



Monitoring Dall's Sheep in Alaska

ARCN and CAKN Inventory and Monitoring Networks, Data Quality Standards

Natural Resource Report NPS/AKRO/NRR—2017/1414



ON THE COVER

A group of ewes and lambs climb a ridge.
Photo by Matt Cameron, NPS YUGA.

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Executive Summary

The purpose of this report is to document the standards used by the National Park Service (NPS) Arctic (ARCN) and Central Alaska (CAKN) Inventory and Monitoring Networks for activities related to the collection, processing, analysis, and publication of Dall's sheep monitoring data as described in Protocol for Monitoring Dall's Sheep: Arctic (ARCN) and Central Alaska (CAKN) Inventory and Monitoring Networks (Rattenbury et al. 2017). This plan also serves as a guide for all ARCN and CAKN 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).

Acknowledgments

Funding for this project was provided through the National Park Service, Inventory and Monitoring Program. The creation of the protocol narrative involved the contributions of numerous individuals.

Introduction

The purpose of this report is to document the standards used by the Arctic and Central Alaska Networks (ARCN and CAKN, respectively) for activities related to the collection, processing, storage, analysis, and publication of monitoring data as described in Protocol for Monitoring Dall's Sheep: Arctic (ARCN) and Central Alaska (CAKN) Inventory and Monitoring Networks (Rattenbury 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 CAKN and supplement the National Inventory & Monitoring Division Quality Management Plan. The Standard Operating Procedures provide detailed protocol/program activities associated with Dall's sheep 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 Dall's sheep "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 two publications in the *Journal of Wildlife Management* (Schmidt et al. 2012, Schmidt and Rattenbury 2013).

Conceptual Framework for Monitoring

The prioritization of the Dall's sheep vital sign by both networks was based on park management priorities; the role of sheep as a key alpine species and sensitive indicator of environmental change (Murphy 1974, Hoefs and Cowan 1979, Burles and Hoefs 1984); the importance of sheep for sport and subsistence hunting and implications for harvest management; and linkages with other vital signs including climate, snow and ice, terrestrial vegetation, and other herbivore and predator species (MacCluskie et al. 2005, Lawler et al. 2009). The NPS is mandated by the Alaska National Interest Lands Conservation Act (ANILCA 1980): (1) "to protect . . . populations of . . . Dall's sheep" (Section 201 (4)(a)); (2) "to provide the opportunity for continued subsistence uses" (Section 801 (4)); and (3) "[to conserve] natural and healthy populations" (Section 814(1)). Dall's sheep can be legally hunted on park and preserve lands by federally qualified subsistence users, and sport hunting is permitted in the preserve portions of DENA, GAAR and WRST and in YUCH and NOAT. Sheep are an important game and subsistence species and populations are monitored throughout Alaska to provide continued harvest opportunities (Alaska Department of Fish and Game 2008). For park visitors, Dall's sheep are the most reliably viewed large mammal because they are non-migratory and are more numerous in alpine areas than moose (*Alces americanus*), wolves (*Canis lupus*), bears (*Ursus americanus* and *Ursus arctos*) or muskoxen (*Ovibos moschatus*). For these reasons, identifying and monitoring changes in Dall's sheep populations are of particular management concern to the parks where sheep occur.

Protocol Activities

ARCN and CAKN have the same two objectives for their Dall's sheep vital sign. This protocol covers monitoring objectives that are top priority for both networks. These objectives are:

- 1) Detect park-wide changes in Dall's sheep abundance and distribution in ARCN (GAAR and WEAR) and CAKN (DENA and WRST).
- 2) Detect changes in the sex and age composition of Dall's sheep populations in ARCN and CAKN park units.

Sampling Design

The survey area for each of these park units is based on all available Dall's sheep habitat within these parks as well as small, contiguous areas outside of NPS boundaries containing historically surveyed areas (Figure 1).

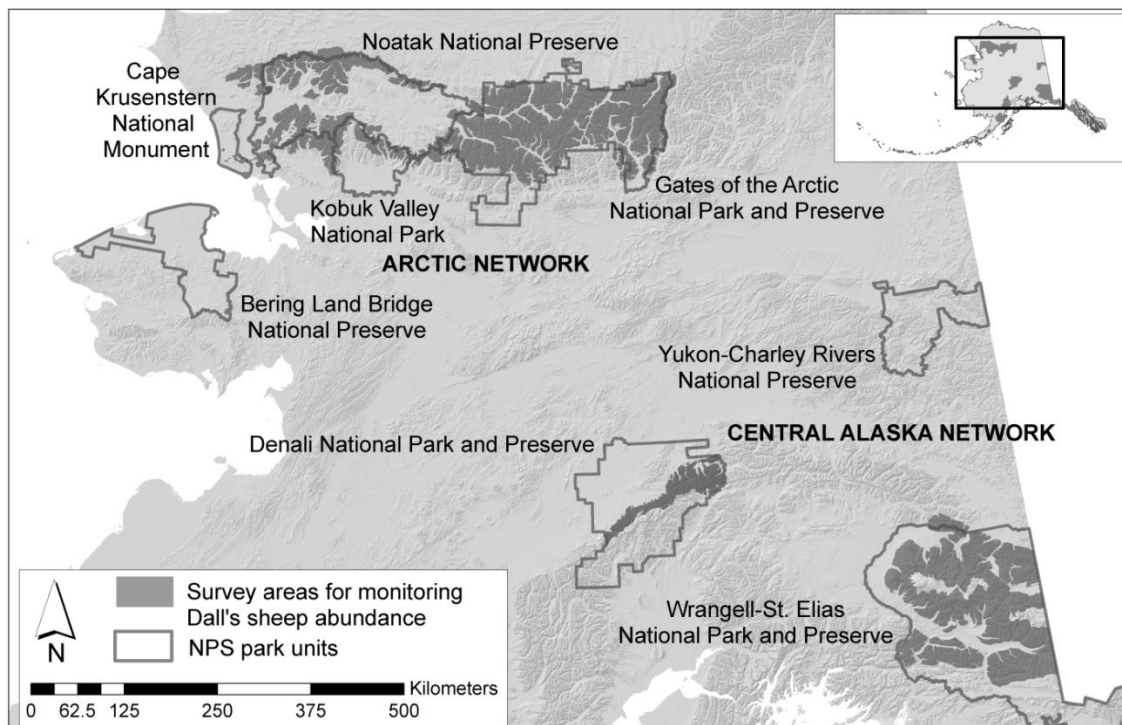


Figure 1. Survey areas for long-term monitoring of Dall's sheep abundance in the Arctic and Central Alaska Network park units.

Transects are generated across the survey area where the center point of each transect is located on a random-start grid of predetermined spacing (see Rattenbury et al. 2017). A new set of transects will be generated each time a survey is conducted for a given survey area (park unit or reference area). Grid spacing can range between five to ten kilometers depending upon the size of and desired sampling intensity for a given survey area. Distance sampling surveys typically require a minimum

of 60–80 detections on transect in order to estimate the detection function, and more detections when populations occur in groups or strata (Buckland et al. 2001) or when higher precision is desired for population monitoring and management (Buckland et al. 2004). However, by combining information across surveys in a spatially explicit framework, sample size requirements and the number of transects for individual surveys may be reduced (Royle et al. 2004, Marques et al. 2007, Schmidt et al. 2012, Schmidt and Rattenbury 2013, SOP 12). Grid spacing should be selected based on expected sheep density to ensure adequate numbers of detections. Tighter spacing may also be used to increase the precision of annual estimates. The recommended transect length is 20 km for all surveys with some exceptions. When small park units or reference areas are surveyed, higher sampling intensity in the form of tighter grid spacing is recommended, and transect length may need to be decreased (e.g., 15km) to reduce overlap of neighboring transects.

Aerial distance sampling surveys are typically conducted in the first two weeks of July following the spring snowmelt but as close as possible to the post-lambing season when sheep are more aggregated and highly visible. ARCN will repeat park-wide surveys across GAAR and WEAR every four years (Table 1). The reference areas (Itkillik subarea and western Baird Mountains) will be surveyed when their respective park units are surveyed and again separately so that they are sampled at least two out of every four year period (Table 1). The primary survey area in WEAR has a higher density of Dall's sheep than the secondary survey area, and will be surveyed on a regular 4-year rotation (see Rattenbury et al. 2017 for definition of primary and secondary areas). The secondary survey area was sampled in 2011, has little to no sheep (Singer et al. 1983, Schmidt and Rattenbury 2013) and will not be repeated any sooner than on a 12-year rotation.

Table 1. Proposed schedule for distance sampling surveys to monitor Dall's sheep abundance in the Arctic and Central Alaska Network park units.

Park Unit / Survey Area	2010 ¹	2011 ¹	2012 ¹	2013 ¹	2014 ¹	2015 ¹	2016 ¹	2017	2018	2019
Arctic Network										
GAAR	X				X ¹	X				X
WEAR		X			X				X	
Itkillik subarea	X	X	X	X	X	X	X	X	X	X
Western Baird Mountains		X		NS ¹	X	X	X	X	X	X
Central Alaska Network ²										
Northern WRST	X									
Southern WRST		X								
DENA		X				X	X			

¹ The surveys conducted in 2010 and 2011 were part of the testing phase for using the new distance sampling and hierarchical modeling methods. The table has also been updated to show actual surveys in from 2012-2016. The 2013 Western Baird Mountains survey was cancelled for weather. GAAR was only partially surveyed in 2014 due to weather.

² CAKN has not established a sampling schedule.

CAKN has not established a sampling schedule due to a lack of funding, but the recommendation is to repeat park-wide surveys of DENA and WRST every four years. DENA may be repeated sooner than that (e.g., every two years) because the survey area is small and can be flown in 32 hours at the sampling intensity used in 2011. WRST may be split into northern and southern survey areas to be sampled in consecutive years as in 2010 and 2011. It is recommended that there be a no-survey year for every four year period for both ARCN and CAKN. However, because of the recent Dall's sheep population decline, the Itkilik and western Baird Mountains reference areas may be surveyed annually to more closely monitor for population recovery. Additionally, if poor weather conditions prevent a survey from being conducted in a scheduled year, the survey will be attempted the following year if funding is available.

Data analysis will meet Objectives 1 and 2 by estimating total abundance and the abundance of Dall's sheep by class (lambs, ewe-like sheep, small rams, full-curl rams) 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 Dall's sheep within each park unit or defined sub-unit 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 distance sampling framework provides estimates of abundance, which can also be converted to densities. Densities are directly comparable through time and among areas. Changes in survey effort (i.e., transect spacing) have no impact on data comparability because each sample will be drawn from the entire population. The approximate 5-year sampling rotation for entire parks will be sufficient to detect large scale trends in overall populations. Due to direct dependence on sheep densities and the number of transects surveyed, power to detect trends cannot be conclusively determined. However, the monitoring program has already detected a ~50% decline in the Itkillik sub-area and an ~80% decline in the Baird Mountains sub-area that occurred in 2013 (Objective 1). From the composition information, we also determined that the decline disproportionately affected the lamb and ewe-like classes (Objective 2). These early results demonstrate the Objectives 1 and 2 will be met through the application of this protocol (see SOP 12).

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 to provide abundance information. Although completing surveys on all transects generated for a particular year in a given unit is desirable, it is not required. Due to the flexibility of the analytical framework, valid estimates can still be produced if some transects are not surveyed. That said, at some point, incomplete coverage becomes a problem. Consultation with a biometrician is considered necessary if >25% of transects remain uncompleted at the end of the survey period. The biometrician must use expert judgement to determine proper inference when surveys are incomplete. While recording of condition variables is desirable (e.g., weather, temperature, turbulence), only total group size and group composition data are absolutely required to meet Objectives 1 and 2.

Measurement Quality Objectives and Performance Standards

Table 2. Quality Objective table for Dall's sheep monitoring protocol.

Measure / Quality Indicator	Quality Objective
Field Observations	
Group location accuracy	+/- 50m (horizontal), no standards for vertical accuracy
Sheep group size	Pilot and observer must mutually agree on total count
Sheep group composition	Pilot and observer must mutually agree on the number of lambs, ewe-like sheep, small rams, and full-curl rams occurring in each group
Temperature	+/- 1 degree F
Turbulence	Based on the pilot's classification of the average turbulence experienced while surveying a given transect
Precipitation	Classified as rain, snow, or none
Cloud cover	Classified as clear, <25%, 25-50%, 50-75%, complete
Derived quantities	
Area surveyed per transect	Calculated using GIS and the actual on-effort survey track for each transect to the nearest 1m ² (SOP 11)
Perpendicular distance to group from the transect	Calculated using GIS to the nearest 1m (SOP 11)
Total abundance	Hierarchical distance sampling analysis (SOP 12, Schmidt et al. 2012, Schmidt and Rattenbury 2013)
Abundance by composition class	Hierarchical distance sampling analysis (SOP 12, Schmidt and Rattenbury 2013)

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