



Monitoring Muskoxen Sex-Age Composition in Alaska

ARCN Inventory and Monitoring Network Data Quality Standards

Natural Resource Report NPS/ARC/NRR—2018/1798



ON THE COVER

A mixed age group of muskoxen in the Cape Thompson population.
(NPS/HILLARY ROBISON)

Monitoring Muskoxen Sex-Age Composition in Alaska

ARCN Inventory and Monitoring Network Data Quality Standards

Natural Resource Report NPS/ARCN/NRR—2018/1798

Joshua H. Schmidt¹

¹ U.S. National Park Service
Central Alaska Network
4175 Geist Road
Fairbanks, AK 99709

November 2018

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

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Report Series is used to disseminate comprehensive information and analysis about natural resources and related topics concerning lands managed by the National Park Service. The series supports the advancement of science, informed decision-making, and the achievement of the National Park Service mission. The series also provides a forum for presenting more lengthy results that may not be accepted by publications with page limitations.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received formal peer review based on the importance of its content, or its potentially controversial or precedent-setting nature. Peer review was conducted by highly qualified individuals with subject area technical expertise and was overseen by a peer review manager. The methods presented in this report are based on established, peer-reviewed protocols.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available in digital format from [Arctic Network website](#) and the [Natural Resource Publications Management website](#). If you have difficulty accessing information in this publication, particularly if using assistive technology, please email irma@nps.gov.

Please cite this publication as:

J. H. Schmidt. 2018. Monitoring muskoxen sex-age composition in Alaska: ARCN Inventory and Monitoring Network, data quality standards. Natural Resource Report NPS/ARC/NRR—2018/1798. National Park Service, Fort Collins, Colorado.

Contents

	Page
Figures and Tables	iv
Executive Summary	v
Acknowledgments.....	v
Introduction.....	1
Protocol Overview	1
Conceptual Framework for Monitoring.....	2
Protocol Activities.....	3
Sampling Design.....	3
Data Quality Objectives.....	3
Representativeness and Data Comparability	3
Completeness.....	4
Measurement Quality Objectives and Performance Standards	4
Literature Cited	5

Figures and Tables

Page

Figure 1. Survey areas for long-term monitoring of sex-age composition of muskoxen in the Arctic Network park units. 2

Table 1. Quality Objective table for the Protocol Implementation Plan for Monitoring Muskox Sex-Age Composition in the Arctic Network. 4

Executive Summary

The purpose of this report is to document the standards used by the National Park Service (NPS) Arctic (ARCN) Inventory and Monitoring Network for activities related to the collection, processing, analysis, and publication of muskoxen sex-age composition monitoring data as described in Protocol Implementation Plan (PIP) for Monitoring Muskox Sex-Age Composition in the Arctic Network (Schmidt et al. 2017). Two muskoxen populations are monitored as prescribed by the PIP, the Cape Thompson population whose distribution includes Cape Krusenstern National Monument and Noatak National Preserve and the Seward Peninsula population whose distribution includes Bering Land Bridge National Preserve. 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), Rattenbury and Schmidt (2017), and Robison et al (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

This report documents 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 the Protocol Implementation Plan (PIP) for Monitoring Muskox Sex-Age Composition in the Arctic Network (Schmidt et al. 2017). The policies and procedures documented in this quality-assurance plan 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 (SOPs) provide detailed protocol/program activities associated with muskoxen 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 muskoxen 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). Two muskoxen populations are monitored as prescribed by the PIP for Monitoring Muskox Sex-Age Composition in the Arctic Network, the Cape Thompson population whose distribution includes Cape Krusenstern National Monument and Noatak National Preserve and the Seward Peninsula population whose distribution includes Bering Land Bridge National Preserve (Figure 1). The study design, data collection methods, and analytical protocols have been previously documented (see Schmidt and Gorn 2013, Gorn and Dunker 2013).

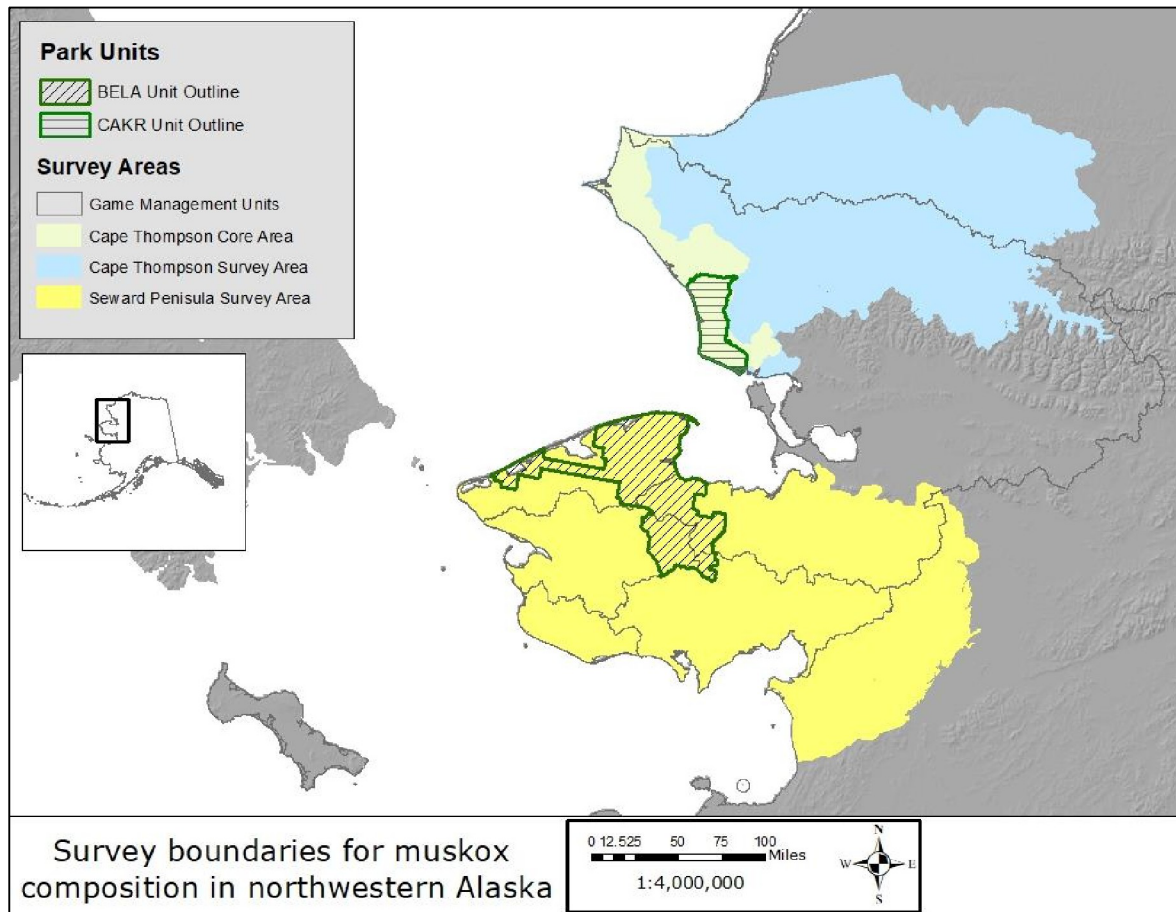


Figure 1. Survey areas for long-term monitoring of sex-age composition of muskoxen in the Arctic Network park units.

Conceptual Framework for Monitoring

Muskoxen are a circumpolar arctic species. Within the NPS system, they are only found in Parks in the ARCN. In the past few decades, climate change has been affecting the northern latitudes more than any place on earth. As a region, Alaska has warmed more than twice as rapidly as the rest of the United States over the past 60 years, with average annual air temperature increasing by 3°F and average winter temperature by 6°F (Chapin et al. 2014). Climate warming is leading to major changes in arctic ecosystems, including significant increases in woody vegetation cover (Pearson et al. 2013). Implications for an arctic ungulate, such as the muskox are substantial. In addition to changes in climate and ecosystems, muskox populations may be impacted by hunting (Schmidt and Gorn 2013). Given the NPS's mandate to provide the opportunity for continued subsistence uses, and to conserve natural and healthy wildlife populations (ANILCA 1980), understanding muskox population levels and sex and age composition is of vital importance for management.

Protocol Activities

ARCN has two objectives for their muskoxen vital sign. These objectives are:

- 1) Determine late winter muskoxen sex composition in the Cape Thompson and Seward Peninsula populations.
- 2) Determine late winter muskoxen age composition in the Cape Thompson and Seward Peninsula populations.

Sampling Design

Muskox sex and age composition are collected following the methods outlined by Gorn and Dunker (2013). Muskox groups that were located during aerial abundance surveys are relocated during muskox composition surveys. In brief, for the Seward Peninsula population (including BELA) the list of muskox groups that are located during the survey-unit wide population survey are divided into 3 classes based on group size: small (1-16), medium (17-33), and large (>33). The sample is comprised of a number of individuals from each group size-class in proportion to the distribution of size-classes in the encountered groups. Groups from each class are randomly selected and sampled in order until ≥ 150 individuals had been sampled within each given sub-area (i.e., Game Management Unit; GMU). If <150 animals are observed in a GMU, all groups are included. Due to the small size of the Cape Thompson population, all groups are sampled if possible. This was consistent with the sample size recommendations for composition surveys proposed by Czaplewski et al. (1983). Cochran's cluster sampling method with a finite population correction factor (Cochran 1977) is then used to calculate ratios summaries and confidence intervals.

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 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 sample size guidelines ensure that adequate numbers of groups and individuals are sampled in each sub-area. Due to direct dependence on muskox abundance and the number of subunits completed, power to detect trends cannot be conclusively determined. However, preliminary analyses suggest estimates with coefficients of variation of ~15-20% are likely. This level of precision should be sufficient to meet protocol objectives.

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 surveys on all sub-areas 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. The biometrician must use expert judgement to determine proper inference when surveys are incomplete.

Measurement Quality Objectives and Performance Standards

Table 1 shows the management quality objectives and performance standards used in this protocol.

Table 1. Quality Objective table for the Protocol Implementation Plan for Monitoring Muskox Sex-Age Composition in the Arctic Network.

Measure	Quality Indicator	Quality Objective
Field Observations	Group location accuracy	+/- 50m (horizontal), no standards for vertical accuracy
	Group composition	Observers must mutually agree on the number of individuals in each sex and age class within the group

Literature Cited

- Alaska National Interest Lands Conservation Act (ANILCA). Public Law 96-487. December 2, 1980.
- Chapin, F III., S. F. Trainor, P. Cochran, H. Huntington, C. Markon, M. McCammon, A. D. McGuire, and M. Serreze. 2014. Ch. 22: Alaska. *Climate Change Impacts in the United States: The Third National Climate Assessment*, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 514-536. doi:10.7930/J00Z7150.
- Gorn, T. and W. R. Dunker. 2013. Unit 22 muskox. Pages 17-51 in P. Harper, editor. Muskox management report of survey and inventory activities 1 July 2010-30 June 2012. Alaska Department of Fish and Game, Species, Management Report ADF&G/DWC/SMR-2013-2, Juneau.
- Lawler, J. P., S. D. Miller, D. M. Sanzone, J. Ver Hoef, and S. B. Young. 2009. Arctic Network vital signs monitoring plan. Natural Resource Report NPS/ARC/NRR-2009/088. National Park Service, Fort Collins, Colorado.
- Pearson, R.G., S. J. Phillips, M. M. Loranty, P. S. A. Beck, T. Damoulas, S. J. Knight, and S. J. Goetz. 2013. Shifts in Arctic vegetation and associated feedbacks under climate change. *Nat Climate Change* 3:673–677.
- Rattenbury, K. L., and J. H. Schmidt. 2017. Monitoring Dall’s sheep in Alaska: ARCN and CAKN Inventory and Monitoring Networks, data quality standards. Natural Resource Report NPS/AKRO/NRR—2017/1414. National Park Service, Fort Collins, Colorado.
- Robison, H. L., J. H. Schmidt, K. L. Rattenbury, B. S. Shults, and S. D. Miller. 2017. Protocol for monitoring brown bears for the Arctic Network: Protocol narrative version 1.0. Natural Resource Report. NPS/AKRO/NRR—2018/1763. National Park Service. Fort Collins, Colorado.
- Schmidt, J. H. and T. S. Gorn. 2013. Possible secondary population-level effects of selective harvest of adult male muskoxen. *PLoS One* 8(6): e67493.
- Wilson, T. L., and T. Shepherd. 2017. Monitoring bald eagles in Southwest Alaska Network parks: Data quality standards version 1.0. Natural Resource Report NPS/SWAN/NRR—2017/1385. National Park Service, Fort Collins, Colorado.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 953/149377, November 2018

National Park Service
U.S. Department of the Interior



[Natural Resource Stewardship and Science](#)

1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525