authorized</p>

Measure	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
	motor and mechanical use.xls
Solitude or Primitive and Unconfined Quality	
4.1 Visitor Study Count of other groups encountered by visitors	<p>Data Source: Visitor Study</p> <p>Protocol: This measure is the average visitor response to a question posed in a survey for the Arctic Refuge Visitor Study. The question asks visitors how many “other groups did [they] encounter?” Record the average response for this Visitor Study question in the Excel data file for this measure and in the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\ Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.1 4.2 4.3 4.4 Visitor Study DATA.xls</p>
4.2 Visitor Study Count of the # of air planes encountered	<p>Data Source: Visitor Study</p> <p>Protocol: This measure is the average visitor response to a question posed in a survey for the Arctic Refuge Visitor Study. The question asks visitors how many “air planes (not jets) did [they] encounter?” Record the average response for this Visitor Study question in the Excel data file for this measure and in the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\ Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.1 4.2 4.3 4.4 Visitor Study DATA.xls</p>
4.3 Visitor Study Count of Evidence of other visitors’ impacts	<p>Data Source: Visitor Study</p> <p>Protocol: This measure is the average visitor response to a question posed in a survey for the Arctic Refuge Visitor Study. The question asks visitors how many “times did [they] encounter the evidence of other visitors’ impacts?” Record the average response for this Visitor Study question in the Excel data file for this measure and in the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\ Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.1 4.2 4.3 4.4 Visitor Study DATA.xls</p>
4.4 Visitor Study Count of encounters with refuge staff or other law enforcement	<p>Data Source: Visitor Study</p> <p>Protocol: This measure is the average visitor response to a question posed in a survey for the Arctic Refuge Visitor Study. The question asks visitors how many “times did you encounter refuge staff or other law enforcement?” Record the average response for this Visitor Study question in the Excel data file for this measure and in the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\ Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.1 4.2 4.3 4.4 Visitor Study DATA.xls</p>
4.5 # of abandoned property or trash sites inside the wilderness	<p>Data Source: Refuge Trash MS Access Database</p> <p>Protocol: This measure is a count of the number of sites in the wilderness with trash, abandoned property or downed aircraft. Abandoned property, trash and downed aircraft are monitored in the trash and downed aircraft database. A staff person should inspect the database every 5 years for the number of trash or downed aircraft sites in wilderness. The total number of these sites inside wilderness should then be recorded in this measure’s Excel data file and the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness \Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.5 # of abandoned property or trash sites inside the wilderness.xls</p>

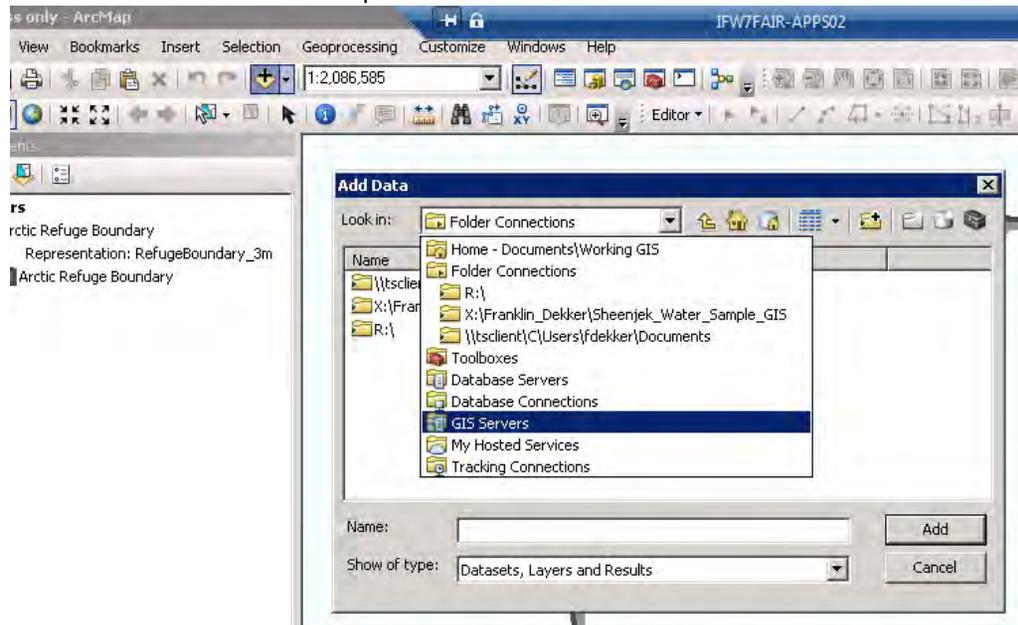
Measure	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
4.6 Visitor use days at select high traffic sites	<p>Data Source: Client Use Database</p> <p>Protocol: This measure uses the client use report database which can be queried for activity in the wilderness and provide data on drop offs, pick ups and the number of visitors in each party. From these data a minimum number of visitor use days at particular high use drop off and pick up sites can be found.</p> <p>To make this count, first query the Client Use MS Access Database for an annual report of activity in wilderness. Next, the drop offs or pickups at the following high traffic sites should be highlighted (1) Drain Creek, (2) Caribou Pass, (3) Grassers, (4) Upper Colleen and (5) Canning River Bend (Arc-02). The number of individuals dropped off or picked up at these sites should then be tallied for an estimate of visitor use days. Enter the total number of visitor use days for each site into this measure's Excel data file and find the percent change between the initial data collected for year 2009. If the percent increase in visitor use days for any of the five sites is greater than 10% then a significant change has occurred. Enter percentage value from the site with the greatest percent increase into the WCM MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness \Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.6 Visitor use days at select high traffic sites.xls</p>
4.7 # of commercial guides in wilderness	<p>Data Source: Permit staff person and permit records</p> <p>Protocol: This measure is a count of commercial guides operating in wilderness. It includes hunting, recreation, education and wildlife viewing guides who are issued permits to operate in wilderness. If the permit for the guide does not include the wilderness then it should not count it in this measure. Record the number of guides operating in wilderness in this measure's Excel data file and in the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness \Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.7 # of commercial guides in wilderness.xls</p>
4.8 Viewshed impacts from developed areas outside the wilderness	<p>Data Source: Refuge staff</p> <p>Protocol: This measure is a simple count of viewshed impacts that can be seen from the wilderness. Data for viewshed impacts can come from (1) a count of new large developments (i.e. oil and gas developments onshore or off shore, windmills, roads and mines) within 15 miles of Arctic Refuge Wilderness, and (2) from in the field observations by refuge staff. Record the number and description of the viewshed impact in this measure's Excel data file, but only the total number in the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness \Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.8 Viewshed impacts from developed areas outside the wilderness DATA.xls</p>
4.9 Agency-provided facilities in the wilderness that decrease self-reliant	<p>Data Source: Refuge Manager, staff and MRAs</p> <p>Protocol: This measure is a count of agency-provided facilities that are recreation related. The refuge manager or staff should know if any new facilities have been installed in the refuge and MRAs can be consulted for more detail. Record the number of facilities and short description of the facilities in this measure's data collection Excel file but only record the total number in the WCMD MS Access Database.</p>

Measure	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
recreation	<p>Data Collection File: T:\Administration\Management\Wilderness\ Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\ 4.9 Agency-provided facilities in the wilderness that decrease self-reliant recreation DATA.xls</p>
4.10 # of sites with obvious visitor created trails in wilderness	<p>Data Source: Refuge staff</p> <p>Protocol: This measure is a count of locations where user created trailing is known to occur. Data collection relies on the professional judgment of the staff member most aware of visitor use issues. At the time of writing this report the refuge lacks a systematic program for field monitoring of social trailing, which is why professional judgment was used. The number of sites and the name of the locations should be recorded in this measure’s Excel data file, and the number of sites should be entered into the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\ Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\ 4.10 # of sites with obvious user created trails in wilderness DATA.xls</p>
4.11 Management restrictions on non-commercially guided visitors	<p>Data Source: Refuge staff knowledgeable about permit requirements for visitors or closed areas.</p> <p>Protocol: This measure is a count of management restrictions for non-commercially guided visitors to the wilderness area. The refuge manager or visitor outreach staff can provide the data for this measure. The number of management restrictions and their description should be recorded in this measure’s Excel data file, and the total number of restrictions should be entered into the WCMD MS Access Database.</p> <p>Data Collection File: T:\Administration\Management\Wilderness\ Wilderness Character Monitoring\Wilderness Character Data\4 Solitude Recreation Quality\4.11 Management Restrictions DATA.xls</p>

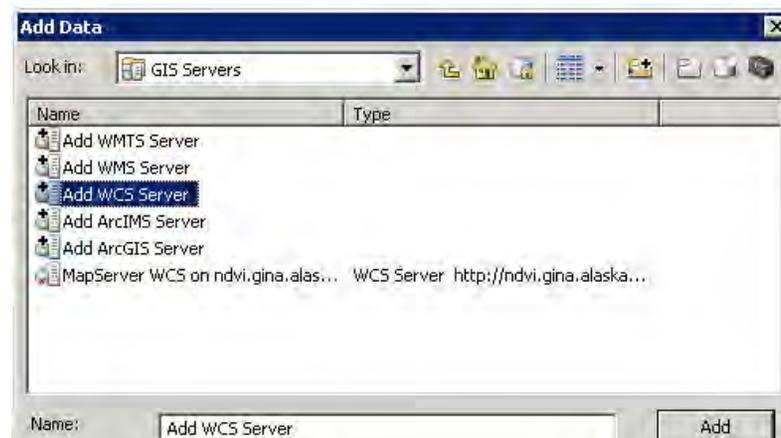
APPENDIX D – Instructions for downloading and processing GINA data for measure 2.2

1) For the first step open ArcGIS, connect to the GINA GIS Server and download data as seen in the images below.

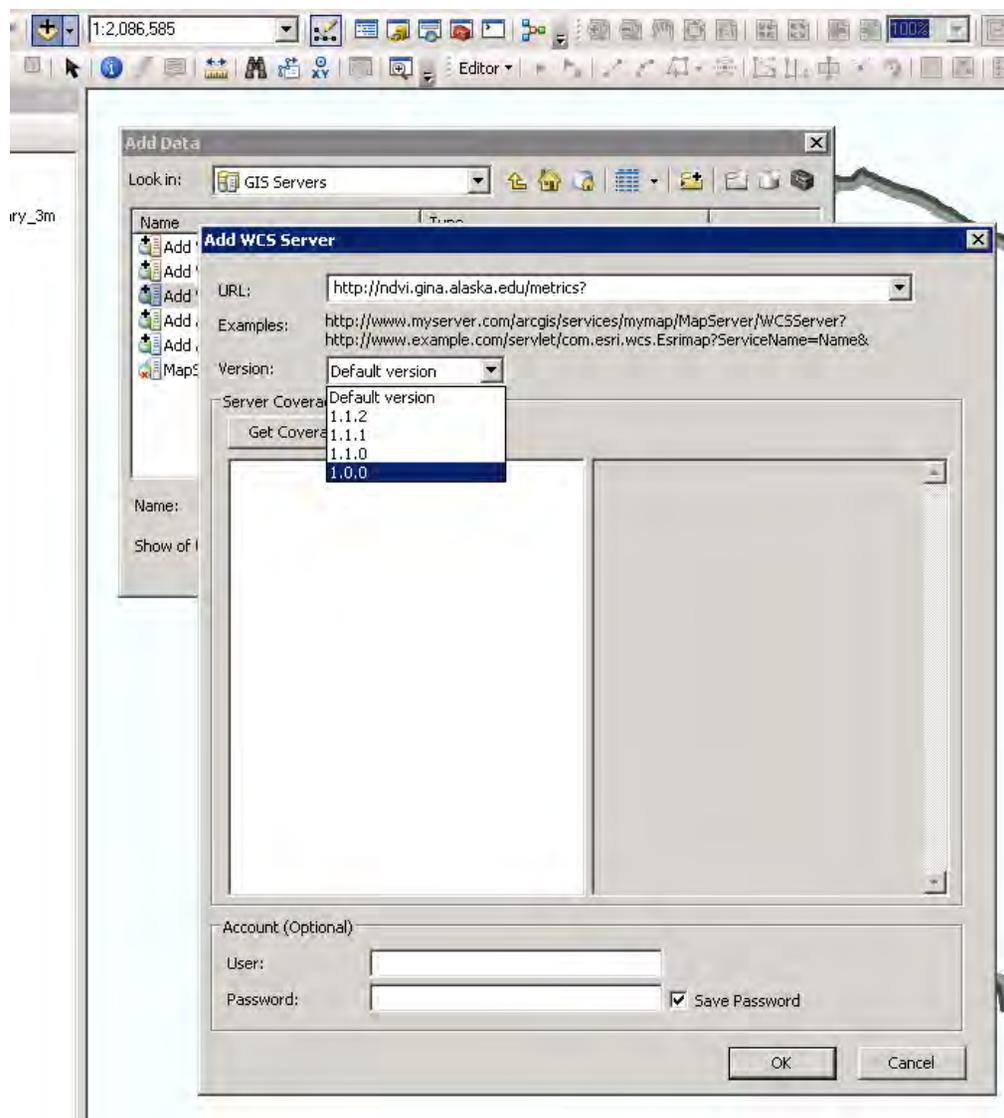
a) Select “add data” and then select “GIS Server” from the drop down.



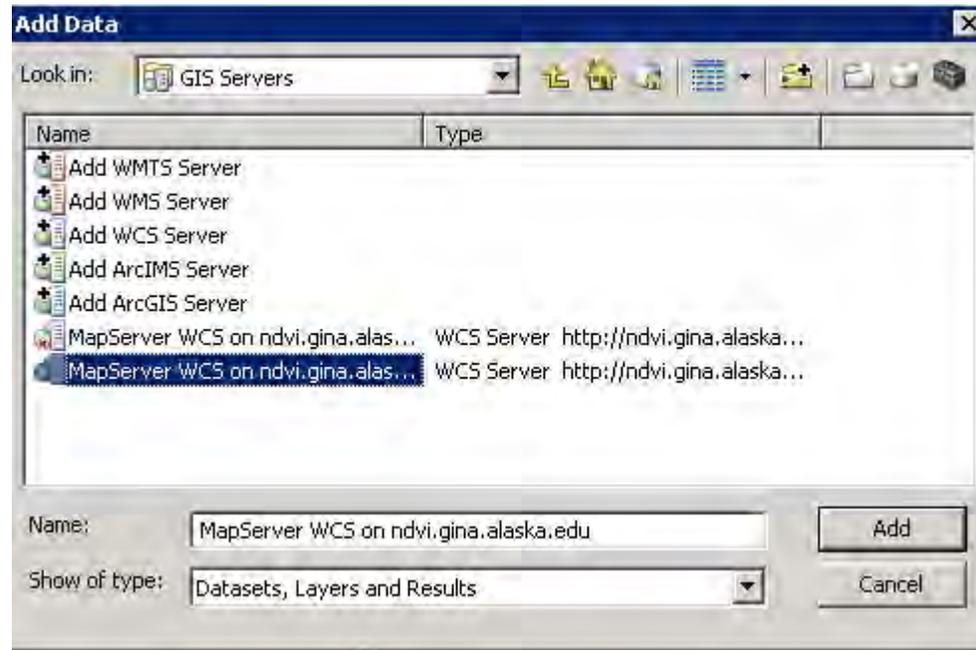
b) Double click on “Add WCS Server”



c) Add the GINA AVHRR data server URL, <http://docs.gina.alaska.edu/ndvi/avhrr.html> to the URL box. Select “1.0.0” from the “Version” dropdown. Click OK.



d) The GINA WCS server should appear in the “Add Data” options as seen below. Highlight and press “Add,” and select the years of data required and press “Add.”



2) In this step clip the raster to the wilderness and find the average value for peak greenness and length of growing season as shown by the images below.

a) Search “Raster Clip” in the search plane and double click the top tool “Clip (Data management).”

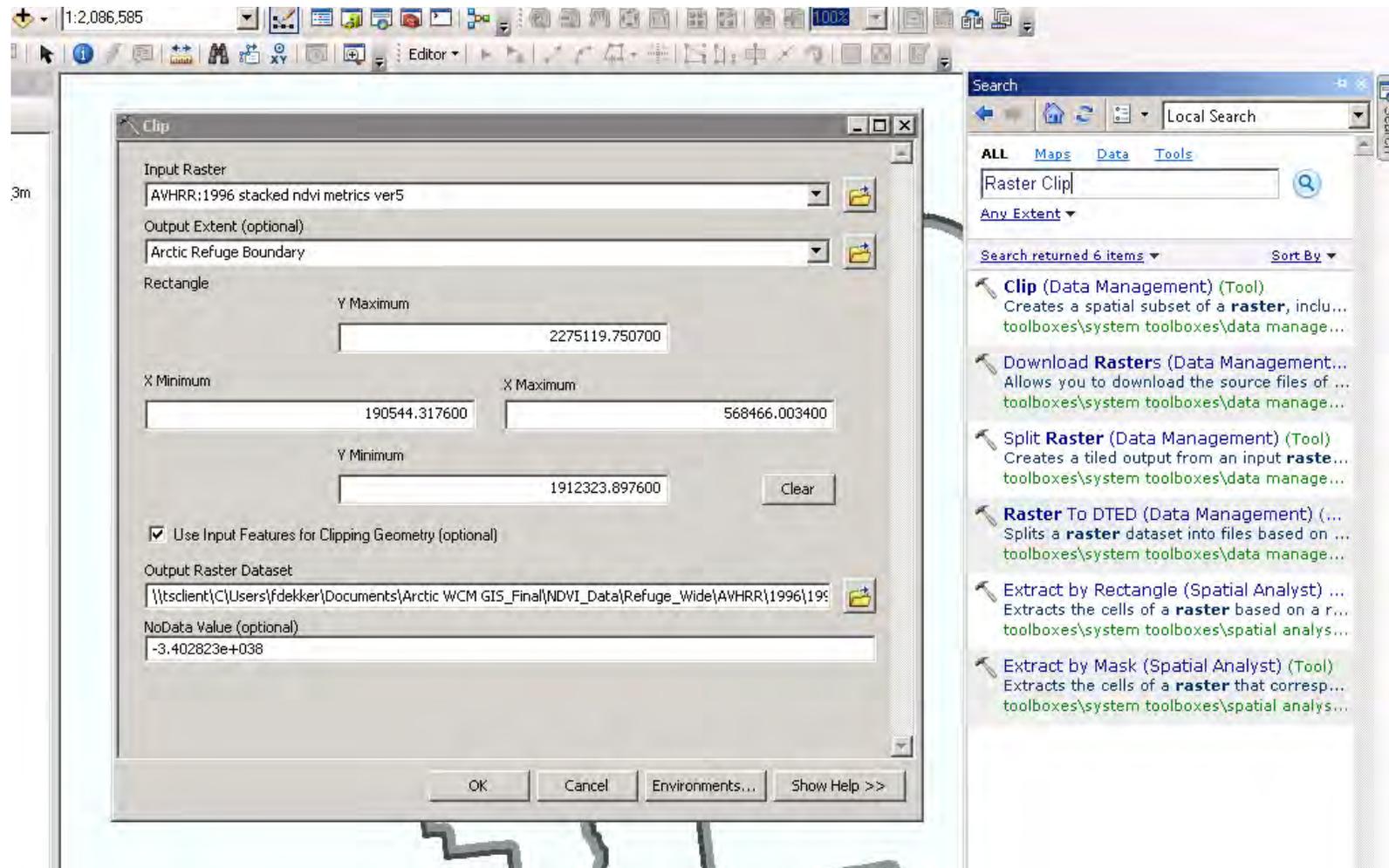
b) In the “Clip” window, select the data you downloaded as the “Input raster” and select a shapefile that contains the wilderness boundary for the “Output Extent.” (shapefile can be found in wilderness gis layers folder)

c) Be sure to check the box next to “Use Input Features...”

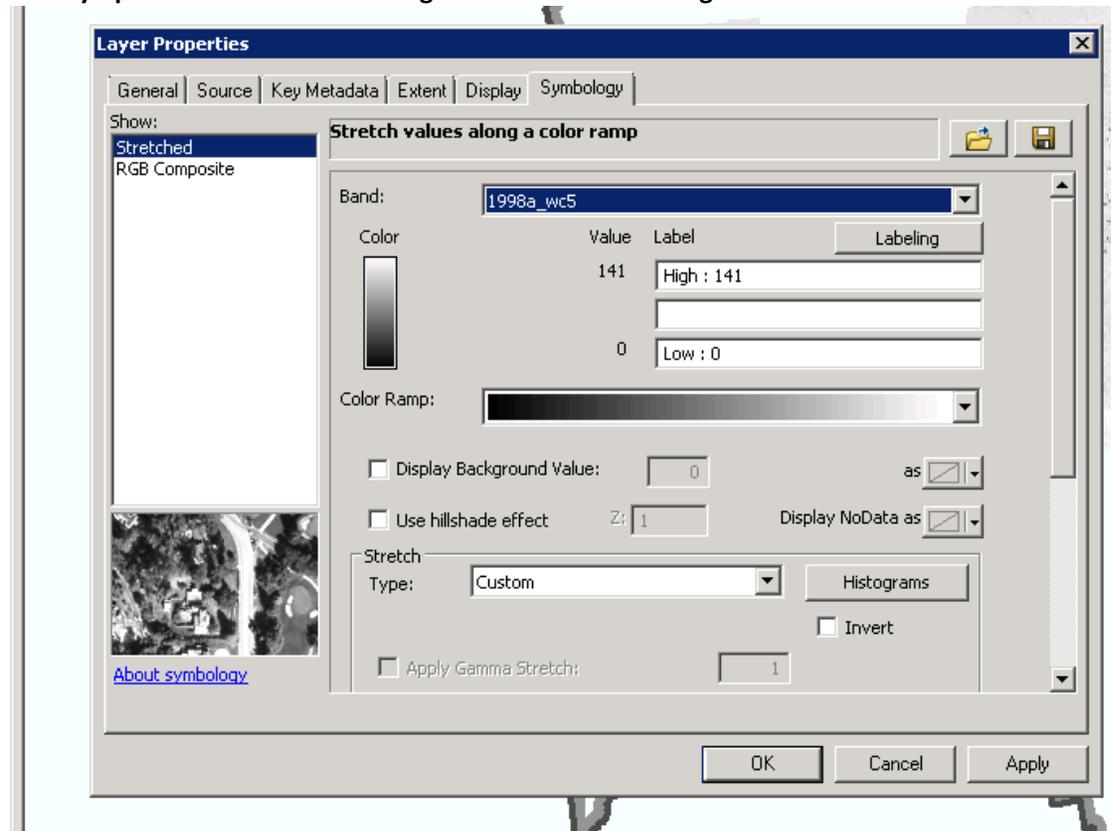
d) Click the file icon next to “Output Raster dataset, name and store the clipped raster in a new folder in:

T:\Administration\Management\Wilderness\Wilderness Character Monitoring\Arctic WCM GIS_Final\NDVI_Data\AVHRR\Wilderness Only\

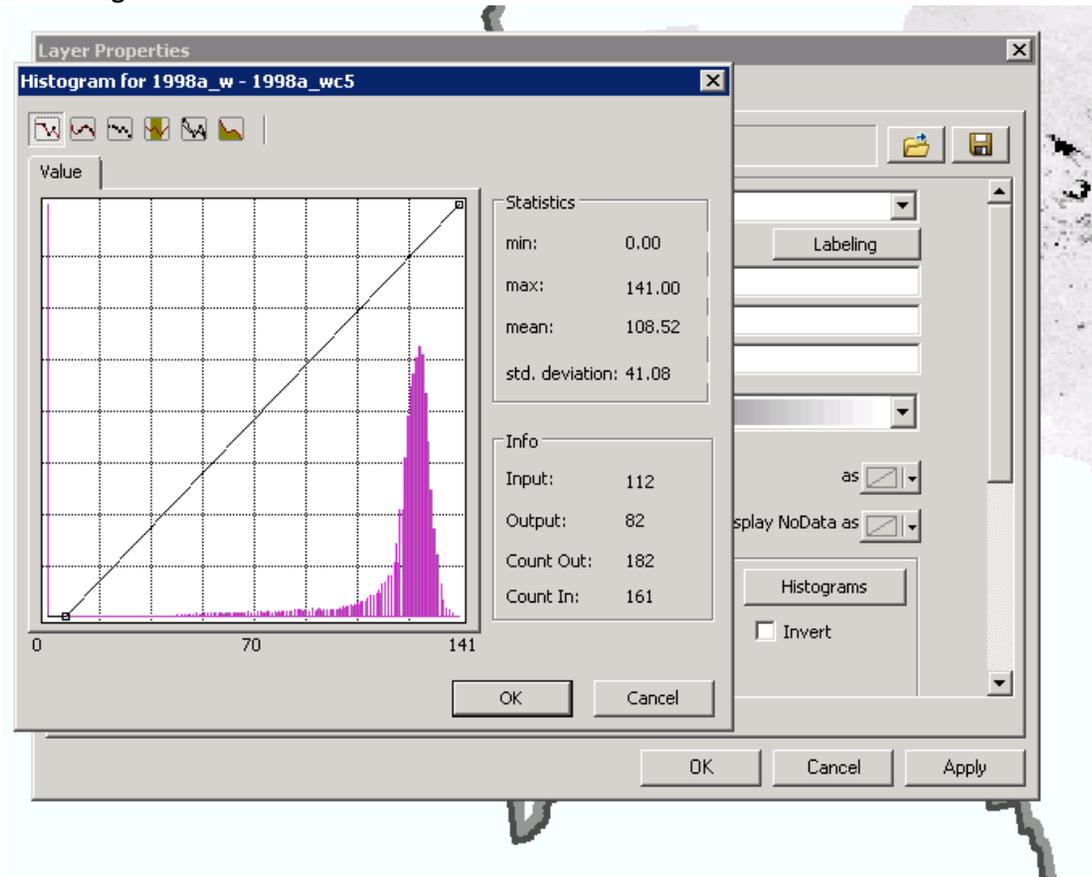
e) Click “OK”



- f) Double click the clipped raster to bring up “Layer Properties” and go to the “Symbology” tab.
- g) Changed “Band” to band # 5 for Growing Season Length (days).
- e) Press “Apply” and refresh the map
- e) Change the Stretch type in the drop down to any option and click the “Histograms” button to the right.



g) From the Statistics box in the Histogram window collect the mean value and add it to this measure's Excel data file.



h) Return to step 2(f) but select band #7 for Max Greenness in step 2(g).

3) Recalculate regression statistics in this measure's Excel data file and follow measure definition instructions for determining significant change.

APPENDIX E – What is a Trammeling Action?

WHAT IS A TRAMMELING ACTION?

Peter Landres, Aldo Leopold Wilderness Research Institute

The purpose of this short document is to provide guidelines and examples to clarify what is and is not a trammeling action. This document does not discuss how to weight such actions, how to find or record the data for these actions, or any other aspect of using this information in wilderness character monitoring. These guidelines and examples 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.

The following definitions are used in this document:

- Trammeling action: 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.
- 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 inside a designated wilderness or inside an area that by agency policy is managed as wilderness.
- Intentional manipulation: an action that purposefully alters, hinders, restricts, controls, or manipulates “the earth and its community of life.”

Based on these definitions, trammeling occurs when a manager makes a decision and takes action that intentionally manipulates the natural quality. Once action is taken the effect on the natural quality cannot typically be halted or stopped or reversed, and therefore the effect typically persists from the moment of the action onwards over time. Because of this persistent or permanent effect on “the earth and its community of life,” managers need to think long and hard about these types of decisions.

Trammeling actions are often considered only in terms of how they degrade the untrammeled quality, but the agency takes all sorts of such actions for many different reasons that support or sustain the other qualities of wilderness character. For example, actions taken to protect and sustain the natural quality include controlling or eradicating non-native species, restoring degraded habitat, or protecting species from harm such as installing gates across caves to prevent people from entering. Resource management actions in wilderness almost always involve tradeoffs, and while there may be valid and good reasons for taking trammeling actions, these actions nonetheless degrade the untrammeled

quality. The framework of wilderness character simply allows agency staff to be transparent about these tradeoffs, for example the tradeoffs that might be involved in actions taken to improve the natural quality that degrade the untrammelled quality. The goal of using the framework of wilderness character is to help agency staff make the decision that is deemed best overall for preserving wilderness character.

TYPES OF TRAMMELING ACTIONS

There are two broad classes of trammeling actions, those that are authorized by the federal land manager and those that are not. Under each of these broad classes there are several subclasses that reflect whether the action is taken on a biological resource, a physical resource, and whether the effect of the action is on a biological or physical resource. Almost always the concern is for actions that occur inside a designated wilderness, but one subclass provides examples of actions taken outside a designated wilderness that would be included as a trammeling action because the intention is to affect biological or physical resources inside the wilderness.

Agency authorized trammeling actions – actions authorized by the federal wilderness land 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 vegetation or fish and wildlife to intentionally and directly affect this vegetation or fish and wildlife. Examples include:
 - a. Removing or killing native vegetation or fish and wildlife
 - b. Adding or restoring native vegetation or fish and wildlife
 - c. Adding non-native vegetation for erosion control
 - d. Adding non-native fish and wildlife
 - e. Spraying chemicals to control non-native vegetation or fish and wildlife
 - f. Releasing biocontrol agents to control non-native vegetation or fish and wildlife
 - g. Collecting vegetation for scientific study
 - h. Collecting or capturing and releasing fish and wildlife for scientific study
 - i. Collecting vegetation or fish and wildlife for commercial purposes
 - j. Enclosing or excluding fish and wildlife from an area to protect vegetation or to study the effects of enclosing or excluding fish and wildlife on protecting vegetation or animals
 - k. Adding pesticides to water to eliminate non-native fish

2. Actions taken inside the wilderness on a physical resource to intentionally and directly affect this physical resource. Examples include:
 - a. Suppressing naturally-ignited fire
 - b. Lighting fire (under management prescription) to reduce fuels or for other purposes
 - c. Constructing or maintaining a dam or diversion structure to alter the quantity or seasonal flow of water
 - d. Constructing a road to allow access to mineral, oil, or gas leases; communication sites; or inholdings

3. Actions taken inside the wilderness on a physical resource that intentionally affects the physical resource to directly or indirectly affect vegetation or fish and wildlife. Examples include:
 - a. Installing a gate across a cave that will protect bats but exclude other animals from using the cave
 - b. Constructing or maintaining a range allotment fence
 - c. Constructing a dam to exclude non-native species from moving up or down a stream
 - d. Installing guzzlers to provide water for wildlife
 - e. Lighting fire (under management prescription) or any other vegetation manipulation to improve wildlife habitat
 - f. Adding acid-buffering limestone to water to neutralize the effects of acid deposition on aquatic flora and fauna

4. Actions taken outside the wilderness on a physical or biological resource to intentionally and directly affect that resource inside a wilderness. Examples include:
 - a. Cloud seeding that occurs above the wilderness, and is therefore outside it, to intentionally increase precipitation inside the wilderness
 - b. Damming a river outside a wilderness to intentionally create a lake or water storage area inside the wilderness
 - c. Killing fish and wildlife outside the wilderness to intentionally affect the population or distribution of this species inside the wilderness
 - d. Planting or stocking fish and wildlife outside the wilderness to intentionally or foreseeably affect the population or distribution of this species inside the wilderness because of known habitat inside the wilderness

Unauthorized trammeling actions – citable and 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 vegetation or fish and wildlife to intentionally and directly affect this vegetation or fish and wildlife. Examples include:
 - a. Adding vegetation or fish and wildlife by a federal agency (other than the federal land managing agency), a state agency, or the public
 - b. Removing vegetation or fish and wildlife by a federal or state agency or the public
 - c. Inclosing or excluding fish and wildlife to study the effects of inclosing or excluding on vegetation or fish and wildlife

2. Actions taken inside the wilderness on a physical resource to intentionally and directly affect this resource. Examples include:
 - a. Modifying water flow to store water or alter the timing of water flow
 - b. Setting arson fire

3. Actions taken inside the wilderness on a physical resource that intentionally affects the physical resource to intentionally (either directly or indirectly) affect vegetation or fish and wildlife. Examples include:
 - a. Modifying water resources to provide water for wildlife

4. Actions taken outside the wilderness on vegetation or fish and wildlife to intentionally and directly affect the occurrence or distribution of these or other species inside a wilderness. Examples include:
 - a. Releasing species outside a wilderness with the intention to affect a population whose range expands into the wilderness
 - b. Killing wildlife outside of the wilderness with the intention to affect populations whose ranges expand into the wilderness

FLOWCHART

In addition to the examples above, the flowchart below is intended to help agency staff determine when an action should be considered a trammeling action. In this flowchart, all of the examples described above would typically fall under the far left branch as trammeling actions, although they may occur under the middle branch of maybe being a trammeling action depending on the circumstances. The flowchart begins with the question “Is there an opportunity for restraint?” because at root the idea behind “untrammeling” is the legislative and policy mandate that managers use restraint in wilderness stewardship. Simply, if there is no opportunity for managerial restraint, or for managers to try and restrain unauthorized action taken by others, then there is no impact to the Untrammeling Quality even though there may be large impacts to the Natural Quality. This question is placed first in the flowchart to help avoid confusing those actions and their effects for which managers typically lack the opportunity for restraint and where there is no intention to manipulate wilderness, such as global climate change, air pollutants, and many others, from actions that intentionally affect “the earth and its community of life” and that managers do have an opportunity to influence.

In some situations managers may assume that they do not have the opportunity for restraint, for example taking action to restore habitat for a listed endangered species, or spraying herbicides to eradicate an invasive non-native plant that is degrading wildlife habitat, or transplanting an extirpated species back into the wilderness, or suppressing a naturally-ignited fire to save timber or homes adjacent to the wilderness. However, even in these situations managers are choosing to take action as well as the type and intensity of action. In addition, there are many situations where managers must choose to take an action that supports one law (such as the Endangered Species Act) that degrades another (in this case the Wilderness Act), or they must make difficult tradeoffs because of agency policy. In all of these situations there is an opportunity for restraint, and these guidelines and flowchart should help managers be consistent and transparent in making these decisions.

If there is an opportunity for restraint, the manager must then consider the intent of the action. Intent is notoriously difficult to discern, but in many cases deciding whether an action is an intentional trammel is straightforward, while in other cases it is more complex and nuanced. These nuanced cases typically involve some type of action where the intent is not to manipulate the “earth and its community of life” but to have some other outcome that is limited in its scope and effect. On the flowchart these situations are under the question “Will the action have a foreseeable and substantial effect on the earth

and its community of life?” These nuanced cases may be confusing because even though the primary intent is not to manipulate species or physical resources, action is nonetheless intentionally being taken and there may be a foreseeable and substantial effect on “the earth and its community of life.”

In the table below, several hypothetical situations illustrate how an action may or may not be a trammeling depending on the scope and scale 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. For every real situation, agency staff need to think through whether the proposed action will have a foreseeable and substantial effect on “the earth and its community of life” and if their answer is “yes” then it’s a trammeling action, and if the answer is “no” then it’s not a trammeling action. Also, in this table an action may not be a trammeling but it still may affect other qualities of wilderness character. For example, installing rebar monumentation would likely not be a trammeling, but such installations would likely degrade the Undeveloped Quality.

Action	Likely Not a Trammeling	Likely a Trammeling
Building system trail	<ul style="list-style-type: none"> • Routing a trail needs around a rock slide that obliterated the former trail • Building a bridge across a stream to prevent stream bank erosion • Installing a small section of corduroy across a wet area to prevent trenching • Installing in water bars • Removing rock in a trail • Building rock-cribbing to support a trail 	<ul style="list-style-type: none"> • Routing a trail through an area of endangered alpine butterfly habitat • Building a large amount of new trail to go around a section of a river or a cliff • Building a trail that requires extensive earth movement or tree cutting
Obliterating non-system trail	<ul style="list-style-type: none"> • Piling vegetation or rocks at the beginning and end of trail sections that cut a switchback • Piling vegetation or rocks to block social trails around campsites 	<ul style="list-style-type: none"> • Obliterating a large section of non-system trail that requires extensive earth movement
Restoring campsites	<ul style="list-style-type: none"> • Restoring a single, isolated campsite • Restoring a number of campsites (e.g., that are clustered around a lake) that doesn’t require degrading the soil or vegetation in the surrounding area 	<ul style="list-style-type: none"> • Restoring a number of campsites that does require moving a significant amount of soil or number of plants in the surrounding area
Closing caves	<ul style="list-style-type: none"> • Installing a bat gate across one or a few caves of many in the area 	<ul style="list-style-type: none"> • Installing bat gates across all the caves in an area
Removing hazard trees	<ul style="list-style-type: none"> • Removing one or a few hazard trees that threaten designated campsites or that are along a trail 	<ul style="list-style-type: none"> • Removing all of the hazard trees over a large area
Treating non-	<ul style="list-style-type: none"> • Hand pulling a small area of non- 	<ul style="list-style-type: none"> • Spraying any herbicide

Action	Likely Not a Trammeling	Likely a Trammeling
native invasive plants	native invasive plants	
Permitting scientific activities	<ul style="list-style-type: none"> • Installing research plot monumentation, such as rebar stakes or nails • Installing most scientific instrumentation • Collecting a limited number of voucher specimens with no impact species distribution or abundance 	<ul style="list-style-type: none"> • Installing enclosures or exclosures that affect the movement of fish and wildlife • Installing instrumentation that disrupts the movement or behavior of plants, or fish and wildlife • Collecting voucher specimens that does affect the species distribution or abundance

