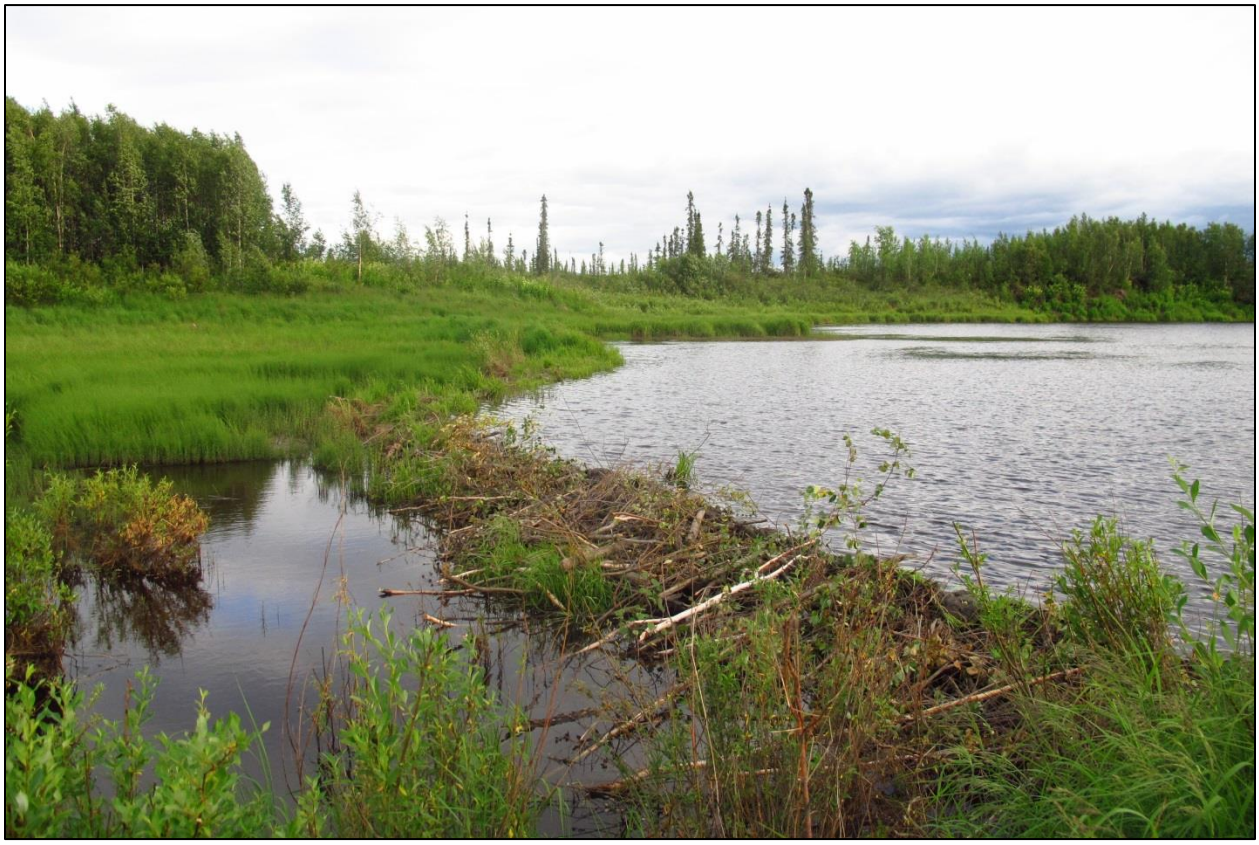
U.S. Fish & Wildlife Service

Inventory and Monitoring Plan for Kanuti National Wildlife Refuge



Ronan Dugan/USFWS

April 2017

Kanuti National Wildlife Refuge
Inventory and Monitoring Plan

I. Signatures

Inventory and Monitoring Plan

For: Kanuti National Wildlife Refuge

Action	*Signature /Printed Name*	*Date*
Prepared By:	**Chris Harwood (Wildlife Biologist)**	10/7/16
	Roy Churchwell (Wildlife Biologist)	10/7/16
Submitted By:	**Mike Spindler (Refuge Manager)**	10/7/16
Reviewed By:	**Diane Granfors (Regional I&M Coordinator)**	1/23/17
Reviewed By:	**Ryan Mollnow (Division of Natural Resources Chief)**	4/20/17
Reviewed By:	**Doug Damberg (Refuge Supervisor)**	5-23-17
Approved By:	**Mitch Ellis (Regional Refuge Chief)**	5-24-17

Contents

II. Introduction

Kanuti National Wildlife Refuge (NWR) was created under the Alaska Native Interest Lands Conservation Act (ANILCA) of 1980 [Section 302(9)(B)]. ANILCA established the following major purposes for Kanuti NWR:

> i. To conserve fish and wildlife populations and habitats in their natural diversity, including but not limited to white-fronted geese and other waterfowl and migratory birds, moose, caribou (including participation in coordinated ecological studies and management of the Western Arctic caribou herd), and furbearers
>
> 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 by local residents
>
> 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

In addition to outlining specific management objectives for public lands under ANILCA, the overarching purposes of ANILCA were to:

> preserve unrivaled scenic and geological values associated with natural landscapes; to provide for the maintenance of sound populations of, and habitat for, wildlife species of inestimable value to the citizens of Alaska and the Nation, including those species dependent on vast relatively undeveloped areas; to preserve in their natural state extensive unaltered arctic tundra, boreal forest, and coastal rainforest ecosystems; to protect the resources related to subsistence needs; to protect and preserve historic and archeological sites, rivers, and lands and to preserve wilderness resource values and related recreational opportunities including but not limited to hiking, canoeing, fishing, and sport hunting, within large arctic and subarctic wildlands and on free-flowing rivers; and to maintain opportunities for scientific research and undisturbed ecosystems [ANILCA Sec.101.(b)].

Kanuti NWR staff conducts inventory, monitoring, and research activities to support the purposes of ANILCA. A Revised Comprehensive Conservation Plan (CCP) for Kanuti NWR (USFWS 2008) defines the end products or benefits toward which Refuge management activities are directed, which uses may be compatible with the purposes of the Refuge, and what general management strategies will be followed. The following biological work listed in this Inventory and Monitoring Plan (IMP) largely corresponds to those CCP objectives.

The goals and objectives identified in the CCP, and the surveys and projects that address them detailed in this IMP, were derived in large part from a biological program review conducted by a 14-member panel in July 2002 (Heglund et al. 2005). The goals of that review were to:

- Determine if the biological program supports the establishing purposes outlined in the Alaska National Interest Lands Conservation Act (ANILCA), the National Wildlife Refuge Improvement Act, and other Service policies regarding fish, wildlife and habitat management;

- Identify measures to: (a) improve fish, wildlife and habitat conservation and management on Kanuti NWR and (b) contribute to the ecological integrity of the National Wildlife Refuge System at regional and national scales;

- Identify inventory, monitoring, and research needs required to implement ecosystem management;

- Identify management priorities and strategies for inventory, monitoring, research, and habitat management plans;

- Help Kanuti NWR identify factors (e.g., personnel, funding, and support) that limit design and implementation of management and research studies.

Following creation of draft biological goals and project objectives, panel members then individually ranked potential projects (i.e., high, medium, or low) and a mean rank score was determined. Recommendations in this report were based largely on these rankings and ultimately helped lead to the biological goals and objectives identified in the CCP, and the inventories, monitoring, and research efforts that were developed to address them. One objective explicitly stated in the CCP was the development and implementation of an inventory and monitoring plan.

The goal of the Kanuti NWR biological program is to provide biological support for informed management. The scope of this support is limited by real world constraints such as budget and staffing. From this perspective, it is useful to document and prioritize the biological inventory and monitoring surveys occurring or expected to occur at Kanuti NWR. This IMP provides the rationale for the ranking and selection of surveys that the Refuge intends to conduct over the life of the plan (about 10 years), and briefly describes the purpose, management context, and partnerships involved in those surveys; the latter is also maintained in the Planning and Review of Inventory and Monitoring on Refuges (PRIMR) database. The IMP provides guidance, transparency and continuity for the biological program and assists managers with budget allocation decisions. It will be revisited annually by refuge staff to ensure that the current surveys are relevant, that the refuge has the resources to conduct them, and that new issues are being considered. Protocols will be developed and approved for implemented surveys using guidance from the survey protocol handbook (USFWS 2013). The addition of new surveys or

deletion of old surveys will require IMP revision and approval. Updating protocols requires IMP amendment and does not require approval. (See Section VII – Revising or Amending the IMP)

This plan documents the prioritization process and results for those inventory, monitoring and research surveys that are currently and proposed to be conducted at Kanuti National Wildlife Refuge from 2016 to 2025. This document was developed in collaboration with the Service's Inventory and Monitoring Initiative, and in accordance with the U.S. Fish and Wildlife Service policy 701 FW 2.

Other documents that guide the biological program include a Fishery Management Plan (USFWS 1993), a Land Protection Plan (USFWS 2002), and a Fire Management Plan (USFWS 2007). In combination with these other step-down plans, this IMP provides a core direction for the biological program to respond to well-identified, important resource issues. Occasionally, and inevitably, the Refuge must respond to ad-hoc, controversial, or hot-topic issues, such as proposed roads within or near the Refuge (e.g., Ambler mining road, Allakaket-to-Bettles winter road), public scoping for management plans of neighboring landholders (e.g., BLM's Central Yukon Resource Management Plan), an invasive species infestation, etc.

For a review of historical biological work conducted on or near Kanuti NWR, the staff is in the process of reorganizing reports, memoranda, proposals, data, and other supportive materials on the shared Kanuti drive; paper copies are well organized in the physical central files. In addition, an EndNote Web library was created in spring 2015 and is regularly being populated with important documents, including those cited in this IMP, as well as links to electronic copies of the papers themselves. Additional background on biological work can also be found in printed station annual narratives created regularly from 1981–2008, located in the Kanuti library. When staff support is provided by the Regional Inventory and Monitoring Branch, much of this material will be made accessible to all DOI employees and the public, as appropriate, through ServCat (https://ecos.fws.gov/ServCat/).

III. Methods

From February to October 2012, the Kanuti NWR biological staff (Lead Wildlife Biologist Tim Craig, Wildlife Biologist (avian) Chris Harwood, Pilot/Wildlife Biologist Les Dillard, and Pathways Intern Erin Julianus) began entering biological program project information into a "distributed desktop" version of the PRIMR database. Most of the project entries were derived from ongoing inventory, monitoring, and research efforts conducted by or for Kanuti NWR from 2008–2012. These surveys had been conducted largely in response to objectives identified in the revised 2008 CCP. Other entries included surveys identified in the CCP but not yet begun, and a few addressing newly identified biological data needs. In November 2012, Lead Wildlife Biologist Tim Craig requested that all staff finalize their submissions in anticipation of PRIMR's migration to an online interface. During 2013, Dillard and Julianus resigned from the USFWS, leaving Craig and Harwood as the remaining biologists.

In January 2014, Craig and Regional I&M Coordinator Diane Granfors scheduled an IMP review for mid-March in Fairbanks. In preparation of the review, Granfors requested that the Kanuti biologists and refuge managers review reference materials, and the I&M needs assessment questionnaire, and complete project entries in PRIMR. On 3 March 2014, Craig, Harwood, Refuge Manager Mike Spindler and Deputy Refuge Manager Joanna Fox met to discuss refuge biological priorities and assess needs. Craig and Harwood completed the needs assessment by 11 March. During 10–11 March, Craig attended the Granfors-facilitated IMP Review of Yukon Flats NWR in Fairbanks.

On 12–13 March 2014, Granfors then met with Craig, Harwood, Spindler, Fox, and I&M Data Manager Hilmar Maier to review Kanuti NWR's completed needs assessment and prioritize existing and prospective refuge I&M surveys addressing identified needs. To guide prioritization and selection of projects, Refuge staff used the I&M Simple Multi-Attribute Ranking Table (SMART) decision support tool (USWFS 2014). First, staff selected among 24 criteria to evaluate each project (Appendix A); 16 criteria were selected and rated and 8 were omitted because they were deemed redundant or not applicable. Based on Refuge staff input, the criteria were ranked 1 to 16. We then weighted each criterion in largely decreasing 6–7% intervals (i.e., 100 divided by 16 equals 6.25), allowing for ties for criteria deemed of similar importance (Appendix A). Each individual survey was assigned scaled scores for each of the 16 criteria. Finally, the SMART tool calculated raw scores that reflected initial rankings for each of 27 projects (Appendix B).[1]

The ranking (Appendix B) generated using the SMART tool criteria generally corresponded with management priorities. However, we recognized that refuge management (e.g., prioritizing surveys) is more nuanced and dynamic than is reflected by the tool and these criteria. For example, our survey for scaup and scoters scores more than our aerial moose survey under the "FWS Subsistence Species" criterion because two species are targeted instead of one; however, Refuge staff members and our local users of the Refuge would rank the moose survey as more important under that criterion. Further, the relatively recent emphasis on invasive weed management and the gradual elevation of abiotic surveys were not reflected well in the scoring process. Therefore, some final adjustment was necessary to increase consistency with the priorities expressed in the Refuge's CCP and current management issues.

[1] The initial list of 27 projects was revised over the next 15 months to reflect: a) newly identified survey needs, b) old projects deemed completed or of lower priority, and c) the input of several new staff members not originally present for the IMP Review. Progress in 2014 was slowed by summer field season activities, and especially when Lead WB Craig retired in early April 2014 and DRM Fox transferred to Arctic NWR in early August 2014. DRM Tina Moran entered on duty in October 2014, and Pilot/Biologist Chris Daniels and Wildlife Biologist Roy Churchwell joined the staff in early 2015. With biological and managerial staff again at full capacity, IMP progress was made a high priority. By March 2015, input from current staff had been fully considered and 27 final projects were evaluated, scored, and ranked using the SMART tool (Appendix B).

We determined the final project prioritizations via a two-step process. First, we evaluated the ranking generated with the SMART tool against a suite of factors that dictated priorities during CCP development and implementation. The following factors were considered:

1. Immediate relevance to management decisions for subsistence species and hunted species. Moose is the most important subsistence and closely managed species on the Refuge.
2. Threats to Refuge ecological integrity.
3. If information needs were nearly identical as indicated by the SMART tool scores, we prioritized
    a. lack of information over areas where some information is available; and
    b. surveys with more immediate management application.

Secondly, we categorized projects as "selected" and "non-selected" regarding consideration in the IMP as follows:

1) Selected

a. "*Current*" surveys that could be completed based on both staff capacity and the biological program budget in 2015. We were confident that the Refuge could complete these surveys over the time span of the IMP with historical or expected levels of funding adjusted annually to account for cost increases due to inflation.

b. "*Expected*" new surveys that have a likely chance of being conducted during the span of an IMP because of moderate to high priority, and because the capacity to conduct the survey comes from less certain sources (e.g., from partners or through grants or possible budget increases).

2) *Non-selected*

a. "*Future*" surveys that were proposed, ranked low priority, and would necessarily require additional collaborative support of the Refuge's partners for completion.

b. "*Historical*" surveys recently completed and therefore dropped from future consideration.

The final priority ranking (Appendix B) reflects consistency with existing management plans and expected information needs. The following discussion summarizes the primary differences between *rankings* assigned using the SMART tool and *priorities* assigned with the combination of the SMART tool and evaluation of the management factors listed above. Priorities for five of the 18 Current surveys that ranked highest with the SMART tool were revised. Two of the six Expected surveys were elevated.

1. Our annual moose census was assigned top priority given its importance for both local subsistence and sport hunters. Survey results (e.g., population estimate, age- and sex-class ratios) directly guide local, annual harvest regulations (e.g., season length, hunting area boundaries, possible emergency hunts or closures).
2. Invasive weed monitoring was elevated from 4th to 3rd because of the potential to negatively affect the Kanuti ecosystem and the possibly high potential for weeds

currently infesting the Dalton Highway to expand westward onto the Refuge; at least six tributaries cross the highway and lead to the Refuge.

3. We elevated beaver monitoring over the similarly ranked Alaska Landbird Monitoring Survey (ALMS) because 1) beaver are an important subsistence animal and a keystone species on the Refuge, 2) we already contribute annually to regional landbird monitoring via the Breeding Bird Survey, and 3) the beaver survey is low frequency (every five years).
4. We elevated the snow marker survey two places above surveys of tied or similar scores as the survey not only contributes to a regional hydrological outlook that helps forecast flooding and predict fire season's start, but also allows monthly reconnaissance for wintering caribou.
5. The Expected bear survey was elevated because of large information gaps in a regularly hunted or trapped species and possible breakthroughs in more cost-effective and practical survey techniques (e.g., camera-trap sampling).
6. The Expected furbearer survey was ranked higher than the similarly scored swan composition survey because our understanding of furbearer populations (e.g., numbers, annual variation) on the Refuge is considerably less than our understanding of swans (i.e., we know what the composition was in 1990). There is also a greater immediate need to understand furbearers on the Refuge to relay potential concerns through outreach to trappers; there is less urgency about the local swan composition because Alaska's Tundra Swan population is healthy, and hunting of Trumpeters is prohibited.

In summary, the final analyses yielded minor but important revisions in survey priority. However, in most cases, we maintained consistency with the rank order of importance assigned with the SMART tool.

Refuge staff estimated average annual staff time for each project, expressed as full time equivalent units (1 FTE = 2,080 hours). To convert hours to average FTE cost (annual), the PRIMR default value of $100K for an annual salary was generally used for GS-9- (and below) - level biologist series and $125K for GS-11 and above employees (pilots, managers, and supervisory biologist. The average annual cost of equipment, costs, and travel for each project was calculated for current projects and estimated for expected future projects. For some projects, accurate calculation of costs especially is difficult because projects are done most efficiently to minimize time, expenses, etc. For example, several spring/summer projects can be done at Kanuti Cabin so travel to/from, food, etc. for each tends to be spread out over multiple projects. We have annotated as such in the following Table 1. Our Breeding Bird Surveys historically were done in isolation (i.e., travel from/to Fairbanks and to/from cabin, was done in one stint; no other surveys were done incidental to it). However since 2008, we have regularly had staff complete stints of 1–3 months out of the cabin in which multiple surveys were conducted. This increase in staff time in the field has resulted in greater efficiency (e.g., reduced travel time) and lower costs per project. However, because of the vagaries of fieldwork, especially when trying to execute tightly coordinated diverse projects in a dynamic ecosystem, Refuge staff decided that listing stand-alone project costs in this plan was most useful for current and future planning exercises.

Estimation for future projects was by consultation with peers, and adjusting costs of equipment, travel, etc. by a normal amount of inflation (about 3% annually).

IV. Results

A. Summary of Selected Surveys

The prioritization process identified 26 Selected Surveys to be implemented within the duration of this IMP (Table 1, Appendix B). Of these, 18 surveys that will be conducted using current capacity and resources were classified as "Current." An additional 8 surveys that we intend to implement within the time span of this IMP were classified as "Expected." Section B provides a list of non-selected surveys, and section C provides narratives of the rationales for consideration of selected surveys.

Table 1. Summary of selected surveys for Kanuti National Wildlife Refuge.

Survey Priority[1]	Survey ID Number[2]	Survey Name/(Type)[3]	Survey Status[4]	Mgmt. Objective Id[5]	Survey Area[6]	Staff Time (FTE)[7]	Avg. Ann Cost (OPR)[8]	Survey Timing[9]	Survey Length[10]	Survey Coord.[11]	Protocol Status[12, 13]
1.01	FF07RKAN00-014	Moose Population Monitoring (CM)	Current	CCP / Objectives 01.0.04, 03.0.32	Entire station	FWS: 0.07	$14,400	After 25 Oct. but before 6 Dec.; Recurring; attempted every year	1999-Indefinite	Roy Churchwell, Wildlife Biologist	Initial Survey Instruct-ions
1.02	FF07RKAN00-007	Molting Geese Monitoring (CM)	Current	CCP / Objectives 01.0.01, 01.0.19, 03.0.32	Regional	FWS: 0.09	$6,340	Early July; Recurring; attempted every year	2001-Indefinite	Chris Harwood, Wildlife Biologist	Initial Survey Instruct-ions
1.03	FF07RKAN00-015	Riparian Invasive Weeds Monitoring (M)	Current	CCP / Objective 01.0.08	Multiple management units (waterways)	FWS: 0.01, Other: 0.07	$1,820	July; Recurring every year	2007-Indefinite	Roy Churchwell, Wildlife Biologist	Initial Survey Instruct-ions
1.04	FF07RKAN00-037	Scoter/Scaup Breeding Pair Survey (BM)	Current	CCP / Objectives 01.0.01, 01.0.23, 01.0.22	Entire station	FWS: 0.07	$1,940	12-16 Jun; Recurring every year	2014-Indefinite	Chris Harwood, Wildlife Biologist	Initial Survey Instruct-ions
1.05	FF07RKAN00-004	Waterfowl Breeding Pair Survey (CB)	Current	CCP / Objectives 01.0.23, 01.0.22	Entire station	N/A	$3,000	Late May-early Jun; Sporadic or Ad Hoc	1997-Indefinite	Chris Harwood, Wildlife Biologist	Initial Survey Instruct-ions
1.06	FF07RKAN00-016	Trumpeter Swan Census (CB)	Current	CCP / Objectives 01.0.01, 01.0.20	Regional	FWS: 0.07	$4,900	late Aug – early Sep.; Recurring; every 5 yr	1990-Indefinite	Chris Harwood, Wildlife Biologist	Initial Survey Instruct-ions
1.07	FF07RKAN00-022	Wintering Caribou Monitoring (M)	Current	CCP / Objectives 01.0.06, 03.0.32, 01.0.14	Multiple management units	FWS: 0.06	$6,220	March; Sporadic or Ad Hoc	2012-Indefinite	Roy Churchwell, Wildlife Biologist	Initial Survey Instruct-ions
1.08	FF07RKAN00-017	Wolf Snow Track Aerial Survey (CB)	Current	CCP / Objectives 01.0.13, 03.0.32	Entire station	FWS: 0.03	$10,640	March; Recurring; every 3 yr	2005-Indefinite	Roy Churchwell, Wildlife Biologist	Initial Survey Instruct-ions

Survey Priority[1]	Survey ID Number[2]	Survey Name/(Type)[3]	Survey Status[4]	Mgmt. Objective Id[5]	Survey Area[6]	Staff Time (FTE)[7]	Avg. Ann Cost (OPR)[8]	Survey Timing[9]	Survey Length[10]	Survey Coord.[11]	Protocol Status[12, 13]
1.09	FF07RKAN00-018	Kanuti River Breeding Bird Surveys (CB)	Current	CCP / Objectives 01.0.18, 01.0.01	Regional (2 routes done by Refuge)	FWS: 0.06	$2,300	Mid-June; Recurring; every year	1993-Indefinite	Chris Harwood, Wildlife Biologist	Initial Survey Instruct-ions
1.10	FF07RKAN00-020	Beaver Cache Survey (BM)	Current	CCP / Objectives 01.0.12, 03.0.32	Entire station	FWS: 0.07	$8,940	23 Sep – 10 Oct; Recurring; every 5 yr	2002-Indefinite	Roy Churchwell, Wildlife Biologist	Initial Survey Instruct-ions
1.11	FF07RKAN00-019	Alaska Landbird Monitoring Survey (CB)	Current	CCP / Objectives 01.0.18, 01.0.01	Regional (2 sites done for Alaska-wide survey)	FWS: 0.07, Other: 0.05	$3,600	5-25 Jun; Recurring; every 2 yr	2003-Indefinite	Chris Harwood, Wildlife Biologist	Initial Survey Instruct-ions
1.12	FF07RKAN00-009	Snow Marker Survey (CB)	Current	CCP / Objectives 01.0.11, 01.0.01	Multiple management units: 6 snow markers in refuge	FWS: 0.04	$7,000	1st of month for Dec, Feb, Mar, Apr, May; Recurring; every year	1998-Indefinite	Chris Daniels, Pilot/ biologist	Initial Survey Instruct-ions
1.13	FF07RKAN00-032	Raptor Stick Nest Survey (BM)	Current	CCP / Objectives 01.0.18, 01.0.01	Entire station	FWS: 0.05	$4,020	May, pre-leaf-out; Recurring every year	2013-Indefinite	Chris Daniels, Pilot/ biologist	Initial Survey Instruct-ions
1.14	FF07RKAN00-035	Post-fire Vegetation and Bird Monitoring (CB)	Current	CCP / Objectives 01.0.01, 01.0.07, 01.0.15	Multiple management units; 6 survey plots located in area burned in 2004–2005 fires	FWS: 0.09	$0	June bird surveys; July veg surveys; Recurring; every 10 yr	2014-Indefinite	Lisa Saperstein, Regional Fire Ecologist	Initial Survey Instruct-ions
1.15	FF07RKAN00-036	Stream Gage Monitoring (BM)	Current	CCP / Objective 02.0.27	Single management unit	FWS: 0.01	$50	Continu-ous; Recurring every year	2015-Indefinite	Chris Daniels, Pilot/ biologist	Initial Survey Instruct-ions
1.16	FF07RKAN00-013	Bird Phenology Monitoring (BM)	Current	CCP / Objectives 01.0.18, 01.0.01	Regional	FWS: 0.17, Other: 0.15	$4,450 (covers survey 1.17)	April - July/ Recurring any year that cabin is occupied	2013-Indefinite	Chris Harwood, Wildlife Biologist	Initial Survey Instruct-ions

Survey Priority[1]	Survey ID Number[2]	Survey Name/(Type)[3]	Survey Status[4]	Mgmt. Objective Id[5]	Survey Area[6]	Staff Time (FTE)[7]	Avg. Ann Cost (OPR)[8]	Survey Timing[9]	Survey Length[10]	Survey Coord.[11]	Protocol Status[12, 13]
1.17	FF07RKAN00-027	Plant Phenology Monitoring (CB)	Current	CCP / Objective 01.0.01	National (contributes to National Phenology Network)	FWS: 0.04, Other: 0.02	$0 (covered in survey 1.16)	April - July/ Recurring any year that cabin is occupied	2013-Indefinite	Chris Harwood, Wildlife Biologist	Initial Survey Instruct-ions
1.18	FF07RKAN00-008	Dragonfly Inventory (CI)	Current	CCP / Objective 01.0.01	Entire station	FWS: 0.01	$1,500	July and August; Each site visited 1x; Takes >1 yr to visit all sites	2008-Indefinite	Chris Harwood, Wildlife Biologist	Initial Survey Instruct-ions
2.01	FF07RKAN00-003	Salmon Run Inventory (I)	Expected	CCP / Objectives 01.0.10, 03.0.32	Multiple management units	FWS: 0.03	$2,380	Early May-early June and early August to mid-Sept; Occurs one time only at each trib.	2017-Indefinite	Randy Brown, Fisheries Biologist	None
2.02	FF07RKAN00-033	Bear Population Inventory (I)	Expected	CCP / Objectives 01.0.01, 01.0.16	Entire station	FWS: 0.11	$7,529	Summer; Occurs one time only	2017-Indefinite	Roy Churchwell, Wildlife Biologist	In develop-ment
2.03	FF07RKAN00-031	Waterfowl Brood Production Survey (CB)	Expected	CCP / Objectives 01.0.23, 01.0.25	Multiple management units	FWS: 0.17	$5,220	mid-July; Sporadic or Ad Hoc	2017-Indefinite	Chris Harwood, Wildlife Biologist	Initial Survey Instruct-ions
2.04	FF07RKAN00-028	Traditional Ecological Knowledge (CI)	Expected	CCP / Objectives 01.0.01, 01.0.10, 03.0.33	Entire station	FWS: 0.1	$700	Can occur any season; Occurs 1 time only	2018-Indefinite	Mike Spindler, Refuge Manager/ Pilot	Initial Survey Instruct-ions
2.05	FF07RKAN00-030	Furbearer Winter Track Survey (M)	Expected	CCP / Objectives 01.0.17, 03.0.32	Multiple management units	FWS: 0.14	$3,720	mid-Dec - mid April; Recurring every year	2016-Indefinite	Roy Churchwell, Wildlife Biologist	In develop-ment

Survey Priority[1]	Survey ID Number[2]	Survey Name/(Type)[3]	Survey Status[4]	Mgmt. Objective Id[5]	Survey Area[6]	Staff Time (FTE)[7]	Avg. Ann Cost (OPR)[8]	Survey Timing[9]	Survey Length[10]	Survey Coord.[11]	Protocol Status[12, 13]
2.06	FF07RKAN00-034	Swan Composition Monitoring (BM)	Expected	CCP / Objective 01.0.21	Entire station	FWS: 0.14	$9,100	mid-June; Sporadic or Ad Hoc	2018-Indefinite	Chris Harwood, Wildlife Biologist	Initial Survey Instruct-ions
2.07	FF07RKAN00-023	Nesting Owl Monitoring (BM)	Expected	CCP / Objectives 01.0.01, 01.0.23	Multiple management units	FWS: 0.04	$910	15 Mar to 25 April; Recurring every year	2016-Indefinite	Chris Harwood, Wildlife Biologist	Initial Survey Instruct-ions
2.08	FF07RKAN00-024	Snowshoe Hare Monitoring (BM)	Expected	CCP / Objectives 01.0.17, 01.0.01	Multiple management units	FWS: 0.04	$3,420	June; Recurring-every year	2016-Indefinite	Roy Churchwell, Wildlife Biologist	Initial Survey Instruct-ions

[1] The rank for each survey listed in order of priority (e.g., numeric, tiered, alpha-numeric, or combination of these).
[2] A unique identification number consisting of refuge code-computer assigned sequential number. Refuge code comes from the FBMS cost center identifier.
[3] PRIMR code for survey type in parentheses. These are: Inventory (I), Cooperative Baseline Monitoring (CB), Monitoring to Inform Management (M), Cooperative Monitoring to Inform Management (CM), Research (R), and Cooperative Research (R).
[4] Surveys selected for the timespan of this IMP (i.e., Current, Expected).
[5] Refers to objectives identified in Comprehensive Conservation Plan (CCP); see Appendix H for CCP goals and objectives
[6] Station management unit names, entire station, or names of other landscape units included in survey.
[7] Estimates of Service (FWS) and non-Service (Other) staff time needed to complete the survey (1 work year = 2080 hours = 1 FTE).
[8] Average annual operations costs for conducting the survey (e.g., equipment, contracts, travel) not including staff time.
[9] Timing and frequency of survey field activities.
[10] The years during which the survey has been or is scheduled to be conducted.
[11] Name and title of the Survey Coordinator for each survey.
[12] "Protocol Citation" column deleted as no formally approved protocols exist yet.
[13] Stage of approval of the survey protocol (Initial Survey Instructions, In Development, In Review, Approved, None)

B. Non-selected Surveys

One survey was not selected for implementation and was classified as "Future" because it would require considerable collaborative support of the Refuge's partners for completion. Eight additional surveys were classified as "Historical" and were dropped from future consideration because they had been completed.

Future

- Hudsonian Godwit Ecology Study

Historical

- Diurnal Forest Raptor Inventory along Selected Rivers
- Radio Telemetry Study of Moose Movements and Distribution
- Refuge-wide Plot-based Integrated Terrestrial Biological Inventory
- Water Quality Investigation (stream gauges)
- Water Quantity Investigation (stream gauges)
- Wetland monitoring pilot project
- Whimbrel Breeding Biology and Habitat Use Study
- Wolf Collaring Study

C. Narratives of Selected Surveys

Current Surveys
Can be conducted with current Refuge Capacity

1.01: Moose Population Monitoring (FF07RKAN00-014)

1) What is the population or attribute of interest, what will be measured, and when?
The population of interest is the moose population in that portion of GMU 24B that overlaps the Kanuti NWR. The metrics produced by the survey include: the estimated density of moose, and the estimated number of bulls (large, medium and small), cows and calves. The core survey area is Kanuti National Wildlife Refuge; however, when management questions dictate, the size of the survey area can exceed the Refuge boundaries. The survey is conducted annually in November provided weather parameters (e.g., adequate snow cover) are met.

The survey actually comprises three spatially nested survey areas over several years. The size of the surveyed area may vary annually. During some years, stratification and sightability surveys are conducted to improve estimates.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.04 = Moose population estimate for the refuge
Objective 03.0.32 = Work with stakeholders through regulatory processes to conserve fish and wildlife

In addition to the above CCP objectives, this survey directly informs harvest management of moose on and near the Refuge.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Moose are a high priority for Refuge management because they are an important component of Kanuti Refuge's biological diversity and are specifically mentioned in the first of the Refuge's establishment purposes ANILCA. These large herbivores influence habitat structure and composition and are prey for the Refuge's top-level predators. Moose are also an important subsistence species for local residents, and therefore are a component of the Refuge's third ANILCA purpose which concerns providing subsistence opportunities. Lastly, moose attract non-local hunters, defined as a priority activity on refuges in the Refuge Improvement Act of 1997.

An early spring subsistence hunt can be opened upon approval by the Refuge manager, depending on population and harvest statistics; if the moose population is <0.5 moose/mile^2, harvest of cows is prohibited. If a spring hunt is allowed, a harvest quota may be set based on population survey data. Bull-to-cow ratios obtained during population surveys must be adequate to support bull harvest after the normal fall season. The Koyukuk River Moose Management Plan (KRMMP) recommends a bull-to-cow ratio of 30–40 bulls per 100 cows to ensure adequate

breeding in low density areas like Kanuti (ADF&G and Koyukuk River Moose Hunters' Working Group 2001). Calf-to-cow ratios are also examined as the KRMMP recommends rates in excess of 30–40 calves per100 cows for a population to grow. Finally, the ratio of yearling bulls-to-cows provides an indication of calf survival over the previous winter, even though recommended minimum ratios have not been specified.

Currently there are no predetermined thresholds for moose abundance, composition, or detected recent population trends that trigger or deny the March antlerless moose subsistence hunt. As noted above, the decision is made based on moose population status and social factors such as fall moose harvest success, and caribou availability near affected villages. Nonetheless, survey results are a primary consideration in deciding whether to offer the hunt and in setting quotas. Other uses of the moose survey data include informing Refuge responses to state proposed harvest regulations, addressing concerns regarding moose population size, and informing permits for air-taxi operators.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
Kanuti NWR supplies the bunkhouse for survey participants, as well as a survey crew (plane, pilot, and observer) and writes reports. ADF&G provides protocol, inputs data, and edits reports. BLM (Central Yukon Field Office) is involved annually, providing funding and sometimes an observer. NPS (Gates of the Arctic NP&P) is involved every fifth year conducting counts as part of larger spatial efforts (e.g., beyond GMU 24B). Piloting (and sometimes observers) is shared among Alaska interior Refuges at times. The contributions of the partners also vary with the annual budgets they are allotted.

5) Protocol status?

Kanuti NWR has completed a draft protocol ("initial survey instructions;" ISI) for this survey in the most recent template format but it has not been reviewed by I&M yet. The general survey method (i.e., Geospatial Population Estimator) is that used by many other agencies in Alaska that conduct winter moose surveys. Given the widespread use of the GSPE as a regional framework protocol, a Quick Review for completeness and applicability will be conducted by regional I&M staff. Kanuti's draft protocol includes all Kanuti-specific information necessary to implement such a framework protocol. Important references include:

1) Kanuti NWR initial survey instructions (Craig 2013a)

2) GSPE operations guide (Kellie and DeLong 2006)

3) GSPE software guide (Delong 2006)

4) Most recent Kanuti NWR survey report (Craig and Stout 2014)

5) Koyukuk River Moose Management Plan (Alaska Department of Fish and Game and the Koyukuk River Moose Hunters' Working Group 2001)

1.02: Molting Geese Monitoring (FF07RKAN00-007)

1) What is the population or attribute of interest, what will be measured, and when?
This aerial survey of molting Greater White-fronted ("white-fronts") and Canada Geese is essentially a census of flightless geese within the survey area at the time of the survey. The study area was originally selected to encompass all white-front breeding/molting habitats on the refuge as well as important molting areas just outside the refuge boundary (e.g., Lake Todatonten); later accommodations were made to better survey Canada Geese. We survey annually in early July. To reduce costs and increase efficiency, in more recent years the refuge has reduced its survey effort, concentrating on known molting "hot spots" rather than all available habitat. Adults and juveniles for both white-fronts and Canada Geese, as well as swans, are recorded in the survey.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.01= Understand boreal forest ecosystems
Objective 01.0.19 = Assist in monitoring mid-continent Greater White-fronted Goose population
Objective 03.0.32 = Work with stakeholders through regulatory processes to conserve fish and wildlife.

The overall management objective for the survey is to contribute to the regional picture of Alaska's boreal-nesting white-front population. These collective results are particularly important for better informing annual harvest regulations, as well as the Midcontinent Greater White-fronted Goose Management Plan (2005, most recent), all of which are made at the flyways (Pacific, Central, and Mississippi) level for this popularly hunted migratory species.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
The refuge's local importance as a nesting, brood-rearing, and molting area for white-fronts was recognized when the refuge was created under ANILCA, and conservation of this species and its habitats was explicitly noted as a purpose for establishment, as were migratory birds in general (e.g., Canada Geese). While this survey's results suggest that the population of molting white-fronts on the Refuge is relatively small (a few hundred birds), white-fronts (and Canada Geese) are a highly regarded and popularly hunted species by local village residents. Also, the two species contribute to ecosystem function as riparian herbivores and as prey for avian and mammalian predators.

This aerial molting goose survey was instituted largely in response to the decline of boreal-nesting white-fronts in Alaska in the 1990s. The original objective of the survey was to monitor white-front distribution and abundance on the refuge and contribute to the regional picture, but difficulties in interpreting survey results have been noted (e.g., local breeders versus molt migrants). Nevertheless, the survey presently represents the best option for annually monitoring 1) goose (primarily white-front) abundance and distribution on/near the refuge during the most conspicuous period (molt) of their seasonal stay, and 2) goose molting habitats. Results remain a desired element of MBM's annual status report for midcontinent white-fronts. Recent modifications have made it more efficient without sacrificing usable estimates of molting white-

front abundance and distribution on and near the refuge. A more extensive, less frequent effort (last done in 2016) should allow a) adequate monitoring of historical distribution and possible colonization of generally unused areas, and b) an assessment of potential changes in goose distribution outside our targeted hot-spots. If the Kanuti survey specifically, or regional surveys generally, showed a marked decline in birds observed again, the refuge would likely increase the annual effort level to look for possible shifts in distribution, especially that may relate to habitat changes. Local declines would likely lead to greater outreach in the villages to assess if local harvest pressure has increased.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
The suite of surveys targeting the monitoring of the mid-continent population (i.e., Alaska boreal breeders) of white-fronts has been organized under the auspices of R7's Migratory Bird Management Waterfowl Division. Kanuti, Koyukuk-Nowitna, Innoko, and Selawik NWRs all contribute to the regional monitoring effort.

Weather and staff permitting, Kanuti NWR's survey is funded and conducted by Kanuti staff (pilot, observer, airplane). The refuge writes an annual report that is incorporated into a regional annual report done by MBM. MBM also collates all stations' data and produces an annual regional report. Refuge provides a refuge-specific report.

5) Protocol status?

Kanuti NWR has a draft protocol ("initial survey instructions") for this survey in the most recent template format. It was reviewed informally by the I&M biometrician several years ago but has not been formally peer-reviewed as per the NWRS Inventory and Monitoring policy (FW702).

1) Kanuti NWR initial survey instructions (draft protocol) (Harwood 2013b)

2) Most recent Kanuti NWR survey report with 2009 Fischer MBM memo (Harwood 2016a)

1.03: Riparian Invasive Weeds Monitoring (FF07RKAN00-015)

1) What is the population or attribute of interest, what will be measured, and when?
The population of interest is occurrence of invasive plant species within or near Kanuti NWR. We will annually search for invasive plant species between mid-June and August along streams that cross the Dalton Highway Utility Corridor (DHUC) and flow onto Kanuti NWR. The riparian areas include: the Kanuti, South Fork Koyukuk and Jim Rivers; and Fish, Prospect, and Bonanza Creeks.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.08 = Survey non-native, invasive plant species.

The refuge management objective is to restrict the spread of invasive plants infesting the DHUC from reaching Kanuti NWR via waterways connecting the corridor and refuge. We use surveillance and site-specific removal to address this objective.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
At its nearest point, the Kanuti Refuge lies just 13 km miles west of the DHUC (BLM lands). At least six Koyukuk River tributaries cross this highway and later enter the Refuge. Kanuti Refuge is increasingly concerned that the waterways listed above could become routes for dispersal of invasive plants like white sweetclover (*Melilotus alba*) and bird vetch (*Vicia cracca*) onto the Refuge. White sweetclover readily invades open and disturbed areas, and has become established along rivers on open gravel bars in interior, south-central, and southeast Alaska in recent years. It has also rapidly colonized the DHUC near the Refuge, moving >120 miles northward between 2000 and 2010. In addition, bird vetch has been identified both within the DHUC and downriver on the Koyukuk River in recent years. The populations of these invasive plants are expanding.

The purpose of this monitoring project is to determine if any invasive species move down waterways near, or on to, the Refuge. If any invasive plants are found on the Refuge, or the waterways leading to the Refuge, their locations will be recorded via GPS, the plants pulled up by their roots and the material transported off Refuge for disposal. If an infestation is found that is too large to manually pull, a control plan will be developed to contain or eradicate the infestation.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
Since 2006, the Friends of Alaska NWRs and other volunteers have cooperated annually with Kanuti NWR, the Bureau of Land Management, the National Park Service, Alaska Department of Transportation, Alyeska Pipeline Service Company, and others to control, if not eradicate, white sweetclover and other non-native, invasive plants at key sites along the Dalton Highway. Control efforts have been focused on manual plant pulling near stream crossings and as of 2015 no invasive, non-native plants had been found on the Refuge.

5) Protocol status?

Kanuti NWR has a draft protocol ("initial survey instructions") that has been reviewed only by Refuge staff to date.

1) Kanuti NWR initial survey instructions (draft protocol)

2) BLM's Weed management plan/EA for DHC (BLM 2013)

1.04: Scoter/Scaup Breeding Pair Survey (FF07RKAN00-037)

1) What is the population or attribute of interest, what will be measured, and when?
The populations of interest are primarily Surf Scoters, White-winged Scoters, and "Scaup" (distinction between Greater and Lesser Scaup not possible from air), and secondarily loons (three species: Common, Pacific, Red-throated) and swans (no distinction between Trumpeter and Tundra). Annually in early June observers will count individuals, pairs, and flocked birds along aerial transects comprising waterfowl habitat on Kanuti NWR.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.23= Monitor migratory birds that demonstrate long-term declines
Objective 01.0.01= Understand boreal forest ecosystems
Objective 01.0.22 = replicate expanded aerial waterfowl breeding pair survey

The management objective is to conserve breeding populations of scaup and scoters on the Refuge. Survey results will contribute to informing regional harvest regulations and conservation concerns for three R7 "Priority Species," Lesser Scaup and White-winged Scoter (both Tier 1) and Surf Scoter (Tier 2).

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Scoters and scaup species are declining in North America. Traditional surveys to monitor ducks (e.g., Continental Breeding Pair Survey) have proven to be mistimed for these two taxa because they nest later than dabblers and other divers/seaducks. In order to better monitor them, a targeted survey timed for later in summer is required. Given the general declines exhibited and the enthusiasm expressed by Interior subsistence hunters for targeting these species, it is important to better monitor their trends. Kanuti NWR may even be important from a strategic point of view as its location may represent a transition in breeding grounds from eastern interior (e.g., Yukon Flats NWR) for Lesser Scaup to Greater Scaup and from White-winged Scoters to Surf Scoters. Any demonstrated declines in scoters and scaup on Kanuti NWR would be conveyed to Migratory Bird Management and the Alaska Migratory Bird Co-management Council for regulatory considerations. Declines would likely encourage greater outreach in the local villages to advocate for residents harvesting more abundant species (e.g., dabblers).

4) Is this a cooperative survey? If so, what partners are involved in the survey?
This survey was initiated by Yukon Flats NWR as an inventory of scoters, scaup, swans, and loons within recognized waterfowl breeding strongholds, including all interior Alaska refuges. Kanuti NWR has recognized a need to replicate the survey where possible to improve monitoring of these waterfowl species in decline to better inform harvest considerations.

5) Protocol status?

In order to conduct our 2015 survey, Kanuti NWR used methods detailed in Yukon Flats NWR's regional survey report (Guldager et al. 2016). We are evaluating whether to increase the number of transects flown on Kanuti NWR so site-specific instructions are pending.

1.05: Waterfowl Breeding Pair Survey (FF07RKAN00-004)

1) What is the population or attribute of interest, what will be measured, and when?
The populations of interest are those species of waterfowl and waterbirds (e.g., loons, grebes, gulls) detectable on wetlands from aerial transect surveys in late May to early June within 3 strata on/near Kanuti NWR: the refuge proper, "North Drainage," and "West" of the refuge. Observers measure single birds, pairs, and flocks for each species from which annual population indices and standard errors are calculated. Distribution and trends can also be determined. The survey occurs approximately every 10 years and optimally covers 2–3 consecutive years to capture interannual variation.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.22 = Replicate expanded aerial waterfowl breeding pair survey
Objective 01.0.23 = Monitor migratory birds that demonstrate long-term declines.

The main management objective is to maintain the abundance and distribution of breeding waterfowl on one of ANILCA's "duck refuges." This survey allows us to monitor this population to ensure the persistence of these species at historical levels.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Kanuti Refuge was largely established for its outstanding wetland resources and the waterfowl and waterbirds therein. Migratory waterfowl and waterbirds are explicit trust resources of the USFWS. In 1997, Migratory Bird Management (MBM) designed and conducted an "expanded" aerial survey (i.e., well beyond the coverage of two transects flown annually for the Continental Breeding Pair Survey) to obtain more precise baseline indices of waterfowl/waterbird abundance and distribution within and near the refuge. MBM largely replicated the 1997 survey in 2008–2010 (multiple years to capture interannual variability) to begin a long-term monitoring of waterfowl on/near the refuge. Survey results are compatible with other waterfowl surveys in the Interior to provide more regional trends and improve regional management, including subsistence harvest of these often targeted species.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
For the 2008–2010 set of surveys, MBM completed most aspects of the survey, including coordinating logistics for flying, piloting/data collection (MBM personnel only), data entry, analysis (both statistical and GIS), and report writing. Kanuti NWR has funded the data collection (flight hours and fuel used) and any MBM personnel overtime and/or hazard pay. MBM has covered their personnel's base salaries and travel costs.

5) Protocol status?
MBM has standardized protocols for aerial waterfowl surveys. The only aspect of the survey specific to Kanuti NWR is the flight lines that are flown. Those lines are depicted in their reports, and are archived by MBM. Kanuti NWR only funds the survey; design, planning, execution, analysis, and reporting of the survey(s) are completed by MBM.

1) MBM's aerial waterfowl survey protocol (USFWS/CWS 1987)

2) 1997 and 2008–2010 Kanuti NWR surveys reports (Platte 1999, Platte and Stehn 2011)

1.06: Trumpeter Swan Census (FF07RKAN00-016)

1) What is the population or attribute of interest, what will be measured, and when?
The primary population of interest is all white phase (>1 yr old) swan pairs (purportedly Trumpeter) that occupy "known or suspected Trumpeter Swan summer habitat" in Alaska (King 1973), and secondarily within the 14 USGS 1:63,360-scale quadrangles that largely encompass Kanuti NWR. For Kanuti NWR, we survey all swan habitats contained within these 14 quads: Bettles A-3 through A-6, B-3 through B-6, C-3 through C-6, and D-3 and D-4.

The population is censused in late August to early September. We consider the number of paired birds as the best indicator of Kanuti's breeding population. However, single, flocked, and total adults are counted, as well as the number of cygnets spotted. This population is surveyed every 5 years.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.01= Understand boreal forest ecosystems
Objective 01.0.20 = Assist Migratory Bird management (MBM) in statewide swan censuses

The management objective for the survey is to contribute to the regional picture of Alaska's boreal-nesting swan (presumably Trumpeter) population. Results from this survey could be used to determine if/when changes to hunting regulations for Trumpeter Swans (currently closed) are warranted, especially given the dramatic growth of Trumpeters during this survey's history.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
The management of Trumpeter Swans on Kanuti NWR is implicitly recognized in the first Refuge purpose under ANILCA: "…to conserve fish and wildlife populations and habitats in their natural diversity, including but not limited to white-fronted geese and *other waterfowl*…" [italics added]. The objectives of this survey are to provide an estimate of late summering swan (presumably mostly Trumpeter) pair abundance and distribution both within "interior" Alaska and on/near Kanuti NWR at 5-year intervals. The results are regionally used in part to assess the Trumpeter's Swan status as a restricted hunted species.

Like the burgeoning Interior-wide population, the nearly 300% increase in "swan" pairs on the Refuge between 1990 and 2010 (Harwood 2010), and the dramatic colonization/reoccupation of Trumpeters elsewhere in interior Alaska (Bryant et al. 2005) suggest that Kanuti NWR's 1989 ratio (60:40) of Trumpeter to Tundra Swans (Wilk 1993) may have become considerably more skewed toward Trumpeters since then. Survey results suggest that a study similar to that at Koyukuk NWR to determine our species composition of swans is needed. Documenting further expansion of this species' distribution north- and westward may also suggest changes in climate (e.g., longer ice-free nesting period) and/or habitat.

4) Is this a cooperative survey? If so, what partners are involved in the survey?

Yes, this is cooperative. The statewide effort is coordinated and primarily conducted by R7 Migratory Bird Management, Waterfowl Division; however, most interior Alaska refuges, parks, and other land managers are frequently active surveyors. Kanuti NWR has been and intends to remain an active participant, including surveying the refuge area, providing survey data to MBM for their regional status report, and writing a refuge-specific report.

5) Protocol status?

Kanuti NWR has a completed draft protocol ("initial survey instructions") for this survey in the most recent template format. It has been informally reviewed by Kanuti staff, but not formally peer-reviewed as per the NWRS I&M policy (701 FW2).

1) Kanuti NWR initial survey instructions (draft protocol) (Harwood 2012)
2) 2010 Kanuti NWR survey report (Harwood 2010)
3) Most recent regional report (Groves and Hodges 2013)

1.07: Wintering Caribou Monitoring (FF07RKAN00-022)

1) What is the population or attribute of interest, what will be measured, and when?
Although two small montane caribou herds are resident year-round near Kanuti NWR (i.e., the Ray Mountains and Hodzana Hills Caribou Herds), caribou do not usually occur on the Refuge, except when migratory herds arrive in the area during the winter. Caribou, primarily from the Western Arctic Herd (WACH), periodically migrate on to the Refuge during the late fall and remain throughout the winter, sometimes in large numbers.

In this survey, the population of interest is migratory caribou that occur in winter in and near the Lichen Protection Zone (LPZ), a 300-km^2 area in the center of the Refuge, where the fire management objective is to maintain terricolous ("reindeer") lichens. Surveying occurs within a 1,233-km^2 study area (SA), which includes the LPZ. The SA (~19% of the Refuge) contains three sampling strata that are based on fire history (includes the LPZ with no recent fire history). There are 90 sample units (blocks) within the SA. From the caribou observed in these sampled units, we can estimate caribou using the greater SA, as well as specifically assess caribou use of the LPZ relative to previously burned areas (non-LPZ). A single survey occurs in March in years that caribou migrate to and winter on the Refuge.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.14 = Document winter abundance and distribution of caribou
Objective 03.0.32 = Work with stakeholders through regulatory processes to conserve fish and wildlife
Objective 01.0.06 = Implement the refuge's Fire Management Plan

The survey's primary management objective is the conservation of caribou and their wintering habitat (e.g., old-growth lichens) on Kanuti NWR.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.

Kanuti's first ANILCA purpose included conservation of caribou and their habitat, and it directed that the Refuge would participate in ecological studies of the WACH. The act also mandated conservation of all wildlife populations in their "natural diversity." Drawing on this direction, Kanuti NWR's CCP (USFWS 2008) and Fire Management Plan (USFWS 2007) established as goals to 1) document winter abundance and distribution of caribou through monthly reconnaissance flights, and 2) provide increased fire protection for lichen habitat used as range by wintering caribou… in the central portion of the Refuge where there had been no recorded wildfires since 1942. The latter goal resulted in establishment of the LPZ. While these Refuge goals are both ostensibly aimed at protecting winter caribou habitat, they also address the Refuge goal of conserving natural diversity of old, open spruce forest that is underlain by lichens and associated biota. Another management goal of the Refuge is to provide an opportunity for sustained subsistence hunting by rural residents, including hunting of caribou. Prudent

management of caribou habitat requires information on the numbers and distribution of wintering animals when they are present on the Refuge.

One purpose of this survey is to determine if caribou use the LPZ in greater numbers than other areas. If there is no detectable, statistical, difference between caribou use inside and outside the LPZ, managers could elect to lift the protection zone and allow wildfire to consume the area, especially if wildfire-fighting resources were limited in a given year.

4) Is this a cooperative survey? If so, what partners are involved in the survey?

This can be accomplished by Refuge staff only. However, R7 I&M Biometrician Anna-Marie Benson helped design the survey and was an observer on the first survey.

5) Protocol status?
I&M Biometrician Benson and Kanuti's then lead Wildlife Biologist Tim Craig wrote a protocol using the Survey Protocol Handbook template. However, the protocol has not been peer-reviewed.

1) Kanuti NWR site-specific draft protocol (Craig 2013b)
2) Most recent survey report (Craig and Benson 2012)

1.08: Wolf Snow Track Aerial Survey (FF07RKAN00-017)

1) What is the population or attribute of interest, what will be measured, and when?
The population of interest is wolves on, and in the vicinity of, Kanuti NWR. A pilot (often contracted) with expertise in tracking wolves conducts a "Stephenson method" survey (Stephenson 1978) from which a minimum density of wolves (but no error measure) is estimated from tracks. Although more frequently done in the past, now the surveys are conducted every three years in March during years when weather and tracking conditions are appropriate; in some years such conditions are elusive. See item #5 under "Protocol Status" section for alternatively using results from ADF&G surveys.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.13 = Estimate the number of wolves on the refuge every 3 years
Objective 03.0.32 = Work with stakeholders through regulatory processes to conserve fish and wildlife

The management objective is to maintain wolves on Kanuti NWR in abundance, composition (e.g., pack size) and distribution commensurate with the documented historical range of variation to ensure this apex predator's proper function in the ecosystem, and Refuge specifically.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Kanuti NWR was established in part to "…conserve fish and wildlife populations in their natural diversity, including furbearers…" and to provide "the opportunity for continued subsistence by local residents." The Refuge is near several Alaskan communities and is an important hunting area for these rural communities. In addition to being a competitor for food and a source of fur for humans, wolves are a key species on the natural functioning of the Kanuti ecosystem.

The Service and/or their partners have conducted wolf density surveys intermittently on the Refuge since 2005 to gain a better understanding of wolf numbers and trends in the population at a much larger scale (e.g., Game Management Unit [GMU] 24B). ADF&G has a management objective of maintaining a *fall* wolf density of 13–23 wolves /1,000 mi^2 (Stout 2003) and 2008 survey results suggest that northern GMU 24 hosts 15–21 wolves/1,000 mi^2 (Stout 2009). Although Kanuti NWR has no specific wolf density as a management objective, our objective is to maintain the number of wolves on the Refuge within the historical range of variation per the first ANILCA purpose for the Refuge. Estimated *spring* densities (typically lower than fall) on Kanuti Refuge in 2001, 2005, 2006, and 2008 were about 14, 17, 28, and 18 wolves/1,000 mi^2, respectively (Saperstein 2006a; 2008).

The wolf population generally occupying federal lands within the Refuge (mostly the southeastern two-thirds) is currently being used as a "non-treatment" group for an intensive management (IM) project that ADF&G solely is conducting on non-federal lands in their "Upper Koyukuk Management Area" (UKMA; ADF&G 2012). The five-year project (2012–2017) entails culling all wolves in the UKMA, which includes private Native lands within the Kanuti

NWR border, mostly near the western boundary of the refuge. The State's objective is to research if culling wolves will increase moose hunting success for villagers in Allakaket. Given that the State's culling of wolves just outside, as well as legally within, the refuge boundary undoubtedly influences the population of wolves using federal lands within the refuge, it is especially important to continue this survey (be it the Refuge or ADF&G as actual surveyors) to track whether we are maintaining wolves in the Refuge per BIDEH. Post-IM wolf density in a study area that included the UKMA and Kanuti NWR in spring 2012 was 14 wolves/1,000 mi^2 (Stout 2012) and within the historical range.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
The cooperative history of this project has been variable. The Refuge itself last contracted for and had conditions to conduct the survey in 2008 (Saperstein 2008). To assess the effectiveness of their IM program, ADF&G has recently conducted wolf surveys (Hollis 2011, Stout 2012) compatible with the historical Refuge-specific efforts (e.g., Stephenson method, ADF&G survey area includes entire Refuge). This has obviated the Refuge paying for and/or conducting the survey in recent years. The Refuge can provide housing for survey participants in the Bettles Bunkhouse facilities for most years' survey efforts. However, we do <u>not</u> extend amenities for those surveys where wolves will be culled. For such IM-related efforts, we only serve as partners where the non-treatment study area is surveyed (i.e., areas where wolves are observed, but not killed).

ADF&G efforts are under the same limitations of adequate weather, tracking conditions, pilot availability, etc. as we are. Further, with State funding considerably low in 2016, Kanuti NWR may need to resume responsibility in conducting the survey, especially to assess if IM efforts have affected wolves on Refuge federal lands.

5) Protocol status?
Kanuti NWR has a draft protocol written that was created for an earlier regional IMP effort but it needs considerable revision. Important references for completing the protocol include:

1) 2006 draft protocol (Saperstein 2006b)
2) 2006 Kanuti survey report (Saperstein 2006a)
3) 2005 Wolf pack study (Maxwell 2005)
4) 2012 ADF&G wolf survey (Stout 2012)
5) Intensive management plan for GMU 24(B) (Alaska Department of Fish and Game 2012)

1.09: Kanuti River Breeding Bird Surveys (FF07RKAN00-018)

1) What is the population or attribute of interest, what will be measured, and when?
The population of interest is breeding landbirds (primarily) detected along two BBS routes conducted annually during the June breeding season on the Kanuti River. As the inference for the BBS is the continent (or Alaska), the sample unit is the route, composed of 50 count points (subsamples) distributed at 0.5-mi intervals. Number of individuals per species detected at each count point is the metric.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.18 = Contribute to continental, statewide, and bioregional monitoring efforts to establish trends in migratory landbird populations
Objective 01.0.01 = Understand boreal forest ecosystems.

The management objective for Kanuti NWR is to contribute to the continental BBS's objective where: "If significant declines [in landbirds] are detected, their causes can then be identified and appropriate actions taken to reverse them before populations reach critically low levels."

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
The data from the two routes are used in continental and Alaska landbird monitoring efforts. Refuge-specific ornithological benefits currently are largely confined to the refuge bird checklist program. Still, given that a) migratory birds are Trust species, b) comprehensive refuge-specific monitoring of landbirds would be prohibitively expensive, and c) Alaska's BBS program is the State's primary tool for landbird monitoring (i.e., the Alaska Landbird Monitoring Survey is a more recent complement to the BBS), participation in regional monitoring efforts is warranted.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
The Alaska Breeding Bird Survey program is coordinated by the landbird coordinator for R7 Migratory Bird Management. The data are co-analyzed by MBM and USGS-Alaska Science Center. The project is promoted by Boreal Partners in Flight and its many contributing partners. Results are submitted to the BBS coordinator for the USGS-Patuxent Research Center.

5) Protocol status?

Kanuti NWR has completed a draft site-specific protocol ("initial survey instructions") for this survey, but it has not been peer-reviewed yet. The more general BBS protocol for all surveyors is available on the BBS website: (https://www.pwrc.usgs.gov/bbs/participate/instructions.html)

1) Protocol for conducting Kanuti NWR's two BBS routes (Harwood 2013a)

1.10: Beaver Cache Survey (FF07RKAN00-020)

1) What is the population or attribute of interest, what will be measured, and when?
The population of interest is beavers on the Refuge. Beaver food caches are counted as a surrogate for the beaver population, using fixed-wing aerial surveys. The survey is conducted every five years in the fall after leaves have fallen from trees, but before ice-up.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.12 = Monitor the beaver population on the refuge.
Objective 03.0.32 = Work with stakeholders through regulatory processes to conserve fish and wildlife

The management objective is tracking the viable persistence of beavers as a keystone species for proper ecosystem function on the refuge.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Kanuti NWR's first ANILCA purpose includes conserving "fish and wildlife populations in their natural diversity, including…furbearers" and providing the "opportunity for continued subsistence by local residents." Beaver are an important subsistence resource throughout interior Alaska, both for food and fur. In addition to their economic and subsistence value, beaver are considered a "keystone species" because of their important ecological effects, including modifying plant communities influencing hydrologic processes. Beaver are also an important source of prey for large carnivores. Cache survey data from Kanuti Refuge are the only long-term data set for GMU 24B and are used by state and federal agencies to detect trends in the beaver population for the larger area. No lower threshold values have been established for the beaver population at the Refuge scale that would trigger a local management action. Because Kanuti Refuge is so remote, direct harvest by people probably does not influence the beaver population at the current trapping intensity, except perhaps near villages. Therefore, any changes in the beaver occupancy, as inferred from a large decline in caches, would likely reflect large-scale environmental changes, such as a warming or drying climate, or widespread disease.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
This is not a cooperative survey. However, the Refuge does use the same ADF&G software as used for our moose survey to analyze the beaver data.

5) Protocol status?

Kanuti NWR has completed a draft site-specific protocol in the most recent template format but it has not been peer-reviewed. The general survey method (i.e., GSPE) is that used by many other agencies in Alaska for winter moose surveys (see 1.01 Moose survey narrative).

1) Draft protocol (Craig 2011)

2) Recent survey report (Craig and Saperstein 2010)

1.11: Alaska Landbird Monitoring Survey (ALMS) (FF07RKAN00-019)

1) What is the population or attribute of interest, what will be measured, and when?
The population of interest is breeding landbirds occurring in more remote parts of Alaska, outside the road system. ALMS aspires to cover all five Bird Conservation Regions (BCR) within Alaska, and Alaska as a whole. Observers record detections of birds during 10-min sampling periods at plots comprising 20–25 count points. Observers also assess and record bird-habitat features associated with each point. Kanuti NWR has two plots (i.e., Chalatna ALMS and Lake Minnkokut) which are surveyed every 2 years between 5–25 June.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.18 = Contribute to continental, statewide, and bioregional monitoring efforts to establish trends in migratory landbird populations
Objective 01.0.01 = Understand boreal forest ecosystems

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Conservation of migratory landbirds is explicitly stated in Kanuti NWR's first refuge purpose, as they are USFWS trust species. Two plots are insufficient in power to serve as a Kanuti-specific monitoring tool and thus the Refuge views the project's value more in contributing to statewide and bioregional monitoring of landbirds and other species detected. ALMS was developed primarily to 1) monitor population trends of landbirds across the vast roadless areas of Alaska and 2) model the distribution and abundance of birds relative to habitat and other landscape features. The program was designed to complement the North American Breeding Bird Survey, which is biased in Alaska and inadequate to estimate population trends because of Alaska's sparse road system. ALMS was designed primarily to monitor passerines during the breeding season; however, these surveys also gather valuable data for other bird species.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
This is a cooperative statewide survey promoted by Boreal Partners in Flight, with major partners being USGS, USFWS, BLM, NPS, USFS, DoD, and State of Alaska. The USGS-Alaska Science Center (ASC) is responsible for the sampling design, field methods, analysis, and products. Contributing land management partners (e.g., refuges, forests, parks) often perform the actual data collection and entry.

Biennial surveying of the Refuge's two ALMS plots has been a collaboration among Kanuti NWR, a contracted local bird observatory, R7 Migratory Bird Management (MBM), USGS-ASC, and R7 I&M branch. Partner contributions have been in the form of funding, survey personnel, logistics, etc.

5) Protocol status?

Kanuti NWR has implemented this survey using the ALMS initial survey instructions (Handel and Cady 2004). A regional protocol is being developed by USGS using the FWS Survey Protocol Handbook guidance.

1) Statewide ALMS protocol (Handel and Cady 2004)

2) Site-specific protocol for Kanuti NWR (under development)

1.12: Snow Marker Survey (FF07RKAN00-009)

1) What is the population or attribute of interest, what will be measured, and when?
The attribute of interest is snow depth measured at six aerially observed markers on Kanuti NWR each year in December, February, March, April, and May. We typically record snow density at two of the sites in April and/or May annually, too.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.11 = Monitor snow depth and density
Objective 01.0.01 = Understand boreal forest ecosystems

The management objective is to contribute to regional snowpack monitoring which is used in hydrologically based 1) forecasting of spring flooding and fire severity, and 2) understanding of wildlife population dynamics and their habitats (e.g., overwinter ungulate mortality).

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Snow is the most salient feature of the landscape in Interior Alaska for up to 8 months of the year. Snow markers provide information on winter severity that is necessary to understand wildlife population trends and habitat use. Information is also valuable for monitoring long-term weather trends and hydrology that may be affected by climate change, as well as for predicting severity of fire seasons. Snow data are baseline information that aids in understanding ecosystem processes (e.g., forecasts for spring run-off and flooding), contributing at local, regional, and statewide scales.

No thresholds have been established for snow depth on Kanuti Refuge that would trigger a management response. Data generated by this project are used in concert with data collected watershed-wide to help managers make decisions at a large scale.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
These Refuge-funded data are provided to and managed by the USDA's Natural Resources Conservation Service in Palmer, Alaska. Other contributors include other refuges, parks, etc.

5) Protocol status?

Kanuti-specific initial survey instructions are available for our aerial survey markers. A paper version of the NRCS-published booklet for measuring snow density is stored in files in Fairbanks and Bettles.

1) Kanuti-specific aerial survey marker protocol (Harwood 2016b)

1.13: Raptor Stick Nest Survey (FF07RKAN00-032)

1) What is the population or attribute of interest, what will be measured, and when?
The attribute of interest is stick-nests on or near the refuge, and consequently the population of raptorial birds (e.g., eagles, hawks, owls, ravens), using them. The survey targets riparian forest in areas with the presumed highest density and most conspicuous nests. We document all stick-nests observed via aerial survey, including any occupancy of these nests at survey time. The survey occurs annually in May pre-leaf out, and optimally while snow is still on the ground and in the nests for maximum detectability.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.18 = Contribute to continental, statewide, and bioregional monitoring efforts to establish trends in migratory landbird populations;
Objective 01.0.01 = Understand boreal forest ecosystems.

The management objective is to maintain the connection of the refuge biologists and the resources and processes of the refuge, primarily stick nesting-raptors, but also the phenology of leaf-out, break-up, etc.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.

Eagles and other stick-nesting birds are of interest to the Service due to responsibilities under the Migratory Bird Treaty Act and their ecosystem roles as apex predators. Although not abundant on the Refuge, future management implication for this survey would be to identify locations of stick-nests, particularly those of eagles, that could help inform management decisions regarding future development on or near the refuge (e.g., siting of the proposed Ambler mining road through the refuge). Currently this survey is conducted to assess methods, feasibility, and possible products of this monitoring long-term on Kanuti NWR. The survey's timing bridges winter and summer work and provides much needed training. It is also a low cost opportunity for reconnaissance of natural resources at an important time in the refuge's annual cycle–arrival of early migratory birds like raptors, timing of leaf-out and break-up.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
The survey could contribute to regional monitoring of stick-nesting raptors which includes other Interior refuges (e.g., in 2015, stick nests surveys were conducted at Kanuti, Yukon Flats, Koyukuk, and Nowitna Refuges). Regional monitoring would require greater coordination than exists currently.

5) Protocol status?

Initial survey instructions for Kanuti NWR exist in form of methods written for prior years' surveys.

1) Most recent Kanuti NWR survey (has methods) (Craig and Dillard 2013)

1.14: Post-fire Vegetation and Bird Monitoring (FF07RKAN00-035)

1) What is the population or attribute of interest, what will be measured, and when?
The populations of interest are bird and plant communities at remote plots that burned in 2004 or 2005 within Kanuti NWR. These plots were first surveyed within 1–3 years post-fire in order to collect burn severity data using the Composite Burn Index and will be revisited in 10–15 year increments post-fire to document status of flora and avifauna. The June bird surveys (detections at count points) target primarily songbirds, while the July vegetation surveys target both vascular and non-vascular plants. Primary plant metrics include species composition (quadrats), percent cover and structure (point intercept), and tree/seedling counts by size class. Fuel loading (Brown's transects) and duff data collection were initiated during the second round of sampling.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.01 = Understand boreal forest ecosystems;
Objective 01.0.07 = Document fire history patterns on refuge;
Objective 01.0.15 = Long-term study of fire effects on small mammals and vegetation

The primary management objective is to better understand post-fire vegetation succession and avifaunal change to comply with BIDEH policy and our Fire Management Plan.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
This project documents changes in the avian and vegetation communities after extensive fires. In 2004 and 2005 over a quarter of the refuge burned. How animals and plants recover from this event can inform fire management decisions on the refuge and will increase our understanding of post-fire trajectories in interior Alaska under a changing climate. Vegetative recovery, which is strongly tied to pre-fire vegetation and burn severity, will influence not only use by wildlife but also the likelihood of a site burning again in the future as the composition, flammability, and quantity of fuels changes. Duff data provides an indication of the status of below ground carbon storage. If these plots re-burn in the future, it will increase our understanding of how habitats respond to repeat fires. Rather than providing information that will result in immediate changes in management, the value of this project lies in its role of helping us understand long-term seral trends, changes in fuels, and possible wildlife relationships given the expectation of increasing area burned in boreal and arctic regions.

We know of no other long-term investigations of the response of bird populations to fire that were initiated immediately after the fire and can be tied to a metric of burn severity. There are post-fire vegetation plots throughout Alaska that were surveyed using a variety of methods, but few included an objective method for documenting burn severity and most were not consistently revisited beyond the first couple of decades post-fire. Methods for this project were adapted from those used by the National Park Service in interior Alaska parks, thereby increasing the sample size within the state.

4) Is this a cooperative survey? If so, what partners are involved in the survey?

This project is coordinated by FWS's Regional Fire Ecologist in R7's Fire Program. In 2014–2016, Kanuti NWR staff completed bird surveys and assisted with the vegetation surveys. Additional field support was provided in 2014 by Arctic LCC (vegetation), Migratory Bird Management (birds), and volunteers. One of the study sites is also an Alaska Landbird Monitoring Survey (ALMS) study site, so birds and general vegetation trends will be monitored biannually with support from R7 I&M. In 2015 and 2016 Doyon regional Native corporation granted permission to camp on tribal lands.

5) Protocol status?

Initial survey instructions for the plant surveys exist in the form of methods developed for Denali National Park & Preserve and implemented in other parks within the Central Alaska Network of parks and preserves. Bird surveys follow Alaska Landbird Monitoring Survey protocol.

1) Initial survey instructions for vegetation sampling (Roland et al. 2004)

2) ISI for bird surveys (Handel and Cady 2004)

1.15: Stream Gage Monitoring (FF07RKAN00-036)

1) What is the population or attribute of interest, what will be measured, and when?

The attributes of interest are discharge, in cubic feet per second, and water temperature in the main stem Koyukuk River at Old Bettles. The gage collects measurements continuously at 15 minute intervals and is monitored throughout the year. This information is transmitted via satellite.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 02.0.27 = Monitor water quantity/quality conditions.

Our management objective is to participate in regional hydrological monitoring, especially for measuring stream flow.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
The gage provides a measure of flow volume (derived from water height) on a portion of the Koyukuk River that is commonly used for transportation between the villages of Bettles and Allakaket. This portion of the river is also used to access many tributaries leading into the Kanuti Refuge. The gage measures flow at a point upstream of the Refuge and will be used to document hydrological events that that impact the Refuge.

To date, the gage has captured five years of continuous flow record for the Koyukuk River and the Refuge. Continued operation will provide an extended stream flow record useful for monitoring changes in river phenology patterns (changes timing and magnitude of flow events over time), water temperature, and hydrologic response in a changing environment. Hydrologic datasets of >10 years are needed for statistically viable analysis due to the variability of flow over time. Such a dataset would provide the Refuge with a valuable tool monitoring change in streamflow that reflects the behavior of the Refuge's other stream systems. It would also contribute to long-term monitoring efforts within the Yukon River Drainage.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
R7 Water Resources Branch originally installed and monitored this gage; however, the continued operation of the gage is a partnership between the Kanuti NWR, The National Park Service (NPS), and the National Weather Service (NWS).

5) Protocol status?
Water Resources are providing Kanuti NWR, NPS, and NWS staff with training and a protocol for gage operation. Winter discharge measurement training was provided in March 2016. Open water measurement and gage operation procedural training were scheduled for May 2016.

1.16: Bird Phenology Monitoring (FF07RKAN00-013)

1) What is the population or attribute of interest, what will be measured, and when?
The population of interest is resident and migrant birds in the vicinity of Kanuti NWR's administrative cabin at Kanuti Lake. Annually, a cabin-based crew with sufficient bird surveying expertise would maintain daily occurrence checklists for all birds during spring migration and breeding (at least all May; preferably mid-April through June), with particular emphasis on observing first and peak arrival. Another possible effort is to replicate weekly point count surveys at both historical (e.g., a nearby bird plot surveyed for 7 weeks in 2014) and newly established routes/plots, representing several major habitats, during May and June. The crew would measure occupancy throughout these seven weeks to monitor timing of peak arrival and singing activity for those birds detected.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.18 = Contribute to continental, statewide, and bioregional monitoring efforts to establish trends in migratory landbird populations;
Objective 01.0.01 = Understand boreal forest ecosystems.

The management objective is to maintain the connection with the refuge biologists and the resources and processes of the refuge, primarily the monitoring of migratory birds and their phenology.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Supervisory Biologists recommended in 2011 that the newly implemented Inventory and Monitoring program develop a phenological monitoring strategy as a high priority for Alaska refuges due to the potential impacts of climate change to biotic resources. Among the reasons specified were: 1) changes in biotic phenology are one of the earliest indicators of climate change, 2) they are fundamental to the issues of climate change, 3) there is the potential for phenological or trophic mismatch, and 4) the data will help interpret other surveys (e.g., bird arrival dates and BBS).

The intended surveys expect to establish baseline timing information on breeding birds near Kanuti Cabin, a location where considerable refuge infrastructure and favorable logistics allow for more reliable long-term monitoring. Several weekly surveys will enable 1) documenting within-season variation of species detectability (e.g., peak singing activity) for passerines and shorebirds to help calibrate one-time surveys (e.g., BBS) at boreal latitudes, 2) a better assessment of peak arrival (vs. the nebulous "first arrival" data gathered heretofore), and an opportunity to pair the bird results with simultaneously gathered plant phenophase information (e.g., leaf-out, flowering). The inferences from this effort are admittedly local, but if eventually employed with other studies of this kind (i.e., "metareplication"), we should expect improved interpretation in traditional bird surveys like ALMS and BBS, as well as a basis for comparison in light of expected future climate change effects. Current funding and staffing at Kanuti precludes this investigation being replicated within the refuge itself and other survey and

personnel priorities may even preclude that such work be done annually at the Cabin. There is possibility for similar work in Bettles if staffing with sufficient expertise in surveying birds were available.

This survey would be done in conjunction with survey 1.17 to a) improve inference (i.e., tie bird timing/occupancy to timing of habitat conditions) and b) help defer costs for those surveys being done alone or separately.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
While not currently a cooperative survey, all results have been and will be furnished to R7 USFWS-MBM and USGS-ASC to possibly complement their current point count surveys, and calibration thereof.

5) Protocol status?

Initial survey instructions for weekly bird surveys follow ALMS protocols (Handel and Cady 2004). No instructions exist for documenting new arrivals. In the past arrival data were collected incidental to other work being done near cabin.

1.17: Plant Phenology Monitoring (FF07RKAN00-027)

1) What is the population or attribute of interest, what will be measured, and when?
The attributes of interest are the phenophases (e.g., leaf-out, flowering) of specific individual plants of select boreal species, especially those listed by the National Phenology Network as important for Alaska. These include quaking aspen, paper birch, and black spruce. Annually, specific phenophases would be assessed weekly between likely mid-April and mid-July (i.e., this was the maximum duration of a crew's stint at the cabin during 2008–2014). Sites, species, and individual plants were selected and monitored most recently in mid-April through June 2014.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.01 = Understand boreal forest ecosystems.

The management objective is to maintain the connection with the refuge biologists and the resources and processes of the refuge, specifically, the phenological monitoring of boreal plants.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
The R7 Supervisory Biologists recommended in 2011 that the newly implemented Inventory and Monitoring program develop a phenological monitoring strategy as a high priority for Alaska refuges due to the potential impacts of climate change to biotic resources. Among the reasons they specified were: 1) changes in biotic phenology are one of the earliest indicators of climate change, 2) they are fundamental to the issues of climate change, 3) and there is the potential for phenological or trophic mismatches.

The intended surveys will monitor the phenology of selected plants species of regional interest near Kanuti Cabin. The National Phenology Network (NPN) facilitates research focused on improving our understanding of the climate drivers of phenology, in addition to the phenological response of organisms to climate change. Initially the results will be used to improve refuge baseline monitoring of plant phenology and contribute to NPN's national database for more widespread application. Dedicated, consistent long-term monitoring will be necessary to accurately assess possible changes in phenology associated with climate change effects.

This survey would be done in conjunction with survey 1.16 to a) improve inference (i.e., tie bird timing/occupancy to timing of habitat conditions) and b) help defer costs for those surveys being done alone or separately.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
This is a cooperative study, the results of which will contribute to the National Phenology Network's national and regional (Alaska) monitoring efforts. Other refuges in Alaska also participate in NPN.

5) Protocol status?

Initial survey instructions for monitoring plant phenophases are derived from the National Phenology Network protocol. Locations of sites and individual plants monitored in 2014 are archived at Kanuti NWR.

1) NPN plant phenology monitoring methods (Denny et al. 2014) (plus its supplement)

1.18: Dragonfly Inventory (FF07RKAN00-008)

1) What is the population or attribute of interest, what will be measured, and when?
Species of odonates (dragonflies and damselflies) on Kanuti NWR will be collected to determine presence/absence during summers on an ad hoc basis.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.01 = Understand boreal forest ecosystems.

The refuge management objective is to continue to build a baseline assessment of dragonflies and damselflies at selected sites on the refuge to develop a more accurate checklist of odonate occurrence on the refuge.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
The first goal of the Refuge is "…to conserve fish and wildlife populations and habitats in their natural diversity…" to include dragonflies and damselflies. The distribution, habitat, and ecology of these insects are poorly understood in the state. Even basic information on odonate diversity in Alaska is lacking as new species are still being reported. A baseline inventory of these insects will inform our understanding of the current importance of the Refuge to this order of insects and may help to inform future management decisions. To conserve fauna, basic inventories must first be conducted.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
Past odonate surveys on Kanuti NWR have regularly included John Hudson of the Alaska Odonata Survey; Hudson is the author of Alaska's dragonfly guide. A 2008 survey included both Kanuti and Koyukuk-Nowitna NWRs.

5) Protocol status?
This inventory is sporadic and would best follow methods detailed in the 2008 survey (Hudson 2008). Kanuti NWR also has a general terrestrial invertebrate protocol to draw from Kruse (2003).

Expected Surveys

Surveys to be conducted provided additional expected capacity.

2.01: Salmon Run Inventory (FF07RKAN00-003)

1) What is the population or attribute of interest, what will be measured, and when?
The populations of interest are Summer Chum and Chinook Salmon that possibly spawn in seven streams on Kanuti NWR. The Fairbanks Fish and Wildlife Field Office, Branch of Fisheries and Habitat Restoration (FHRB), has suggested a suite of survey strategies to complement and improve upon earlier efforts (see #3 below). These include aerial surveys for enumerating the number of adult salmon, using ADF&G protocols (e.g., slow-flying aircraft) during early August through mid-September. Other methods include access via helicopter, motor boat, or raft (depending on stream access) for sampling of juveniles (to determine if successful spawning salmon are present) during early May through early June, via electrofishing, beach seining, dip nets, or minnow traps or sampling of adults during early August- mid-September using hook and line, carefully attended gill nets, beach seining, etc. Techniques and timing will depend on species of interest. Results will be entered into the Anadromous Waters Catalog (AWC) to refine previously reported life stages and distributions of salmon in these watersheds. The following streams would be sampled on Kanuti NWR: Kanuti-Kilolitna River, Fish Creek, Holonada Creek, Kodosin-Nolitna Creek, Nolitna Creek, Kanuti River and tributaries, and an unnamed creek that drains Tokusatatquaten Lake.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.10 = Map spawning areas of anadromous fish
Objective 03.0.32 =Work with stakeholders through regulatory processes to conserve fish and wildlife
Also addresses recommendation under "Water Rights" (pg 65) in Refuge's Water Resources Inventory and Assessment (USFWS 2017) = Document the presence of anadromous fish at various life stages in Refuge rivers, for addition to the AWC.

The main management objective is to identify spawning areas for salmon to protect them from possible development impacts outside the refuge.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
The Refuge is located near the villages of Allakaket, Alatna, and Bettles in north-central Interior Alaska. Salmon are an important subsistence resource for these villages. Within federal conservation units, continued subsistence use by rural residents of fish and wildlife resources and the conservation of those resources are mandated in ANILCA. In addition, Chinook and Chum Salmon from the Refuge contribute to the mixed stock subsistence and commercial fisheries occurring in the Yukon River drainage. Declines of Yukon River salmon stocks began in the late 1990s and led to harvest restrictions, complete fishery closures, and spawning escapements below management goals. The commercial, sport and subsistence fisheries value of salmon has led to a strong interest in identifying and protecting salmon spawn areas.

Confirmation of presence (or absence) of salmon in Kanuti's rivers and streams is highly warranted in light of Yukon Chinook and Chum Salmons' statuses as proposed Surrogate Species for the Northwest Boreal geography. Confirmation is especially desirable in those streams where R7's Water Resources Branch completed long-term water quality and quantity monitoring as part of the process to acquire State appropriative water rights, quantify existing Federal reserved water rights, and provide legal protection for an adequate water supply for refuge needs. We would like to take advantage of these abiotic stream data by conducting appropriate biotic surveys to identify the possible presence of spawning salmon in these river segments. Identification of previously unknown spawning areas within the refuge would help inform management of those grounds during the spawning period, including possible closures to boat traffic there, etc.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
This work would continue to be led by FHRB with Kanuti Refuge support as needed.

5) Protocol status?
No initial survey instructions have been developed. The field office developed for Kanuti NWR the aforementioned techniques available for sampling streams for salmon. Kanuti NWR would rely on FHRB to develop a full protocol that includes multiple sampling techniques.

References for developing a protocol include Carter (2010) and Legere (2011)

2.02: Bear Population Inventory (FF07RKAN00-033)

1) What is the population or attribute of interest, what will be measured, and when?
The main population of interest is black bears on the Refuge and the attribute would be a population estimate of black bear population on the refuge; ancillary information on the less common brown bears would be helpful. We have explored several methods of obtaining a population estimate, but the Refuge doesn't have the funding to conduct such a survey at this time. The best that we can do currently is to put out a camera trap grid to coarsely quantify occupancy of both black and brown bears across the Refuge. Determining occupancy will provide necessary background information until such a time that funding is available to estimate the black bear population. This preliminary "occupancy phase" of the study will provide seasonal distribution data of bears across the refuge and allow us to map potential bear hotspots. The data collected will allow us to measure bear use across the refuge throughout the period that they are out of the den. The method will also allow us to collect ancillary information on other species detected throughout the year, including moose, lynx, wolf, wolverine, etc.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.16 = Investigate and assess the feasibility of conducting surveys to index bear abundance in select refuge locations.
Objective 01.0.01 = Understand boreal forest ecosystems

The management objective is to maintain a black bear population on the refuge that is within the range of natural variation, thereby informing sound harvest management.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Pilot camera trap work suggests possibly high black bear numbers on the refuge (i.e., bears are abundant at least where cameras were deployed). Traditional ecological knowledge suggests that black bear population are one of the most stable populations of any of the Refuge's mammals (Nelson et al. 1982) As observed on Yukon Flats (Bertram and Vivion 2002) and near Galena (Osborne et al. 1991), high numbers of black bears may have high predation rates on moose calves. Moose are also the most important terrestrial subsistence species for people in the local villages. We currently lack data to substantiate or refute the idea that bears are negatively impacting the moose population. These data have been a need for the refuge since some of the first refuge reports were written on the interactions of moose and their predators in the 1980s. Given ADF&G's ongoing wolf control project both within and around the Refuge, determining if the Refuge bear population is of sufficient abundance/density to possibly curb moose calf survival is critical in light of ADF&G's premise that wolves are limiting the moose population. Hands-on management of the bear population would be difficult on the Refuge, but hunter harvest might be influenced by publicizing bear numbers and areas of concentration if limiting the size of the population became an objective.

4) Is this a cooperative survey? If so, what partners are involved in the survey?

This is not a cooperative survey at this time, although many entities (e.g., BLM, NPS, ADF&G, local villages/tribes) would be very interested in our results and may show some interest in collaboration if we are able to develop a feasible technique. We are not currently at a stage in project development to approach collaborations.

5) Protocol status?
No initial survey instructions have been developed. The project is still being designed by Refuge staff, with assistance from the I&M biometrician.

2.03: Waterfowl Brood Production Survey (FF07RKAN00-031)

1) What is the population or attribute of interest, what will be measured, and when?
The population of interest is duckling total abundance on Kanuti NWR. We will be measuring the occupancy of waterfowl/waterbird broods on sampled waterbodies in the refuge, as well as a suite of habitat covariates (e.g., emergent vegetation, water level). This survey will occur in mid- to late July to coincide with peak scaup and scoter hatch.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.25 = Design and implement a long-term waterfowl and waterbird production survey of the refuge.
Objective 01.0.23 = Monitor migratory birds that demonstrate long-term declines.

The management objective is to document the status and trends of waterfowl production on this "duck refuge." We also will contribute to regional assessments of production for long-term harvest considerations.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Despite the fact that Kanuti NWR was largely established through ANILCA for being a "duck refuge," production of waterfowl and waterbirds on the refuge has not been investigated since 1993. Waterfowl and waterbird production may serve in part as bio indicators of ecosystem health, especially in light of potential threats such as drying wetlands and other factors associated with climate change.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
Yes. We would mirror the same survey being done on Yukon Flats NWR (FF07RYKF00-029) and our results could be compared to theirs for a more regional perspective. In the past R7 Migratory Bird Management has coordinated statewide duck brood production surveys so they would likely be of assistance.

5) Protocol status?
Yukon Flats has produced a draft protocol for this survey type and plans to submit this draft for an I&M-sponsored review. Kanuti NWR would adapt this protocol for our area.

2.04: Traditional Ecological Knowledge (FF07RKAN00-028)

1) What is the population or attribute of interest, what will be measured, and when?
The populations of interests are traditionally harvested species on/near Kanuti NWR, including the following taxa: moose, caribou, wolves, bears, furbearers, waterfowl, fish (primarily salmon and whitefish species), and berry-producing plants. Assessment of historical take of these taxa will be through interviews of local village experts in the form of a standardized questionnaire. In this procedure, each interviewee is equivalent to a sample unit in conventional biological studies. Each question is analogous to a variable in social research. Responses from the standardized questions can be used qualitatively, or quantitatively, if a sufficient number of interviewees are available.

Oral history interview timing is mainly dictated by availability of interviewer and interviewee. Generally interviewees want to avoid busy subsistence times (salmon fishing, moose hunting, trapping), or holidays. In the Koyukon region we have found April, August, and October to be the easiest months to schedule interviews.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 03.0.33 = Partner with local residents to review historical subsistence use data
Objective 01.0.10 = Map spawning areas of anadromous fish
Objective 01.0.01 = Understand boreal forest ecosystems.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
ANILCA required that "The Secretary [of the Interior or Agriculture], in cooperation with State and other appropriate federal agencies, shall undertake research on fish and wildlife subsistence uses on public lands; seek data from, consult with, and make use of, the special knowledge of local residents engaged in subsistence uses; and make the results of such studies available to the State, the local and regional councils..." (ANILCA Sec. 812).

In the Koyukon Region, long-time rural residents possess considerable knowledge about wildlife and fish species that traditionally have been used for subsistence (Clark 1974;1981, Nelson 1983). Elders living in the region who were born as late as the 1930s are among the last generation of people who totally relied on subsistence resources for a living. It is this generation, with both recent and 50–60-year-old subsistence experience, that provides a valuable relative comparison. Members of this generation who once relied on subsistence, but still continue to at least partially subsist off the land, have a keen sense of relative abundance of key resource species based on difficulty in catching or time required to fill a bag. Their descriptions of changes in animal relative abundance, and amount of effort and techniques required to harvest them, may provide the only indication of long-term species trends which predate the period when quantitative biological surveys began (usually the 1970s or 1980s). Furthermore, it is critical to gather these oral histories before these key sources of knowledge are unable to provide it.

The purposes of this procedure are to: (1) develop a baseline of qualitative abundance and habitat descriptions for key subsistence resources which includes the time period before scientific monitoring was initiated; and (2) provide a formal, standardized, basis for the inclusion of traditional environmental knowledge into resource monitoring and management efforts. The intent is to complement the western scientific approach to research with the qualitative information available from oral history interviews of local experts. The goal for the oral history subsistence documentation project is to obtain interviews with experts from each of the Native villages on or near the Kanuti NWR (Allakaket, Alatna, and Evansville).

4) Is this a cooperative survey? If so, what partners are involved in the survey?
Yes. We would require the cooperation of the Tribes and/or village corporations, as well as possibly a contractor to conduct the interviews, if more appropriate.

5) Protocol status?

Kanuti NWR has very complete protocol that could serve as "initial survey instructions." The protocol was created over 10 years ago for Koyukuk-Nowitna NWR. It is not in current format and it would have to be updated and peer-reviewed.

2.05: Furbearer Winter Track Survey (FF07RKAN00-030)

1) What is the population or attribute of interest, what will be measured, and when?
Track surveys would be conducted by snowmachine throughout the Refuge during the winter to estimate relative density and occurrence of red fox, marten, lynx, wolverine, ermine, and wolves. Surveys could be conducted any time throughout the winter after a fresh snowfall.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.17 = Monitoring distribution/ abundance of snowshoe hares and furbearers;
Objective 03.0.32 = Work with stakeholders through regulatory processes to conserve fish and wildlife.

This project's management objective is to develop a better understanding of the boreal forest, and ensuring that the refuge supports healthy furbearer populations for ecosystem function and subsistence needs.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
The first goal in the Kanuti NWR CCP is "…to conserve fish and wildlife populations and habitats in their natural diversity including, but not limited to… furbearers." Furbearers represent part of the natural diversity within the refuge and have economic and cultural importance to both rural and other Alaskan trappers. Fox, marten, lynx, snowshoe hares, wolverine, ermine, and wolves are regularly trapped on Kanuti Refuge. The purpose of the survey is to estimate occupancy rates and distribution of furbearers across the Refuge, in both trapped and non-trapped areas. The data will provide baseline population information about furbearers in both areas. Trends in occupancy rates of furbearers could be used to evaluate whether further life history studies are required to understand community dynamics in this region and will help managers understand population dynamics of furbearers over time. The results will provide foundation data to allow adjustments in trapping regulations on the Refuge.

4) Is this a cooperative survey? If so, what partners are involved in the survey?

The actual survey is not cooperative but we hope to improve our tracking proficiency by training in the field with an expert Allakaket trapper.

5) Protocol status?
A protocol is currently under development and will most likely follow a spatial/temporal occupancy model approach used by Whittington et al. (2015).

2.06: Swan Composition Monitoring (FF07RKAN00-034)

1) What is the population or attribute of interest, what will be measured, and when?
The populations of interest are the relative numbers of Trumpeter and Tundra Swans breeding on Kanuti NWR, especially relative to their abundance, distribution, and proportions in 1991. We will use breeding pairs during incubation (mid-June) as the metric; this will likely require random sampling of nesting swan pairs to determine species.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.21 = Determine current species composition of swans

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Currently all swans observed during the 5-year swan census are considered Trumpeter Swans. During a 1991 survey on Kanuti NWR (Wilk 1993), the proportions were about half and half on the refuge. A recent determination of swan composition for the Koyukuk and Nowitna Refuges to the west suggested that the proportion of Trumpeter Swans there had dramatically increased (Bryant et al. 2005). We would like to confirm if our swan species proportions have stayed the same or skewed toward Trumpeters as in other areas, especially in light of the population increase we have observed (Harwood 2011). Given that the statewide Trumpeter Swan census purports that the species is showing geometric growth (Groves and Hodges 2013), confirmation of that assumption has become a higher priority for R7 Migratory Bird Management (MBM). These survey results may also suggest a displacement of Tundra Swans in Interior Alaska at the expense of an expanding Trumpeter population. Further, a growing Trumpeter Swan population might eventually lead to legalizing hunting of Trumpeter Swans.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
We would minimally seek the expertise of Koyukuk-Nowitna NWRs' staff for their past efforts addressing this question. We would also expect to work with MBM and I&M on sampling design and operations.

5) Protocol status?
If the above "partners" thought it were still an appropriate approach, we could adopt the survey methods used by Koyukuk-Nowitna NWR. However, more recent discussions with MBM suggest that a different method might need to be developed and implemented for Kanuti NWR and other areas.

2.07: Nesting Owl Monitoring (FF07RKAN00-023)

1) What is the population or attribute of interest, what will be measured, and when?
The population of interest includes all owls nesting along the winter trail between Bettles and Allakaket. Annual owl species occurrence and density will be measured at each listening post along the route and a population trend will be determined. Listening posts will be located along this trail, from the northern boundary of the Refuge (mile = 0) to approximately mile 10 on the trail and will be visited in late winter (March–April). Ideally additional routes originating from Bettles and Kanuti Lake Cabin would be added later.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.01= Understand boreal forest ecosystems.
Objective 01.0.23 = Monitor migratory birds that demonstrate long-term declines.

The objective is to survey owl populations to develop a better understanding of their role in the boreal forest ecosystem, while monitoring for major changes in populations. We also want to document possible changes in owl populations as habitats change due to frequent fires and other climate change impacts.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
There is no evidence that owl populations on or around the Refuge have been affected by anthropogenic activities, and no habitat changes caused by direct human activity are expected there in the future. However, models of vegetation change for interior Alaska indicate that by 2100, boreal habitat may decline greatly, and be replaced by montane cordillera and boreal transition habitats (Chapin III et al. 2006), currently occurring well south of the Refuge. Such vegetational changes would undoubtedly affect habitat for and densities of owls. Further, migratory birds, which includes these owls (50 CFR §10.13), are an explicit trust species of the USFWS. Owls are high tropic-level predators and may serve as indicator species of ecological changes or "barometers" of significant impacts in the ecosystem. Four species of owls are known to breed in late winter/early spring within Kanuti NWR, but little information exists to determine their population status or trends. Over time, this study will provide a relative density index of the owl species present and their density along the Bettles-Allakaket winter trail. Greater inference would be gained with additional transects.

4) Is this a cooperative survey? If so, what partners are involved in the survey?

No, this would be likely be carried out by Kanuti NWR staff only.

5) Protocol status?

No initial survey instructions have been developed yet. Like owl surveys done in southeast Alaska (Kissling and Lewis 2009), we would likely follow the guidelines of Takats et al. (2001), which included listening bouts following broadcast calls.

2.08: Snowshoe Hare Monitoring (FF07RKAN00-024)

1) What is the population or attribute of interest, what will be measured, and when?
The populations of interest are snowshoe hares occurring in the Kanuti and Koyukuk River corridors. Annual hare densities will be estimated from pellet counts at transects extending from the Koyukuk and Kanuti Rivers during June/July. We will also try to develop an index of hare abundance from the winter track survey (see survey 2.05). These data will be used to monitor population trends.

2) Which refuge management objective does the survey support? Is the objective derived from the CCP, interim objectives, an HMP, or other?
CCP:
Objective 01.0.17 = Monitoring distribution/ abundance of snowshoe hares and furbearers
Objective 01.0.01= Understand boreal forest ecosystems.

The management objective is to learn more about the role of snowshoe hares in the refuge ecosystem, and to determine annual population fluctuations in snowshoe hares populations on the Kanuti and Koyukuk River corridors within the Refuge to better inform furbearer harvest regulations.

3) Why is it important to conduct the survey? Describe how survey results will be used to make better informed refuge management decisions. If survey results are used to trigger a management response, identify the management response and threshold value for comparison to survey results.
Snowshoe hares are a keystone species in the boreal ecosystem. Typically the dominant herbivore in boreal forests, hares are an important prey item for a wide variety of terrestrial and avian predators and hare densities can greatly influence production and recruitment of those populations. Hare densities are also positively correlated with other species such as Spruce Grouse, Willow Ptarmigan and arctic ground squirrel. Great-horned Owl and Northern Goshawk production and densities are also strongly influenced by hare density. Other species such as wolves, red fox, and marten may be less dependent on hares, but their use of hares likely increases during cyclic highs. Finally, hares can have significant impacts on vegetation during portions of their cycle, and may affect plant survival and composition on a local level. Changes in hare population indices will be used by Refuge management when reviewing proposals related to furbearer regulations. Data generated by this project will help managers understand changes in population levels in other species for which they have management responsibility under ANILCA.

4) Is this a cooperative survey? If so, what partners are involved in the survey?
While this local survey would be likely be carried out by Kanuti NWR staff only, multiple entities, including Tetlin NWR, Gates of the Arctic NPP, and University of Alaska Fairbanks, follow the same protocol. Kanuti's results could potentially contribute to a regional picture of hares.

5) Protocol status?
Initial survey instructions are derived from methods used by Tetlin NWR (Collins et al. 2004). These methods largely follow Krebs (1987, 2001). A site-specific protocol is not currently written.

V. References

Alaska Department of Fish and Game. 2012. Operational plan for intensive management of moose in Game Management Unit 24(B) during regulatory years 2012–2017. Alaska Department of Fish and Game, Divsion of Wildlife Conservation. Fairbanks, Alaska.

Alaska Department of Fish and Game and the Koyukuk River Moose Hunters' Working Group. 2001. Koyukuk River moose management plan 2000–2005.

Bertram, M. R., and M. T. Vivion. 2002. Moose mortality in eastern interior Alaska. Journal of Wildlife Management 66:747–756.

Brown, R. J. 2009. Distributions and demographics of whitefish species in the Upper Koyukuk river drainage, Alaska, with emphasis on seasonal migrations and important habitats of broad whitefish and humpback whitefish. Alaska Fisheries Technical Report Number 104, U.S. Fish and Wildlife Service, Fairbanks, AK.

Bryant, J. M., S. B. D, and M. R. Hans. 2005. Sympatric nesting range of Trumpeter and Tundra Swans on the Koyukuk National Wildlife Refuge in northwest interior Alaska. Unpublished USFWS report, Koyukuk/Nowitna National Wildlife Refuge Complex, Galena, Alaska.

Bureau of Land Management (BLM). 2013. Dalton Management Area integrated invasive plant strategic plan: Environmental Assessment, May 2013; EA Number: DOI-BLM-AK-03000-2010-0051-EA, Invasive Plants Management Strategy, Project Location: Central Yukon Field Office (CYFO), Dalton Highway Corridor Management Area (DHCMA), Alaska. Bureau of Land Management, Central Yukon Field Office, Fairbanks, Alaska.

Carter, B. 2010. Kanuti National Wildlife Refuge salmon survey. Unpubl. report. USFWS Fairbanks Fish and Wildlife Field Office, Fisheries and Habitat Restoration Branch, Fairbanks.

Chapin III, F. S., M. W. Oswood, K. Van Cleve, L. A. Viereck, and D. L. Verbyla. 2006. Alaska's changing boreal forest. Oxford University Press, New York.

Clark, A. M. 1974. Koyukuk River Culture. Canadian Ethnol. Serv., Ottawa.

_____. 1981. Koyukon. Pages 582–601 *in* J. Helm, editor. Handbook of North American Indians: Subarctic. Smithsonian Institution Press, Washinton D.C.

Collins, G. H., H. K. Timm, and W. N. Johnson. 2004. Snowshoe hare pellet counts, Tetlin National Wildlife Refuge, eastern Alaska. U.S. Fish and Wildlife Service.

Craig, T. 2011. Site-specific protocol for beaver food cache monitoring. Kanuti National Wildlife Refuge, U.S. Fish and Wildlife Service, Fairbanks, AK. Report Protocol FF07RKAN00002M2008.

_____. 2013a. Site-specific protocol for monitoring moose abundance and composition for Kanuti National Wildlife Refuge. Kanuti National Wildlife Refuge, U.S. Fish and Wildlife Service, Fairbanks, AK.

_____. 2013b. Site-specific protocol for monitoring the relative abundance and distribution of, and habitat selection by, caribou in and near the lichen protection zone. Kanuti National Wildlife Refuge, U.S. Fish and Wildlife Service, Fairbanks, AK.

Craig, T., and A.-M. Benson. 2012. Caribou and the Kanuti National Wildlife Refuge Lichen Protection Zone — 2012. U.S. Fish and Wildlife Service unpublished report, Kanuti National Wildlife Refuge, Fairbanks, AK.

Craig, T., and L. Dillard. 2013. Aerial raptor stick nest survey — Spring 2013. Unpubl. report. USFWS, Kanuti NWR, Fairbanks, AK.

Craig, T., and L. Saperstein. 2010. Beaver cache surveys on the Kanuti National Wildlife Refuge. Unpubl. report, U.S. Fish and Wildlife Service, Kanuti NWR, Fairbanks, AK.

Craig, T., and G. W. Stout. 2014. Aerial moose survey on and around Kanuti National Wildlife Refuge, November 2013. Unpublished report. Kanuti National Wildlife Refuge, U.S. Fish and Wildlife Service, Fairbanks, AK.

Delong, R. A. 2006. Geospatial population estimator software user's guide. Alaska Department of Fish and Game, Fairbanks, AK.

Denny, E. G., K. L. Gerst, A. J. Miller-Rushing, G. L. Tierney, T. M. Crimmins, C. A. F. Enquist, P. Guertin, A. H. Rosemartin, M. D. Schwartz, K. A. Thomas, and J. F. Weltzin. 2014. Standardized phenology monitoring methods to track plant and animal activity for science and resource management applications. International Journal of Biometeorology 58:591-601.

Glesne, R. S., W. K. Carter, and D. W. Daum. 2011. Lake habitat and fish surveys on interior Alaska National Wildlife Refuges, 1984–1986. Alaska Fisheries Data Series Number 2011–2012, U.S. Fish and Wildlife Service, Fairbanks, AK.

Groves, D. J., and J. I. Hodges. 2013. A survey of Trumpeter Swans on Alaskan summering habitats, 2010. Unpublished report, U.S. Fish and Wildlife Service, Migratory Bird Management, Waterfowl Management Branch, Juneau, AK.

Guldager, N., M. R. Bertram, and B. Lake. 2016. Aerial scoter and scaup monitoring survey of the Yukon Flats National Wildlife Refuge (NWR), and expanded survey of Tetlin, Kanuti, Koyukuk and Nowitna NWRs, Minto Flats State Game Refuge, and lake areas south of Tanana village, Alaska – 2014 and 2015. Unpubl. report. USFWS, Yukon Flats National Wildlife Refuge Report – 2016-001, Fairbanks, AK.

Handel, C. M., and M. N. Cady. 2004. Alaska landbird monitoring survey: protocol for setting up and conducting point count surveys. USGS Alaska Science Center, Anchorage, AK.

Harwood, C. M. 2010. Trumpeter Swan survey, Kanuti National Wildlife Refuge,August - September 2010: Kanuti NWR Progress Report FY11. U.S. Fish and Wildlife Service, Kanuti NWR, Fairbanks, AK.

_____. 2012. Draft protocol: Trumpeter Swan survey — aerial Census. Kanuti National Wildlife Refuge, Fairbanks, AK.

_____. 2013a. Site-specific protocol for inventory and monitoring of landbirds along two Breeding Bird Survey routes. Kanuti National Wildlife Refuge, U.S. Fish and Wildlife Service, Fairbanks, AK.

_____. 2013b. Site-specific protocol for monitoring of molting Greater White-fronted Geese, Kanuti National Wildlife Refuge. Kanuti National Wildlife Refuge, Fairbanks, AK.

_____. 2016a. Aerial surveys of molting geese on Kanuti National Wildlife Refuge, July 2015: Kanuti NWR Progress Report FY15. U.S. Fish and Wildlife Service, Kanuti NWR, Fairbanks, AK.

_____. 2016b. Instructions for measuring snow depth at aerial markers. Draft protocol, U.S. Fish and Wildlife Service, Kanuti NWR, Fairbanks, AK.

Heglund, P. J., L. B. Saperstein, and E. J. Taylor. 2005. Kanuti National Wildlife Refuge biological program review. Final report. September 1, 2005. Anchorage, AK.

Hollis, T. 2011. Unit 24 wolf survey, March 2011. Unpubl. report, Alaska Department of Fish and Game, Division of Wildlife Conservation, Fairbanks, AK.

Hudson, J. 2008. Results of odonate collecting in central Alaska, summer 2008: An effort to expand knowledge of dragonfly and damselfly species diversity and distribution in Alaska. USFWS Challenge Cost-Share Agreement 70181-8-J530.

Julianus, E.L. 2016. Moose (*Alces alces*) browse availability and use in response to post-fire succession on Kanuti National Wildlife Refuge, Alaska. Master's thesis. University of Alaska Fairbanks, Fairbanks, AK.

Kellie, K. A., and R. A. DeLong. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game, Fairbanks, AK.

King, J. G. 1973. The use of small airplanes to gather swan data in Alaska. Wildfowl 24:15–20.

Kissling, M. L, and S. B. Lewis. 2009. Distribution, abundance, and ecology of forest owls in Southeast Alaska. U.S. Fish and Wildlife Service, Juneau Field Office, Alaska, and Alaska Department of Fish and Game, Division of Wildlife Conservation, Douglas, Alaska.

Krebs, C. J., R. Boonstra, V. Nams, M. O'Donoghue, K. E. Hodges, and S. Boutin. 2001. Estimating snowshoe hare population density from pellet plots: a further evaluation. Canadian Journal of Zoology 79:1–4.

Krebs, C. J., B. S. Gilbert, S. Boutin, and R. Boonstra. 1987. Estimation of snowshoe hare population density from turd transects. Canadian Journal of Zoology 65:565–567.

Kruse, J. J. 2003. Insect sampling and monitoring. Kanuti National Wildlife Refuge, Final Report FY03-01.

Legere, N. 2011. Kanuti National Wildlife Refuge salmon survey. Unpubl. report. USFWS Fairbanks Fish and Wildlife Field Office, Fisheries and Habitat Restoration Branch, Fairbanks.

Maxwell, M. M. 2005. Wolf studies on Kanuti National Wildlife Refuge, Alaska. Unpubl. report. U.S. Fish and Wildlife Service, Kanuti NWR, Fairbanks, AK.

Nelson, R. K. 1983. Make prayers to the raven. University of Chicago Press, Chicago.

Nelson, R. K., K. H. Mautner, and G. R. Bane. 1982. Tracks in the wildland: a portrayal of Koyukon and Nunamiut Subsistence. Anthropology and Historic Preservation, Cooperative Park Studies Unit, University of Alaska, Fairbanks.

Osborne, T. O., T. F. Paragi, J. L. Bodkin, A. J. Loranger, and W. N. Johnson. 1991. Extent, cause, and timing of moose calf mortality in western Interior Alaska. Alces 27:24–30.

Paragi, T., C. Seaton, and K. Kellie. 2008. Identifying and evaluating techniques for wildlife habitat management in Interior Alaska: moose range assessment. Alaska Department of Fish and Game, Division of Wildlife Conservation. Report Federal Aid in Wildlife Restoration, Grants W-33-4 through W-33-7, Project 5.10.

Platte, R., and R. Stehn. 2011. Aerial survey of waterbirds on Kanuti National Wildlife Refuge and adjacent wetlands. Migratory Bird Management, U.S. Fish and Wildlife Service, Anchorage, AK.

Platte, R. M. 1999. Water bird abundance and distribution on Koyukuk and Kanuti National Wildlife Refuges and adjacent wetlands, Alaska, 1996–1997. U.S. Fish & Wildlife Service.

Rexstad, E. 2003. Small mammal community dynamics investigation for Mouse Lake, Kanuti National Wildlife Refuge 1993–2002. Fairbanks, AK.

Roland, C. A., K. Oakley, E. M. Debevec, and T. Loomis. 2004. Monitoring vegetation structure and composition at multiple scales in the Central Alaska Network. NPS Technical Report CAKN-001. National Park Service, Fairbanks, Alaska, USA. Available from: https://irma.nps.gov/App/Reference/DownloadDigitalFile?code=456508&file=CAKN_Vegetation.zip.

Saperstein, L. 2006a. 2006 Wolf Survey Results, March 14–18. Unpubl. report, U.S. Fish and Wildlife Service,Kanuti NWR, Fairbanks, AK.

_____. 2006b. Wolf inventory and monitoring survey protocol (draft). Unpubl. report, U.S. Fish and Wildlife Service, Kanuti NWR, Fairbanks, AK.

_____. 2008. 2008 Wolf Survey (Excerpted from Western Interior Regional Advisory Council briefing book, fall 2008 meeting). USFWS unpubl. memo, Kanuti NWR, Fairbanks, AK.

Stephenson, R. O. 1978. Characteristics of exploited wolf populations. Alaska Department of Fish and Game Final Report, Federal Aid in Wildlife Restoration. Projects W-17-3 through W-17-8, Job 14.3R, Juneau, AK.

Stout, G. 2012. Unit 24B Wolf Survey, 22–26 March 2012. Unpubl. report, Alaska Department of Fish and Game, Division of Wildlife Conservation, Fairbanks, AK.

Stout, G. W. 2003. Unit 24 wolf management report. *in* C. Healy, editor. Wolf management report of survey and inventory activities 1 July 1999–30 June 2002. Alaska Department of Fish and Game, Juneau, AK.

_____. 2009. Unit 24 wolf. Pages 237–247 *in* P. Harper, editor. Wolf management report of survey and inventory activities 1 July 2005–30 June 2008. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska, USA.

Takats, D. L., C. M. Francis, G. L. Holroyd, J. R. Duncan, K. M. Mazur, R. J. Cannings, W. Harris, and D. Holt. 2001. Guidelines for nocturnal owl monitoring in North America. Beaverhill Bird Observatory and Bird Studies Canada, Edmonton, Alberta.

U.S. Fish and Wildlife Service. 1993. Fishery Management Plan: Kanuti National Wildlife Refuge. Unpublished Fishery Resource Office Report, Fairbanks, Alaska.

_____. 2002. Land Protection Plan for Kanuti National Wildlife Refuge: Options for the protection of fish and wildlife habitats. Unpublished USFWS report. Anchorage, AK.

_____. 2007. Kanuti National Wildlife Fire Management Plan. U.S. Fish and Wildlife Service, Fairbanks, AK.

_____. 2008. Revised comprehensive conservation plan for the Kanuti National Wildlife Refuge. U.S. Fish and Wildlife Service, Anchorage, Alaska.

_____. 2013. How to develop survey protocols, a handbook (Version 1.0). Fort Collins, Colorado: U.S. Department of the Interior, Fish and Wildlife Service, National Wildlife Refuge System, Natural Resource Program Center.

_____. 2014. A User's guide for a SMART survey prioritization tool, version 2.2. Inventory and Monitoring Initiative, Natural Resource Program Center, U.S. Fish and Wildlife Service, Fort Collins, CO.

_____. 2017. Water Resources Inventory and Assessment: Kanuti National Wildlife Refuge, Alaska. U.S. Department of the Interior, U.S. Fish and Wildlife Service, Anchorage, Alaska.

U.S. Fish and Wildlife Service and Canadian Wildlife Service (USFWS/CWS). 1987. Standard operating procedures for aerial waterfowl breeding ground population and habitat surveys in North America, Unpublished manual.

Whittington, J., K. Heuer, B. Hunt, M. Hebblewhite, and P. M. Lukacs. 2015. Estimating occupancy using spatially and temporally replicated snow surveys. Animal Conservation 18:92–101.

Wilk, R. J. 1993. Observations on sympatric tundra, *Cygnus columbianus*, and trumpeter swans, *C. buccinator*, in north-central Alaska, 1989–1991. The Canadian Field-Naturalist 107:64–68.

VI. Amending or Revising the IMP

A. Amending the IMP

When new survey protocols or new versions of existing protocols are approved and assigned to a survey, the refuge and I&M staff need to amend the refuge IMP. When amending an IMP:

1. Update protocol citations and status in ServCat and PRIMR.
2. Update the estimates of survey cost and staff time in PRIMR.
3. Generate a new Table 1 with the changes to protocol status and citation and upload it into ServCat.
4. No signatures are required.

B. Revising the IMP

Selecting a new survey or removing a selected survey from an approved IMP triggers a revision. This differs from an amendment in that it changes the survey priorities of a refuge. When revising an IMP:

1. Reassign the survey priorities in PRIMR.
2. If a new survey is included, provide a narrative justifying the survey and add required information for Table 1 into PRIMR.
3. Generate a new narrative and Table 1 for review and approval.
4. Obtain signatures from refuge staff, the Regional I&M Coordinator, Regional Refuge Biologist/Division Chief, and the Refuge Supervisor, but not the Regional Refuge Chief. Use Figure 3 in Exhibit 1 of the I&M Policy.
5. Store the revised IMP (including the narrative, revised Table 1, and signature page) in ServCat.

VII. Appendices

Appendix A. SMART Tool Survey Prioritization Criteria

To prioritize projects, 16 criteria were selected from a set of 24 criteria. Based on Refuge staff input, the criteria were then loosely ranked 1 to 16. We then weighted each criterion in largely decreasing 6-7% intervals (i.e., 100 divided by 16 equals 6.25). Criteria with equal weights were deemed to have equal importance in evaluating a survey's priority. Weights are effectively percentages (i.e., sum to 100).

No.	Criteria	Scale	Weighting
1	Refuge Purpose	1–4	11.8
2	CCP or other plan objectives	1–4	11.8
3	Threat	1–4	11.8
4	Management Utility	1–4	9.5
5	NWRS Objectives	1–4	8.7
6	Listed Species or Vegetation Communities	1–4	8.7
7	Controversy	1–4	7.2
8	Baseline Data	1–2	6.5
9	FWS Program Need	1–4	5.7
10	FWS Partner Need	1–4	4.9
11	FWS Subsistence Species	1–4	4.1
12	Refuge Ecological Processes	1–3	3.4
13	Survey Breadth	1–4	2.6
14	Integration with Other Survey	1–4	1.9
15	Spatial Scale	1–4	1.1
16	Survey Scope	1–3	0.4

Definitions of these criteria follow on the next four pages.

Criteria considered for survey prioritization

Refuge Priorities and Management Needs

1) **Refuge Purpose:** Does the survey provide information to evaluate if the station is achieving its purpose(s)?
   Note: Refuge purposes are generally those defined under the Refuge's founding legislation (Executive Order) or under ANILCA in Alaska; additional guidance is given in Appendix 1. Example 1: A survey addressing wilderness character addresses purpose for a station with proposed or designed wilderness. Example 2: Kodiak Refuge was founded to protect the breeding and feeding grounds of brown bears. A brown bear survey directly relates to this purpose.
   1. No
   2. Yes, one purpose
   3. Yes, two purposes.
   4. Yes, three or more purposes

2) **CCP or other management plan objectives:** How many station CCP or other management plan objectives (e.g., HMP) are met by the focus of this survey?
   Example 1: A survey of staff gauge readings for water levels in representative units can be used to evaluate a range of wetland habitat objectives including seasonal, emergent, and permanent types. Example 2: An Early Detection Rapid Response survey can be used to discover the presence of highly invasive plant species in multiple refuge habitats.
   1. Does not address an objective
   2. Addresses one objective
   3. Addresses two objectives
   4. Addresses three or more objectives

3) **Threat:** Does the survey support decision-making to monitor and mitigate a known or suspected threat to refuge resources?
   Examples of threats may include invasive species and climate change.
   1. No existing threat or potential for a threat to Refuge resources.
   2. No known threat, but potential for a threat to Refuge resources.
   3. Known threat to Refuge resources, but immediate management action is not currently needed but may be in the near future.
   4. Urgent threat to Refuge resources; immediate data are needed to support management action.

4) **Management Utility (Decision Support) for the Refuge:** Does the survey provide data for recurring management decisions, especially as part of an existing decision framework that is implemented on a regular basis?
   1. No set application for the refuge
   2. May have management implications, but they are not explicitly defined
   3. Has management implications, but no current decision framework
   4. Part of an existing adaptive management decision framework

5) **NWRS Objectives**: Does the survey provide information to evaluate if the station is achieving regional or national objectives of the NWRS such as Biological Integrity, Diversity, and Environmental Health (BIDEH); NWR Resources of Concern (e.g., migratory birds, anadromous fishes, marine mammals); and compatibility of refuge uses especially wildlife-dependent recreation (so called "Big 6")?
Federally listed species are addressed under criterion #6 so they should not be considered as a NWR Resources of Concern under this criterion. For BIDEH, only consider surveys addressing the highest measure of biological integrity, which is viewed as those intact and self-sustaining habitats and wildlife populations existing during historic conditions (see 601 FW 3.10).
    1. No
    2. One objective
    3. Two objectives
    4. Three or more objectives

6) **Listed species or vegetation communities:** Is the objective of the survey a species or vegetation community federally listed under ESA, state listed (threatened or endangered only), ranked by the state's natural heritage program (S1 or S2 rank only), globally ranked by NatureServe (G1 or G2 rank only), or globally listed on the IUCN Red List of Threatened Species (Critically Endangered, Endangered, or Vulnerable only)?
    1. Not state, federally or globally ranked
    2. Yes, state listed or ranked by state's natural heritage program
    3. Yes, globally listed by NatureServe or IUCN
    4. Yes, federally listed under the ESA as threatened or endangered

7) **Controversy:** Does the survey support decision-making to address a controversial action or management decision related to refuge resources?
Examples of controversy include changes to livestock grazing, predator control, and changes to harvest regulations.
    1. Not controversial and little to no potential for controversy.
    2. Not currently controversial, but potentially or suspected of controversy
    3. Known controversy, but immediate management action is not currently needed but may be in the near future.
    4. Pressing controversy; data required to support immediate management action.

8) **Baseline data:** Does the survey provide high-priority information that contributes to baseline data needs?
Example: Inventories of species guilds (e.g., invertebrates, plants, reptiles) or abiotic parameters (soils, waters).
    1. No
    2. Yes

9) **FWS programs:** Does the survey provide information that directly contributes to evaluating the status and trends of resources that are a priority for another FWS regional or national program (e.g., Migratory Birds, Fisheries, Water Resources/Hydrology *other than ESA*

species)? *Example 1: North American Breeding Bird Survey, North American Amphibian Monitoring Program, Mid-Winter Waterfowl Survey, and Circumpolar Biodiversity Monitoring Network are priority surveys for regional or national FWS programs.*

1. Does not address a management priority identified by a FWS regional or national program or initiative
2. Addresses a management priority identified by 1 FWS regional or national program or initiative
3. Addresses a management priority identified by 2 FWS regional or national programs or initiatives
4. Addresses a management priority identified by ≥3 FWS regional or national programs or initiatives

10) **FWS partners**: Does the survey address an identified priority of your Landscape Conservation Cooperative(s) (LCC), or an identified information need of state agencies, or other conservation partners?
    1. Does not focus a management priority identified by FWS partners (e.g., LCC, state agency).
    2. Focus on a management priority identified by 1 FWS partner (e.g., LCC, state agency).
    3. Focus on a management priority identified by 2 FWS partners (e.g., LCC, state agency).
    4. Focus on a management priority identified by ≥3 FWS partners (e.g., LCC, state agency)

11) **FWS Subsistence Species:** Does the survey focus on a subsistence species selected by the FWS?
    1. No
    2. Yes, one FWS subsistence species
    3. Yes, two FWS subsistence species
    4. Yes, three or more FWS subsistence species

12) **Refuge Ecological Processes:** Does the survey focus on an ecological process (e.g., fire, water temperature, climate) that is changing at a rate that is important to the refuge or an indicator species associated with that process?
    1. No
    2. Yes, one significant ecological process or species
    3. Yes, two or more significant ecological processes or species

13) **Survey Breadth:** The focus of the survey is:
    1. A single species or abiotic parameter.
    2. Multi-species or multi-abiotic parameters.
    3. A community – multi-trophic level or biota.
    4. An ecosystem – biotic community and abiotic parameters

14) **Integration:** Is the survey conducted in conjunction with, reliant on, or required by another survey to provide a more complete picture of the targeted resource?
Example: A vegetation survey and two bird surveys together drive a predictive model that informs bird management decisions. Berry density data and salmon spawning data work in conjunction with bear density and habitat use data to predict salmon escapement goals required to maintain bear populations.
    1. No.
    2. Yes, survey is conducted in conjunction with another survey, but the results are independent.
    3. Yes, the results from this survey are reliant on, or required by, another survey for a complete picture of the targeted resource.
    4. Yes, the results from this survey are reliant on, or required by, more than one other survey for a complete picture of the targeted resource

15) **Spatial Scale:** At what scale does the survey most benefit the scientific information needed for resource management?
Note: Only surveys with a standard protocol and established systems of data management and analysis are scored higher than a 1. Terms are defined in the Appendix. This criterion is applicable to surveys covering areas on and adjacent to the station. Example: If a refuge participates and contributes to a regional survey involving neighboring US Forest Service lands, then this criterion would apply.
    1. Small scale: Applicable to only a single refuge.
    2. Medium scale: Applicable to a few refuges, a refuge complex, or includes the refuge and a small area beyond the refuge boundary.
    3. Large scale: Applicable to multiple refuges/complexes across an entire ecoregion, LCC, or region.
    4. Continental scale: Component of a large landscape level survey (e.g., North American Breeding Bird Survey, North American Amphibian Monitoring Program).

16) **Survey Scope:** What proportion (%) of the species', subspecies', or communities' (i.e., vegetation) geographic range under U.S. jurisdiction will be covered by the survey on the station?
    1. Low: Survey covers <1% of the species' or communities' population/range.
    2. Medium: Survey covers 1-10% of the species' or communities' population/range.
    3. High: Survey covers ≥10% of the species' or communities' population/range.

Appendix B. Initial SMART Tool Prioritization Scores and Rankings

Scores used to initially prioritize and select inventory and monitoring surveys likely to be conducted during the life of this IMP. Prioritization scores were generated for candidate surveys by Refuge staff scoring each survey on the SMART tool criteria provided in Appendix A. Scores were then used as a starting reference to assign final priority and operational status of surveys (see Appendix C).

SMART Tool-based Priority	Survey Name	SMART Tool Raw Score
1	Salmon Run Inventory	0.74
2	Molting Geese Monitoring	0.62
3	Waterfowl Brood Production Survey	0.62
4	Scoter/Scaup Breeding Pair Survey	0.61
5	Traditional Ecological Knowledge	0.59
6	Waterfowl Breeding Pair Survey	0.56
7	Riparian Invasive Weeds Monitoring	0.51
8	Trumpeter Swan Census	0.51
9	Moose Population Monitoring	0.49
10	Wintering Caribou Monitoring	0.49
11	Bear Population Inventory	0.49
12	Wolf Snow Track Aerial Survey	0.45
13	Kanuti River Breeding Bird Surveys	0.44
14	Alaska Landbird Monitoring Survey	0.41
15	Beaver Cache Survey	0.39
16	Raptor Stick Nest Survey	0.35
17	Swan Composition Monitoring	0.33
18	Furbearer Winter Track Survey	0.32
19	Hudsonian Godwit Ecology Study [1]	0.31
20	Post-fire Vegetation and Bird Monitoring	0.29
21	Bird Phenology Monitoring	0.28
22	Stream Gage Monitoring	0.28
23	Snow Marker Survey	0.28
24	Nesting Owl Monitoring	0.22
25	Snowshoe Hare Monitoring	0.14
26	Plant Phenology Monitoring	0.13
27	Dragonfly Inventory	0.13

[1] This project was subsequently dropped from discussion. It was deemed a "Future" research project that would require considerable support of the Refuge's partners for completion. Thus, it was not selected for typical consideration in the plan.

Appendix C. Final SMART Tool Prioritization within Survey Types

The following table lists the **final** prioritization of surveys as evaluated via a combination of original raw score/rank (Appendix B), additional mitigating criteria (see methods), and survey type. ***Note that surveys were first grouped by survey type (Current vs. Expected) so original priorities differ from Appendix B***. Current surveys will be completed if future program staffing and funding remains commensurate with those of 2015. One or more expected surveys could be completed if program (or partner) funding exceeds this level of funding.

Final Priority within Survey Type	Survey Name	Original SMART Tool Priority within survey type	Survey Type
1	Moose Population Monitoring	6	Current
2	Molting Geese Monitoring	1	Current
3	Riparian Invasive Weeds Monitoring	4	Current
4	Scoter/Scaup Breeding Pair Survey	2	Current
5	Waterfowl Breeding Pair Survey	3	Current
6	Trumpeter Swan Census	5	Current
7	Wintering Caribou Monitoring	7	Current
8	Wolf Snow Track Aerial Survey	8	Current
9	Kanuti River Breeding Bird Surveys	9	Current
10	Beaver Cache Survey	11	Current
11	Alaska Landbird Monitoring Survey	10	Current
12	Snow Marker Survey	16	Current
13	Raptor Stick Nest Survey	12	Current
14	Post-fire Vegetation and Bird Monitoring	13	Current
15	Stream Gage Monitoring	15	Current
16	Bird Phenology Monitoring	14	Current
17	Plant Phenology Monitoring	17	Current
18	Dragonfly Inventory	18	Current
1	Salmon Run Inventory	1	Expected
2	Bear Population Inventory	4	Expected
3	Waterfowl Brood Production Survey	2	Expected
4	Traditional Ecological Knowledge	3	Expected
5	Furbearer Winter Track Survey	6	Expected
6	Swan Composition Monitoring	5	Expected
7	Nesting Owl Monitoring	7	Expected
8	Snowshoe Hare Monitoring	8	Expected

Appendix D. Estimated Annual Survey Costs.

(A) Current Surveys

Survey Name	Survey Priority	Average Annual KNWR Staff Time, (hrs)[1]	KNWR Staff Total ($)[2]	Average Annual non-KNWR Time (hrs)[3]	Average Annual Operations Cost ($)	Total Cost
Moose Population Monitoring	1.01	140	$8,413	0	$14,400	$22,813
Molting Geese Monitoring	1.02	180	$8,654	0	$6,340	$14,994
Riparian Invasive Weeds Monitoring	1.03	148	$7,115	0	$1,820	$8,935
Scoter/Scaup Breeding Pair Survey	1.04	138	$6,635	0	$240	$6,875
Waterfowl Breeding Pair Survey	1.05	0	$0	0	$3,000	$3,000
Trumpeter Swan Census[4]	1.06	154	$7,404	0	$4,900	$12,304
Wintering Caribou Monitoring	1.07	118	$7,091	0	$6,220	$13,311
Wolf Snow Track Aerial Survey[4]	1.08	66	$3,173	0	$10,640	$13,813
Kanuti River Breeding Bird Surveys	1.09	132	$6,346	0	$2,300	$8,646
Beaver Cache Survey[4]	1.10	146	$8,774	0	$8,940	$17,714
Alaska Landbird Monitoring Survey[4]	1.11	150	$6,707	112	$3,600	$10,684
Snow Marker Survey	1.12	73	$4,387	0	$7,000	$11,387
Raptor Stick Nest Survey	1.13	97	$4,663	0	$4,020	$8,683
Post-fire Vegetation and Bird Monitoring[4]	1.14	180	$8,654	0	$0	$8,654
Stream Gage Monitoring	1.15	16	$769	0	$50	$819
Bird Phenology Study	1.16	362	$16,186	312	$4,450[5]	$20,636
Plant Phenology Study	1.17	90	$4,024	48	$0[5]	$4,024
Dragonfly Inventory	1.18	30	$1,442	0	$1,500	$2,942

[1] Includes Kanuti (KNWR) permanent staff time
[2] Computed by dividing annual salary costs by 2080 (hrs worked/year) multiplied by $100,000 (GS-5/7/9) or $125,000 (GS-11 and above)
[3] Includes non-permanent staff time, such as Student Conservation Interns or volunteers
[4] Occurs every 5 (swans, beaver), 3 (wolf), 2 (ALMS), or 10 (fire) years. See Appendix G for more detailed annual timing.
[5] Bird and Plant Phenology Monitoring studies share operational costs noted in bird study as they occur during same long stint by same crew (biologist and volunteer).

(B) Expected Surveys

Survey Name	Survey Priority	Average Annual KNWR Staff Time, (hrs)[1]	KNWR Staff Total ($)[2]	Average Annual non-KNWR Time (hr) [3]	Average Annual Operations Cost ($)	Total Cost
Salmon Run Inventory	2.01	64	$3,846	0	$2,380	$6,226
Bear Population Inventory	2.02	234	$11,250	0	$7,529	$18,779
Waterfowl Brood Production Survey	2.03	359	$17,260	0	$5,220	$22,480
Traditional Ecological Knowledge	2.04	200	$9,615	0	$700	$10,315
Furbearer Winter Track Survey	2.05	292	$14,038	0	$3,720	$17,758
Swan Composition Monitoring	2.06	294	$14,135	0	$9,100	$23,235
Nesting Owl Monitoring	2.07	74	$3,558	0	$910	$4,468
Snowshoe Hare Monitoring	2.08	92	$5,529	0	$3,420	$8,949

[1] Includes Kanuti (KNWR) permanent staff time
[2] Computed by dividing annual salary costs by 2080 (hrs worked/year) multiplied by $100,000 (GS-5/7/9) or $125,000 (GS-11 and above)
[3] Includes non-permanent staff time, such as Student Conservation Interns or volunteers

Appendix E. Data Management.

Raw electronic data, analyses, reports, etc. for all surveys have historically been archived by the principal investigator (PI) on their hard drives and external drives; more recently copies of raw data have been stored on Kanuti's Fairbanks-housed server (aka "Team drive"). Non-electronic data (e.g., paper data forms) have been typically stored in the PI's files, as well as copies in the Refuge's general files. The hard drives (with project data) for departing employees are copied to the Team drive.

Data from multiple long-term, recurring surveys are entered, sometimes via online links, into existing electronic databases off site, as well as being stored on the workstation of the principal investigator (PI). Data from moose and beaver cache surveys are stored in the former PIs' archived folders, and in addition, into the GSPE moose survey software (DeLong 2006) hosted on the Alaska Department of Fish and Game WinfoNet system. Retrieving data from the web server is facilitated through a web login. Snow marker survey data are faxed immediately to NRCS who compiles and analyzes state-wide data. In addition to being stored locally by the PI, data for the swan census and molting goose survey are provided to Migratory Bird Management (MBM) at their request. Breeding Bird Survey (BBS) data are entered online through USGS's BBS website portal. Alaska Landbird Monitoring Survey (ALMS) data are kept here, as well as provided to USGS where all state-wide ALMS data are archived and analyzed.

Less frequent surveys tend to vary in their data management. MBM (Anchorage) actually collects, archives, and analyzes the decadal waterfowl breeding pair survey data and provide copies of the data to Kanuti, typically in both spreadsheet and GIS (e.g., shapefile or geodatabase) formats. R7 Fire Management Program manages the post-fire vegetation survey using a Kanuti-created and populated Access database. Bird data from this project are in a sister Kanuti Access bird database (including ALMS data). Scoter/Scaup survey data are provided to Yukon Flats for a combined analysis so their archival is redundant. For surveys not mentioned explicitly, their datasets are typically sparse and/or recent, and are archived ad hoc on PI's hard drives and former employee PI's folders on the shared drive.

Although proper data management and preservation is a recognized priority for the Refuge, historically the staff has not typically adhered to "best practices." Fortunately, most data are organized electronically as spreadsheets (MS Excel) where preservation on a server as comma-delimited files could be easily accomplished as a first step; a few are in relational database format. Formal organization of spreadsheets into relational databases may be desired for some surveys, however, would take much more time, as would the addition of metadata to current and historical data. Currently, most data exist on staff member hard drives that are backed up weekly, are copied to the Fairbanks server for Kanuti NWR, and some historical data are available only in hard copy. The serious lack of standardized practices for handling GIS data and projects has been identified. Preservation of data and projects and the addition of metadata are a priority for the Refuge though at present there are no written protocols or policy for organizing or backing up data. Refuge staff have been consulting with the I&M data manager to develop general SOPs for data management that will facilitate retrieval of historical datasets, reinforce the need to back up data and emphasize best practices, and provide guidance for the development of metadata.

Appendix F. Estimated Monthly Schedule for Selected Current and Expected Inventory and Monitoring Surveys.

Survey Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CURRENT												
Moose Population Monitoring	A[1]	R	R						P	P FW	FW	DE A
Molting Geese Monitoring						P	FW	DE	AR	R		
Riparian Invasive Weeds Monitoring					P	FW	FW	DE, A, R				
Scoter/Scaup Breeding Pair Survey					P	FW	DE		A	R	R	
Waterfowl Breeding Pair Survey[2]	R				FW	FW					DE	A
Trumpeter Swan Census								P FW	FW DE	DE A	AR	R
Wintering Caribou Monitoring	P	FW	DE A	R							FW	FW P
Wolf Snow Track Aerial Survey	P	P	FW	DE	A	R						
Kanuti River Breeding Bird Surveys					P	FW	DE	A	R	R		
Beaver Cache Survey	A R	R					P	P	FW	FW		DE A
Alaska Landbird Monitoring Survey				P	P	FW			DE	A	R	R
Snow Marker Survey		FW	FW	FW	FW	A R						FW
Raptor Stick Nest Survey				P	FW			DE	A	R	R	
Post-fire Vegetation/ Bird Monitoring				P	P	FW	FW	DE	DE	A	R	R
Stream Gage Monitoring		FW	FW		FW	FW			FW		FW	
Bird Phenology Monitoring	P	P	P	P FW	FW	FW	FW	DE	DE	A	R	
Plant Phenology Monitoring	P	P	P	P FW	FW DE	FW DE	FW DE	DE	DE	A	R	
Dragonfly Inventory					P	FW	FW	DE	A	R		
EXPECTED												
Salmon Run Inventory[2]	R			P	FW	FW		FW	FW	DE	A	R
Bear Population Inventory	P	P	FW	FW	DE				A	A	A	R

Survey Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Waterfowl Brood Production Survey						P	FW	DE	A	R	R	R
Traditional Ecological Knowledge	A	R		FW				FW		FW	DE	DE
Furbearer Winter Track Survey		FW	FW	FW					DE A	R		FW
Swan Composition Monitoring				P	P	FW			DE	A	R	R
Nesting Owl Monitoring		P	FW	FW DE	A R							
Snowshoe Hare Monitoring					P	FW			DE A, R			

[1] P=Planning, FW=Field Work, DE=Data Entry, A=Analysis, R=Reporting

[2] Surveys funded by Kanuti NWR, but carried out by other FWS programs (e.g., Migratory Bird Management, Fisheries Office)

Training is not indicated here, despite its time commitment and importance in conducting surveys. We omit because it occurs intermittently throughout each year, its completion varies among individual staff, its application spans multiple surveys (e.g., First Aid/CPR, aircraft safety), and pilots, observers, and ground- or water-based crews have different requirements.

Appendix G. Estimated Yearly Schedule for Selected Current and Expected Inventory and Monitoring Surveys, 2015–2026.

Survey Name	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
CURRENT												
Moose Population Monitoring	X[1]	x[2]	x	X	x	x	X	x	x	X	x	x
Molting Geese Monitoring	X	X	X	X	X	X	X	X	X	X	X	X
Riparian Invasive Weeds Monitoring	X	X	X	X	X	X	X	X	X	X	X	X
Scoter/Scaup Breeding Pair Survey	X	X	X	X	X	X	X	X	X	X	X	X
Waterfowl Breeding Pair Survey				X	X	X						
Trumpeter Swan Census	X					X					X	
Wintering Caribou Monitoring		?[3]						?				?
Wolf Snow Track Aerial Survey			X			X			X			X
Kanuti River Breeding Bird Surveys	X	X	X	X	X	X	X	X	X	X	X	X
Beaver Cache Survey		X					X					X
Alaska Landbird Monitoring Survey		X		X		X		X		X		
Snow Marker Survey	X	X	X	X	X	X	X	X	X	X	X	X
Raptor Stick Nest Survey	X	X	X	X	X	X	X	X	X	X	X	X
Post-fire Vegetation & Bird Monitoring	X	X									X	X
Stream Gage Monitoring	X	X	X	X	X	X	X	X	X	X	X	X
Bird Phenology Monitoring	x	x	x	x	x	x	x	x	x	x	x	x
Plant Phenology Monitoring	x	x	x	x	x	x	x	x	x	x	x	x
Dragonfly Inventory				?					?			
EXPECTED												
Salmon Run Inventory			?						?			
Bear Population Inventory			X	X	X	X	?					

Survey Name	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Waterfowl Brood Production Survey			?		?		?		?		?	
Traditional Ecological Knowledge				?		?		?				
Furbearer Winter Track Survey		?	?	?	?	?	?	?	?	?	?	?
Swan Composition Monitoring				?								
Nesting Owl Monitoring		?	?	?	?	?	?	?	?	?	?	?
Snowshoe Hare Monitoring	X	X	X	X	X	X	X	X	X	X	X	X

[1] Large X suggests high likelihood that survey will be done that year

[2] Small x suggests survey will be at least attempted each year that conditions, staff, funding, and/or schedules allow.

[3] Question mark suggests exact survey year and/or its likelihood is unknown. Includes both intentionally infrequent (e.g., Salmon Run Inventory) and annually desired (e.g., furbearer)

Appendix H. Environmental Action Statement (EAS)

UNITED STATES FISH AND WILDLIFE SERVICE
ENVIRONMENTAL ACTION STATEMENT

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA) (40 CFR 1500-1508), and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and determined that the following proposed action does not require additional NEPA documentation.

Proposed Action, Alternatives, and NEPA Documentation.

The proposed action is to implement an Inventory and Monitoring Plan (IMP) for the Kanuti National Wildlife Refuge. This IMP is a refinement of the 2008 Revised Comprehensive Conservation Plan (CCP) and associated Environmental Impact Statement (EIS) for Kanuti National Wildlife Refuge. This IMP provides more specific guidance for surveys of the Refuge's fish, wildlife, plant, habitat, and abiotic resources to fulfill the Refuge's purposes and help achieve Refuge goals and objectives.

The EIS for Kanuti National Wildlife Refuge's CCP included goals and objectives for the Refuge and assessed the impacts associated with a range of reasonable alternatives to achieve those goals and objectives. The rationale for selection of one specific alternative for implementation is explained in the Record of Decision (ROD) accompanying the final CCP. The goals, objectives, and survey strategies included in this IMP fall within the bounds of those described and assessed in the CCP and EIS.

Pursuant to 40 CFR 1502.9, no additional NEPA documentation is required to implement this IMP beyond the EIS and ROD prepared concurrently with the CCP. No substantial changes to the proposed action alternative that was identified, analyzed, and selected for implementation within the CCP, EIS, and ROD are proposed through this IMP. Similarly, no significant new information or circumstances exist relevant to environmental concerns and bearing on the proposed action or its impacts.

In accordance with 43 CRF 46.205 and 40 CFR 1508.4, some surveys within this IMP are covered by the following Departmental categorical exclusion because they would not have significant environmental effects.

"Research, inventory, and information collection activities directly related to the conservation of fish and wildlife resources which involve negligible animal mortality or habitat destruction, no introduction of contaminants, or no introduction of organisms not indigenous to the affected ecosystem." 516 DM 8.5B(1)

Mike Spindler, Refuge Manager

2/23/2017
Date

Appendix I. Kanuti NWR Goals and Objectives.

The following lists the six goals, and their associated objectives, from the Comprehensive Conservation Plan for Kanuti NWR (USFWS 2008). Examples of current projects are listed under applicable objectives. Goals #4–6 are not addressed by projects in this plan. Historical projects that addressed specific objectives are listed and designated with an asterisk. References for studies cited here are listed in Section V.

GOAL 1. Conserve the refuge's diversity of wildlife, fish, and habitats, while allowing natural processes, including wildland fire and the natural hydrologic cycle, to shape the environment.

OBJECTIVES

01.0.01 Collaborate with staff of other refuges, agencies, and research institutes to gain a better understanding of boreal forest ecosystems.

- Moose Population Monitoring
- Molting Geese Monitoring
- Scoter/Scaup Breeding Pair Survey
- Trumpeter Swan Census
- Kanuti River Breeding Bird Surveys
- Alaska Landbird Monitoring Survey
- Snow Marker Survey
- Raptor Stick Nest Survey
- Post-fire Vegetation and Bird Monitoring
- Bird Phenology Monitoring
- Plant Phenology Monitoring
- Dragonfly Inventory
- Bear Population Inventory
- Traditional Ecological Knowledge
- Nesting Owl Monitoring
- Snowshoe Hare Monitoring

01.0.02 By 2009, complete the Inventory and Monitoring step-down plan to integrate and direct inventory and monitoring of plants, fish, and wildlife.

- Addressed by this plan*

01.0.03 Within 20 years of adoption of the plan, complete an inventory of breeding birds and their habitats, vascular plants, fire history, and terrestrial insects within the refuge using an integrated plot-based approach.

- Implemented 2004–2010 ("Refuge-wide Plot-based Integrated Terrestrial Biological Inventory")*

01.0.04 At intervals of 1–3 years, obtain a moose population estimate for the refuge, including age and sex ratios, by conducting aerial surveys in cooperation with neighboring State and Federal land managers.

- Moose Population Monitoring

01.0.05 Obtain baseline information about late winter availability and use of moose forage species.

- Moose browse study (including Kanuti NWR in 2007) with ADF&G (Paragi et al. 2008)*
- Post-fire browse availability study (Julianus 2016)*

01.0.06 Implement the refuge's Fire Management Plan within the first two years of its approval.

- Wintering Caribou Monitoring

01.0.07 Document fire history patterns on the refuge by collecting data on tree age annually, in association with inventory plots (see Objective 1), and by participating in research on Alaskan fire regimes during the life of this plan.

- Post-fire Vegetation and Bird Monitoring

01.0.08 Conduct surveys to determine if non-native, invasive plant species are becoming established on the refuge.

- Invasive Weeds Monitoring along Refuge Waterways
- Annual weed-pulls off-refuge along Dalton Highway where rivers eventually entering Kanuti NWR intersect the highway (2007–current)

01.0.09 Determine the seasonal distribution (spawning and wintering areas) and migratory patterns of select species of whitefish (broad whitefish, humpback whitefish, and least cisco) within five years of adoption of this plan and assess the potential for similar studies of other resident fish such as pike and grayling.

- 2003–2005 Brown et al. study (Brown 2009)*
- Lake habitat and fish surveys (1984–85 on Kanuti) (Glesne et al. 2011)*

01.0.10 Map spawning areas of anadromous fish and assess escapement of salmon within 10 years of adoption of this plan.

- Salmon Run Inventory
- Traditional Ecological Knowledge

01.0.11 Monitor snow depth and density at six snow markers on a monthly basis (December–May).

- Snow Marker Survey

01.0.12 Monitor the beaver population on the refuge by conducting fall aerial surveys of beaver food caches at 5- to 10-year intervals.

- Beaver Cache Survey

01.0.13 Estimate the number of wolves on the refuge in late winter at 3- to 5-year intervals.
- Wolf Snow Aerial Track Survey
- Collared wolf study (Maxwell 2005)*

01.0.14 Document winter abundance and distribution of caribou through monthly reconnaissance flights.
- Wintering Caribou Monitoring

01.0.15 During the life of the plan or until results indicate that the population and habitat has stabilized, continue long-term studies of fire effects on small mammals and vegetation to document changes through different stages of forest succession.
- Post-fire Vegetation and Bird Monitoring
- Post-fire small mammal trapping at Mouse Lake (Rexstad 2003)*

01.0.16 Investigate and assess the feasibility of conducting surveys to index bear abundance in select refuge locations.
- Bear Population Inventory

01.0.17 Assess the feasibility of monitoring the distribution and abundance of snowshoe hares and other furbearers using aerial surveys of tracks.
- Furbearer Winter Track Survey
- Snowshoe Hare Monitoring

01.0.18 Contribute to continental, statewide, and bioregional monitoring efforts to establish trends in migratory landbird populations. This will be done through annual participation in scientifically defensible, peer-recognized programs such as the continental Breeding Bird Survey (BBS) and Alaska Landbird Monitoring Survey (ALMS). Participation in these programs would include implementation and assistance in the refinement and testing of procedures.
- Kanuti River Breeding Bird Surveys
- Alaska Landbird Monitoring Survey
- Raptor Stick Nest Survey
- Bird Phenology Monitoring
- Diurnal Forest Raptor Inventory along Selected Rivers*

01.0.19 Continue to assist in annual monitoring of the Alaska mid-continent greater white-fronted goose population.
- Molting Geese Monitoring

01.0.20 Assist U.S. Fish and Wildlife Service Migratory Bird Management in statewide programs, including but not limited to swan censuses.
- Trumpeter Swan Census

01.0.21 Determine current species composition of swans on the refuge.
- Swan Composition Monitoring

01.0.22 Within the life of the this plan, replicate (and where necessary, modify) the 1997 expanded aerial waterfowl breeding pair survey, in cooperation with U.S. Fish and Wildlife Service Migratory Bird Management. The survey should be conducted regularly (e.g., every five years) thereafter. Survey(s) should ensure adequate sampling for the three main groups of ducks: dabblers, divers, and sea ducks.

- Waterfowl Breeding Pair Survey (early)
- Scoter/Scaup Breeding Pair Survey (late)

01.0.23 For those species of migratory birds that regularly breed on the refuge and are demonstrating long-term population declines, continue collaboration towards conservation, including monitoring, research, and outreach.

- Waterfowl Breeding Pair Survey (early)
- Scoter/Scaup Breeding Pair Survey (late)
- Waterfowl Brood Production Survey
- Nesting Owl Monitoring

01.0.24 Collaborate with the Boreal Program for Regional and International Shorebird Monitoring (Boreal PRISM) to help design and implement appropriate inventory and monitoring techniques for breeding and migrant shorebirds.

- Whimbrel Breeding Biology and Habitat Use Study*

01.0.25 Design and implement a long-term waterfowl and waterbird production survey of the refuge.

- Waterfowl Brood Production Survey

GOAL 2. Ensure the natural function and condition of water resources necessary to conserve fish and wildlife populations and habitats in their natural diversity.

OBJECTIVES

02.0.26 Within the life of this plan, develop a water resource inventory and assessment study plan in conjunction with the Service's Water Resources Branch.

- Water Resources Inventory and Assessment (completed 2016)*

02.0.27 At the conclusion of the initial assessment, evaluate the need to continue monitoring stream flow and/or water quality conditions to support research or management objectives.

- Stream Gage Monitoring
- Water Quantity Investigation (9 stream gauges; 2009–2015)*
- Water Quality Investigation (9 stream gauges; 2009–2015)*

02.0.28 Formulate a strategy to inventory wetland and lake resources within the refuge, including aquatic plants, fish, wetland-dependent wildlife, aquatic invertebrates, and physical and chemical properties of lakes and wetlands.

02.0.29 Formulate a strategy to inventory the river and stream resources within the refuge boundaries, including aquatic plants, river dependent fish and wildlife, aquatic invertebrates, riparian and floodplain habitat, and physical and chemical properties of rivers and streams.

02.0.30 Assess the feasibility of developing a hydrologic model for the refuge.

GOAL 3. Provide opportunities for local residents to pursue their subsistence lifestyle.

OBJECTIVES

03.0.31 As a continuing commitment, conduct annual informational meetings in each village associated with the refuge and regularly attend other subsistence-related meetings, providing information regarding the status of subsistence resources and their use, and commenting on proposals related to subsistence management within the refuge to maintain a respectful dialogue with refuge resource stakeholders and subsistence users.

- Moose Population Monitoring
- Molting Geese Monitoring
- Wintering Caribou Monitoring
- Wolf Snow Track Aerial Survey
- Beaver Cache Survey
- Salmon Run Inventory
- Furbearer Winter Track Survey

03.0.32 Continue to work closely with stakeholders to address issues and concerns through the State and Federal regulatory processes as provided in ANILCA to conserve fish and wildlife. Stakeholders include tribal councils, the Koyukuk River State Fish and Game Advisory Committee, the Western Interior Federal Subsistence Regional Advisory Council, other local and regional working groups, Alaska Department of Fish and Game, and the Office of Subsistence Management.

- all surveys listed in previous objective (03.0.31) apply here, too

03.0.33 Develop a partnership with tribal councils, Alaska Department of Fish and Game Subsistence Division, and the Office of Subsistence Management to seek funding to review historical subsistence use data (hunting, trapping, and fishing), identify data gaps, and develop a research protocol that will incorporate western science and traditional ecological knowledge to document changing resource and use patterns.

- Traditional Ecological Knowledge

03.0.34 Work with stakeholders to develop and implement a subsistence harvest monitoring plan to conserve migratory bird populations for continued subsistence use. Stakeholders include tribal councils, Alaska Department of Fish and Game Subsistence Division, the Office of Subsistence Management, Alaska Migratory Bird Co-management Council, and the Interior Region Management Body (Tanana Chiefs Conference)

GOAL 4. Provide opportunities for quality public use and enjoyment of refuge resources through compatible wildlife dependent recreation activities, including hunting, fishing, wildlife observation, and photography.

OBJECTIVES

04.0.35 Review methods of monitoring levels and types of public use, and implement new methodology if deemed appropriate.

04.0.36 Continue to provide a range of opportunities for multi-day recreational trips within the refuge that allow the public to experience and explore the dynamic landscape and wildlife of the refuge in solitude, incorporating various methods of access.

04.0.37 Working with community, State and Federal authorities, develop a comprehensive law enforcement program with an emphasis on educating visitors to prevent violations.

04.0.38 Assess and evaluate levels and patterns of snowmobile use on the refuge and off-road vehicle (ORV) use on adjacent and private lands within refuge boundaries.

04.0.39 Continue working with Evansville, Incorporated, the National Park Service; Alaska Department of Transportation and Public Facilities; and the City of Bettles to design and build an interpretive nature trail near Bettles on land adjacent to the northern boundary of the refuge.

GOAL 5. Provide outreach, environmental education, and interpretive programs to develop and/or increase a sense of stewardship for wildlife, cultural resources, and the environment, and to enhance visitor experiences on the refuge.

OBJECTIVES

05.0.40 Update the 1992 Environmental Education and Interpretative Plan, reviewing and revising periodically as necessary.

05.0.41 Continue to provide the public timely and accurate information about the refuge through a wide variety of communication tools; reevaluate the tools used and update and correct information at least twice annually.

05.0.42 In partnership with the Bureau of Land Management and the National Park Service, continue providing interpretive and educational experiences to visitors at the Arctic Interagency Visitor Center in Coldfoot by contributing staff and operational support.

05.0.43 In Fairbanks, Bettles, Evansville, Allakaket, Alatna, and Coldfoot, participate when possible in community events, festivals, and programs that will facilitate education and interpretation of Service and refuge goals.

05.0.44 Expand opportunities for individuals, organized groups, and families to learn about the refuge through activities such as environmental education programs, nature walks, and interpretive programs.

05.0.45 As opportunities arise, provide classroom visits and educational materials as requested by educators in the Yukon-Koyukuk School District.

05.0.46 Work closely with the National Park Service and U.S. Fish and Wildlife Service staff (including staff in the Divisions of Engineering and on refuges) to operate and maintain the "shared" office, visitor center, bunkhouse, and other facilities in Bettles.

GOAL 6. Foster an appreciation for the cultural resources of the refuge through conservation and interpretation.

OBJECTIVES

06.0.47 Update, compile, and organize the refuge cultural resource atlas and database to include all known historical and archaeological sites, place names, and paleontological locality information. Identify priority areas to inventory for archaeological and other cultural sites and conduct surveys as time and personnel allow. Perform surveys at a level sufficient to evaluate the eligibility of identified sites to the National Register of Historic Places.

06.0.48 Seek out and develop partnerships with Native corporations, universities, other government agencies, etc., to cooperatively inventory, manage, and protect cultural and historical resources.

06.0.49 Update the refuge's Cultural Resources Guide by 2011 (15 years after it was first completed).

06.0.50 In cooperation with the communities of Allakaket, Alatna, Bettles, and Evansville, develop a plan to preserve traditional information, maps, or other products using existing traditional place names information for the refuge.