



Monitoring Brown Bears in Alaska

Arctic Inventory and Monitoring Network, Data Quality Standards

Natural Resource Report NPS/ARC/NRR—2018/1743



ON THE COVER

A mating pair of brown bears observed in Noatak National Preserve.
(NPS/HILLARY ROBISON)

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Executive Summary

The purpose of this report is to document the standards used by the National Park Service (NPS) Arctic Network (ARCN) Inventory and Monitoring program for activities related to the collection, processing, analysis, and publication of brown bear monitoring data as described in Protocol for Monitoring Brown Bears: Arctic (ARCN) Inventory and Monitoring Network (Robison et al. 2017). This plan also serves as a guide for all ARCN personnel who are involved in protocol/program activities and as a resource for identifying memoranda, publications, and other literature that describe associated techniques and requirements in more detail. The format and content of this document borrows heavily from Wilson and Shepherd (2017) and Rattenbury and Schmidt (2017).

Acknowledgments

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Introduction

The purpose of this report is to document the standards used by the Arctic Network (ARCN) for activities related to the collection, processing, storage, analysis, and publication of monitoring data as described in Protocol for Monitoring Brown Bears: Arctic (ARCN) Inventory and Monitoring Network (Robison et al. 2017). The policies and procedures documented in this quality-assurance plan for activities follow the quality-assurance plan for other monitoring activities conducted by the ARCN and supplement the National Inventory & Monitoring Division Quality Management Plan. The Standard Operating Procedures provide detailed protocol/program activities associated with brown bear monitoring. This plan serves as a guide for all personnel who are involved in protocol/program activities and as a resource for identifying memoranda, publications, and other literature that describe associated techniques and requirements in more detail.

Protocol Overview

This protocol outlines how monitoring data will be collected, managed and reported for the brown bear “Vital Sign”, as part of the NPS Vital Signs Inventory and Monitoring program and as described in the ARCN Monitoring Plan (Lawler et al. 2009). The study design, data collection methods, and analytical protocols have been previously documented in a publication in *Biological Conservation* (see Schmidt et al. 2017).

Conceptual Framework for Monitoring

The brown bear is an iconic species of Alaska’s national parks, and its presence symbolizes the wilderness character of these vast landscapes. National Park Service units in Alaska exemplify and promote the simplest conceptual model of brown bear conservation: *habitat and human tolerance* (Schoen 1990). With both habitat and human tolerance, bear populations can persist, but the loss of either requires substantial efforts to maintain or restore viable bear populations. In spite of the vast habitat protection provided by Alaska’s national park units and regulated harvest, however, the vulnerability of brown bear populations to anthropogenic disturbance is high and their resilience to anthropogenic disturbance is minimal (Mattson et al. 1996, Weaver et al. 1996, McLoughlin et al. 2003). Increasing demands for oil, gas, coal, and minerals along with accompanying industrial development (e.g. especially roads [McLellan and Shackleton 1988, McLellan 1990, and Waller and Servheen 2005]) on adjacent private, state, and federal lands may pose a threat to the long-term viability of brown bear populations because of habitat fragmentation and human-caused mortality (Audubon Alaska 2003). For these reasons, identifying and monitoring changes in brown bear populations are of particular management concern to the parks.

Protocol Activities

The objective of the ARCN brown bear monitoring protocol is to:

1. *Determine brown bear population trends and distribution in the ARCN parks by:*
 - a. *Detecting trends in density, abundance, and occupancy over time in each survey area and across ARCN as a whole.*

Sampling Design

The survey area size that overlaps the ARCN park units are as follows: BELA 19,998 km², Lower Noatak (NOAT, CAKR) 23,596 km², Upper Noatak (NOAT, GAAR) 23,559 km², and GAAR 18,213 km² (Figure 1). In each survey area, we used a systematic sampling design to provide uniform coverage and to minimize movement of bear groups between sampled units during the survey period (Schmidt et al. 2017). Sample units within the survey areas are approximately 31 km² in size. This size was, in part, chosen because it allows each plane to complete 2 primary units (each composed of 4 subunits [i.e., sample units]) per day. This size was also chosen because it accommodates the distance female brown bears in the Noatak River drainage have been found to move during a day (Ballard et al. 1993).

Aerial surveys are timed to coincide with the end of den-emergence and prior to leaf-out of woody vegetation, which occurs in late May or early June. The method is a photographic mark-resight approach. A pilot and observer team fly in a single engine tandem aircraft (e.g., super cub, husky) to search subunits for bears (Schmidt et al. 2017). Each day, pairs of teams are assigned 2 primary units (8 subunits [i.e., sampling units]) to survey (Schmidt et al. 2017). The first team thoroughly searches a sampling unit and ‘marks’ the bear groups they observe by taking their spatial location and high resolution photos of the bears (Schmidt et al. 2017). The pilot records a tracklog of their flight path and waypoints of bears on their GPS unit (e.g., Garmin 296/496). The observer records flight path and bear observation data on an iPad using the Park Observer application developed by the NPS Alaska Regional Office GIS Team and on paper data sheets as backup. After the first team surveys the sampling unit, the second team surveys the subunit using the same method and may or may not re-sight bear groups that the first team observed (Schmidt et al. 2017). Teams search each subunit thoroughly for bears and dens with the guideline of spending about 1 h of search time in each subunit. Pilots are free to choose the search pattern as long as the entire subunit is covered. Each evening, teams compare photographs and locations of the bear groups and dens they saw throughout the day. Surveys will be conducted on approximately a 5-year sampling rotation (Table 1).

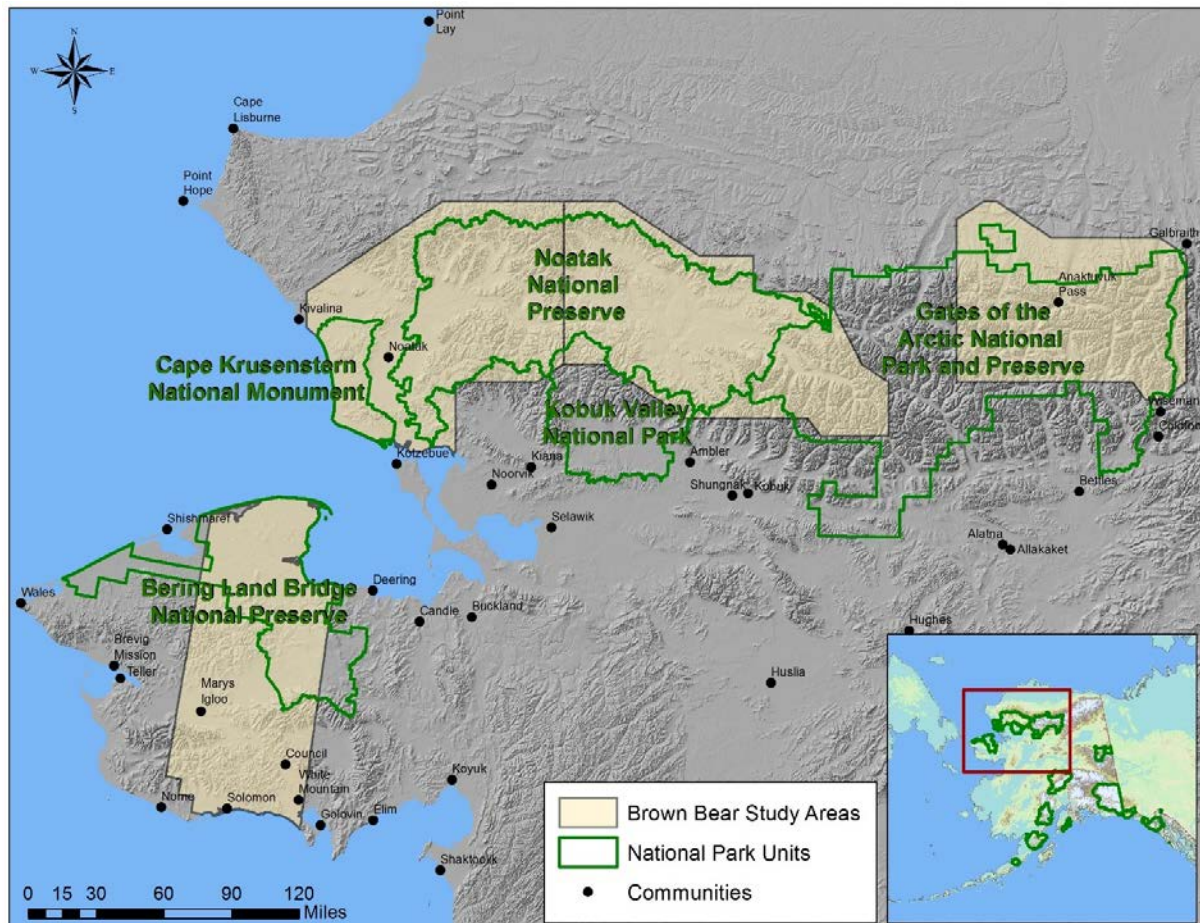


Figure 1. The four brown bear survey areas in the ARCN park units.

Table 1. Schedule for brown abundance and occupancy surveys in Arctic Network (ARNC) park units Bering Land Bridge National Preserve (BELA), Cape Krusenstern National Monument (CAKR), Noatak National Preserve (NOAT), Gates of the Arctic National Park and Preserve (GAAR).

Survey Area/Park Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Seward Peninsula/BELA	X	–	–	–	–	X	–	–	–	–	X
Lower Noatak (CAKR/NOAT)	–	X	–	–	–	–	X	–	–	–	–
Upper Noatak (NOAT/GAAR)	–	–	X	–	–	–	–	X	–	–	–
Gates of the Arctic (GAAR)	–	–	–	X	–	–	–	–	X	–	–

Data analysis will meet Objective 1 by estimating occupancy, abundance, and density after each survey. Trends will be assessed based on series of such estimates over time.

Data Quality Objectives

This section is intended to demonstrate how this project generates data of known and documented quality, resulting in complete, accurate and transferable information.

Representativeness and Data Comparability. The systematic survey design of the project assures that the entire population of brown bears within each survey area is included in the sampling frame. Therefore, there is no sample selection bias and the sample is representative of the entire population for each survey conducted under the protocol. The double sampling framework provides estimates of abundance, which can also be converted to densities. Densities are directly comparable through time and among areas. Similarly, occupancy at the level of the subunit can also be estimated. Changes in survey effort (i.e., more or less subunits completed) have no impact on data comparability as long as spatial coverage is fairly complete because each sample will be drawn from the entire population. The approximate 5-year sampling rotation for each area will be sufficient to detect large scale trends in overall populations. Due to direct dependence on bear densities and the number subunits completed, power to detect trends cannot be conclusively determined. However, preliminary analyses suggest estimates with coefficients of variation of ~15% are likely. This level of precision should be sufficient to meet protocol objective.

Completeness. If surveys are unable to be completed in a scheduled year due to funding or logistical issues, they will be attempted in the next year if possible. Although completing double surveys on all subunits for a particular year in a given survey area is desirable, it is not required. Due to the flexibility of the analytical framework, valid estimates can still be produced if some subunits are not surveyed. That said, at some point, incomplete coverage becomes a problem. If the survey is expected to be incomplete, allocating remaining effort across the survey area to ensure representative spatial coverage is strongly recommended. Consultation with a biometrician is considered necessary if >20% of subunits are expected to be left unsurveyed. The biometrician must use expert judgement to determine proper inference when surveys are incomplete

Measurement Quality Objectives and Performance Standards

A list of quality objectives is provided in Table 2.

Table 2. Quality Objectives table for the brown bear monitoring protocol.

Measure	Quality Indicator	Quality Objective
Field Observations	Group location accuracy	+/- 50m (horizontal), no standards for vertical accuracy
	Bear group size	Pilot and observer must mutually agree on total count
	Bear group composition	Pilot and observer must mutually agree on the number adults and cubs occurring in each group
	Bear group ID	Both teams must agree on the identification of each bear group seen within each covered subunit each day

Table 2 (continued). Quality Objectives table for the brown bear monitoring protocol.

Measure	Quality Indicator	Quality Objective
Derived quantities	Total abundance	Double observer mark-resight analysis (SOP 10, Schmidt et al. 2017)
	Occupancy	Double observer mark-resight analysis (SOP 10, Schmidt et al. 2017)
	Density	Double observer mark-resight analysis (SOP 10, Schmidt et al. 2017)

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