



Protocol for Monitoring Caribou Populations in Wrangell- St. Elias National Park and Preserve, Central Alaska Network

Narrative – Version 1.0

Natural Resource Report NPS/CAKN/NRR—2018/1750



ON THE COVER

Photograph of a radiocollared cow from the Mentasta caribou herd.
Photograph courtesy of the National Park Service

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Revision History Log

All edits and amendments made to this document since its inception should be recorded in the table below. Users of this protocol should promptly notify the project managers of recommended edits or changes. The project managers will review and incorporate suggested changes as necessary, record these changes in the revision history log, and modify the date and version number on the title page of this document to reflect these changes.

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

Contents

	Page
Revision History Log	iii
Figures.....	ix
Tables.....	ix
Executive Summary	xi
Acknowledgments.....	xiii
Acronyms	xv
Introduction.....	1
Rationale for Monitoring Caribou	1
Review of Previous Caribou Monitoring	4
Measurable Objectives	5
Sampling Design	7
Rationale for Sampling Design Selection.....	7
Identifying the Survey Area	7
Field Methods	9
Capture and Radiocollaring of Caribou.....	9
Estimation of Herd Size.....	10
Mentasta Caribou Herd.....	10
Chisana Herd	11
Fall Sex and Age Composition.....	11
Radiotelemetry: Survival and Seasonal Distribution.....	12
Data Management	13
Data Management Life Cycle.....	13
NPS Standards.....	14
Data Quality.....	14
Freedom of Information Act.....	14
Records Management	14
Core Functional Model.....	14
Data Sensitivity Statement	15

Contents (continued)

	Page
System Architecture	16
Deliverables Schedule and Roles and Responsibilities	17
Deliverables Schedule	18
Master Database	19
Quality Control and Assurance	19
Certification.....	20
Reporting	20
Master IRMA Project Reference	20
Protocols and Standard Operating Procedures	21
Website	21
Reports.....	22
Resource Brief.....	22
Product Archival and Documentation	22
Metadata	22
Line of Sight.....	23
Data and Information Security	23
Analysis and Reporting.....	25
Personnel Requirements and Training	27
Roles and Responsibilities.....	27
Qualifications and Training.....	27
Operational Requirements	29
Annual Workload and Field Schedule.....	29
Capture and radiotagging	29
Herd size estimate.....	29
Fall composition surveys.....	29
Radiotracking	29
Facility and Equipment Needs.....	29
Budget	29

Contents (continued)

	Page
References.....	33

Figures

	Page
Figure 1. Mentasta and Chisana Caribou Herd annual ranges.	2
Figure 2. Long term monitoring project life cycle.	13
Figure 3. The CAKN Core Functional Model overview.	15
Figure 4. WRST Caribou data management system components.	17
Figure 5. Overview of data collection and archival process.	21
Figure 6. Line of Sight relationships between vital sign data records and supporting documents within the IRMA Data Store.	23

Tables

	Page
Table 1. Caribou monitoring data deliverables schedule.	18
Table 2. Estimated costs to accomplish caribou monitoring objectives	30

Executive Summary

This document outlines the methods for collecting, managing and reporting monitoring data for caribou (*Rangifer tarandus*) in Wrangell-St. Elias National Park & Preserve (WRST) for the Central Alaska Network (CAKN). The CAKN has adopted a holistic view of network ecosystems and will track the major physical drivers of ecosystem change and responses of the two major components of the biota: plants and animals. The *Fauna Distribution and Abundance* Vital Sign comprises monitoring efforts for a suite of vertebrate species spanning the significant elevation gradient found in CAKN parks, and also includes species of specific interest within each park. Protection of caribou populations and habitat is specifically mentioned within the enabling legislation of WRST (Alaska National Interest Lands Conservation Act or ANILCA). Caribou occur in all three network parks and are an important component of the ecosystem. Together with moose (*Alces alces*), Dall's sheep (*Ovis dalli*), and smaller prey they help support a diverse mix of predators and scavengers including wolves (*Canis lupus*), brown bears (*Ursus arctos*), black bears (*U. americanus*), golden eagles (*Aquila chrysaetos*), foxes (*Vulpes vulpes*), coyotes (*C. latrans*), lynx (*Lynx canadensis*) and wolverines (*Gulo gulo*). All are important to the functioning of a natural ecosystem that includes humans.

The measurable objectives are to determine population size and trend of the Mentasta and Chisana Caribou Herds, estimate calf recruitment and adult sex ratios, estimate annual adult female survival, document seasonal distribution throughout the year, and assess trends in mass and body size of adult females. These objectives will be accomplished by placing radiocollars on a sample of adult cows within each herd.

Acknowledgments

We thank Layne Adams (USGS) for his extensive work on caribou in Wrangell-St. Elias National Park & Preserve (WRST) and contributions to the methods employed in this protocol. We also thank the Chisana Caribou Herd working group, Yukon Department of Environment (YDE), Alaska Department of Fish and Game (ADFG) and the previous wildlife biologists at WRST that have contributed to caribou monitoring in WRST.

Acronyms

ADFG	Alaska Department of Fish and Game
ACETA	Animal Capture, Eradication, and Tagging of Animals
ANILCA	Alaska National Interest Lands Conservation Act
CAKN	Central Alaska Network, Inventory and Monitoring Program, NPS
DENA	Denali National Park & Preserve
IACUC	Institutional Animal Care and Use Committee
KFN	Kluane First Nation
NEPA	National Environmental Protection Act
NPS	National Park Service
OAS	Office of Aviation Services, U.S. Department of the Interior
TNWR	Tetlin National Wildlife Refuge
USGS-ASC	United States Geological Survey- Alaska Science Center
YDE	Yukon Department of Environment
YUCH	Yukon-Charley National Preserve
WRFN	White river First Nation
WRST	Wrangell-St. Elias National Park & Preserve

Introduction

The Central Alaska Network (CAKN) has adopted a holistic view of network ecosystems and will track the major physical drivers of ecosystem change and responses of the two major components of the biota: plants and animals. Thus, the CAKN has identified *Fauna Distribution and Abundance* as one of its top three Vital Signs. In general, the CAKN wants to know where fauna are distributed across the landscape and to track changes in both their distribution and abundance. The *Fauna Distribution and Abundance* Vital Sign comprises monitoring efforts for a suite of vertebrate species spanning the significant elevation gradient found in CAKN parks, and includes species of specific interest within each park. The purpose of this document is to describe the protocol used for long-term monitoring of the abundance, distribution and sex and age composition of caribou (*Rangifer tarandus*) in Wrangell-St. Elias National Park & Preserve (WRST), 1 of 3 park units in the CAKN. Caribou will be monitored in Denali National Park & Preserve (DENA) within the CAKN under a separate monitoring protocol.

Rationale for Monitoring Caribou

Caribou occur in all 3 CAKN parks and are of interest from several perspectives. They are 1 of 6 keystone large mammal species in interior Alaska that are of great importance to the ecosystem and to people for both consumptive and non-consumptive uses. WRST is mandated by the Alaska National Interest Lands Conservation Act (ANILCA 1980) to protect habitat for and populations of caribou (Section 201 (9)), to provide the opportunity for continued subsistence uses (Section 804 (4)), and to conserve natural and healthy wildlife populations (Section 814(1)). General statewide hunting is allowed throughout all National Preserves in Alaska and subsistence harvest by federally qualified residents is allowed within 12 of 13 park units created by ANILCA, including the three CAKN units. This monitoring protocol focuses on 2 caribou herds, the Chisana and Mentasta, which have primary spring, summer (calving), and fall ranges in WRST (Figure 1).

The Chisana Caribou Herd is a small international caribou herd that ranges across the Alaska-Yukon border. In Canada, the Chisana Caribou Herd is classified taxonomically as *Rangifer tarandus caribou*, and is grouped under the Northern Mountain ecotype of woodland caribou. In Alaska, the herd is classified as *R. tarandus granti*, barrenground caribou. The summer range is primarily within WRST, while the winter range has a larger proportion of the herd occurring in Yukon. Estimated at approximately 1800 animals in the late 1980's, the population experienced a 14-year decline associated with very low calf recruitment from 1989-2002. Human harvest from the herd in Alaska and Canada was closed in 1994 due to the decline. In 2002 the herd was listed as a "Specially Protected" population under Yukon's Wildlife Act and as part of the Northern Mountain Caribou population, was designated a species of "Special Concern" in Canada under the federal Species at Risk Act (SARA). In 2003 the herd was estimated at 720 caribou and a 4-year captive calf rearing program was initiated in Yukon to increase calf recruitment in the herd (Chisana Caribou Recovery Team 2010).

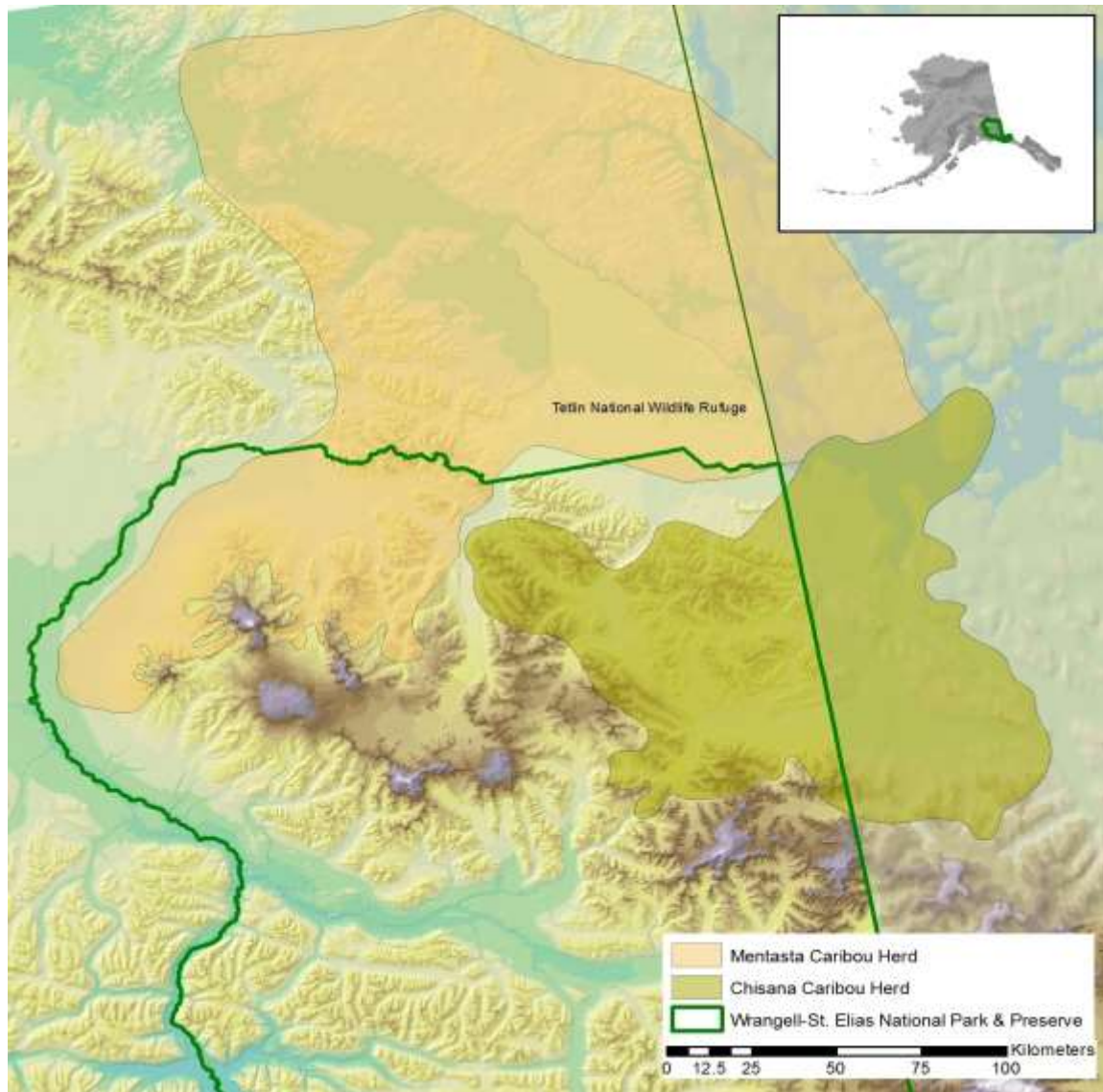


Figure 1. Mentasta and Chisana Caribou Herd annual ranges.

The Chisana Caribou Herd is managed under an international, multi-agency Chisana Caribou Herd working group and management plan that was finalized in 2011 (Chisana Caribou Herd Working Group 2012). Managing agencies in Yukon include the Yukon Department of Environment (YDE), White River First Nation (WRFN), and Kluane First Nation (KFN). Alaska managing agencies include WRST, Alaska Department of Fish & Game (ADF&G), and Tetlin National Wildlife Refuge (TNWR).

The goal of the Chisana Caribou Herd Working Group (2012) was “...management authorities will implement management strategies that support a stable or increasing population, and recognize the limiting factors that affect the herd. This will be measured through continued monitoring of sex ratios, calf recruitment and population size.” Objectives of the plan are (Chisana Caribou Herd Working Group 2012):

- 1) Regularly monitor the Chisana Caribou Herd, track population trends, sex ratios and recruitment, and maintain a herd that is stable to increasing.
- 2) Cooperatively manage harvest of the Chisana Caribou Herd with Yukon and Alaska management authorities to maintain a stable of increasing population.
- 3) Better understand the relationship between vegetation on the landscape and the implications to Chisana caribou and other wildlife species.
- 4) Obtain more current information on predators in the Chisana Caribou Herd range to advance our understanding of predators as limiting factors on the Chisana Caribou Herd.
- 5) Continue to learn more about the Chisana Caribou Herd and its range so that management agencies are able to make well informed decisions.
- 6) Inform the public, First Nations, and key interest groups about the status of current initiatives, conservation, and population trends for the Chisana Caribou Herd.

One of the purposes of the management plan is to allow a small harvest provided the herd remains stable and meets a minimum ratio of ≥ 35 bulls per 100 cows each year, and an observed 3-year average of ≥ 15 calves per 100 cows. Results of the 2010 Chisana caribou census met these criteria and a small annual harvest, limited to 2% of the herd, began in September 2012. The harvest quota is currently split between a subset of federally-qualified subsistence hunters in Alaska and First Nations hunters in Yukon.

The Mentasta Caribou Herd is also cooperatively managed. In the case of the Mentasta Herd, cooperators include WRST, Alaska Department of Fish & Game (ADF&G), and Tetlin National Wildlife Refuge (TNWR). In 1995, a plan was developed with the goal of "...allow[ing] for 'natural' population fluctuations which are primarily the result of natural environmental factors" (Route et al. 1995). In this plan, humans are considered an integral component of the predator prey system, thereby, allowing a harvest opportunity for local subsistence hunters. Harvest is allowed for either sex if the populations is $\geq 2,000$ caribou, number of calves is ≥ 80 , and bulls per 100 cows is ≥ 35 in a given year. Below these thresholds, harvest of bulls is allowed if certain criteria are met. Objectives of the plan are (Route et al. 1995):

- 1) To the extent possible, allow for human harvest that will have minimal affects on the production, composition and abundance of Mentasta caribou
- 2) To provide harvest priority to federally-eligible subsistence users and to allow state authorized hunting to occur whenever possible.
- 3) To monitor the herd demographics and harvest such that all pertinent data on the health of the herd are collected and disseminated to all agencies and citizens concerned with their management.

The Mentasta Caribou Herd experienced dramatic population declines in the 1990's. This herd was an important subsistence resource for local hunters but the population decline led to closure of state regulated hunting in 1990 and closure to federal subsistence harvest in 1992. The Mentasta Caribou Herd continues to fail to reach the population and demographic goals established in the management plan and hunting within WRST remains closed. In addition, some Mentasta Herd caribou winter in neighboring TNWR and are subject to incidental harvest during a subsistence winter season targeting the larger Nelchina Caribou Herd. They also can overwinter on state-managed lands, exposing them to incidental sport hunting harvest as well.

Estimates of herd size, rate of change, sex and age composition, recruitment, and distribution are crucial to making informed management decisions for caribou populations. Information gained from monitoring caribou in WRST will be compared with other vital signs monitored in CAKN. The vital sign of vegetation structure and composition will be determined by monitoring forage plants that caribou depend on. Weather data, predominately snow depths, can be used as an indicator of winter severity and any correlations with overall weather change can be compared to changes in the caribou population.

Review of Previous Caribou Monitoring

The Chisana Caribou Herd has been cooperatively monitored by ADF&G, YDE and NPS since 1987. Radiocollars were maintained on a number of adult females and calves to determine seasonal movements, and facilitate population estimates, annual sex and age composition counts, and estimates of birth rates and adult mortality. From 1987 to 2002, population estimates were derived using late June minimum counts, fall sex and age composition, recruitment, and mortality data in an ADF&G population model. The captive calf rearing program from 2003-2006 led to changes in the Chisana Caribou Herd monitoring program. All cows and calves held in the predator-free holding pen were radio-collared (208 individuals) prior to release to evaluate the success of the program. As a partner in the recovery program, U.S. Geological Survey- Alaska Science Center (USGS), implemented a fall census technique that corrects for undetected caribou using these radio-collared animals (Adams 2003; Adams and Roffler 2005, 2007).

The Mentasta Caribou Herd has been monitored consistently since the mid-1970s. During 1987-1989, ADF&G and NPS obtained herd size estimates and determined productivity, cow and calf mortality, seasonal range use, and herd interactions using radiocollared caribou (Leib et al. 1994). Herd size estimates were obtained from a fixed-wing aerial census during the postcalving aggregation period in late June followed by a helicopter sex and age composition survey immediately after the census. Sex and age composition surveys were also conducted in October. That work was followed by NPS research from 1992-1997 to determine factors contributing to the 1989-1992 rapid decline of the herd (Jenkins 1995; Barten et. al. 2001; Jenkins and Barten 2005). The primary objective was to understand factors influencing high rates of juvenile mortality. Herd size estimates were obtained using methods consistent with those used previously (Leib et al. 1994). During 1997-2003, Roffler et al. (2012) investigated individual movements, breeding season range overlap, and genetic differentiation between the Mentasta and Nelchina Caribou Herds. Beginning in 2000, herd size estimates were derived using a sightability model to account for missed cows during June post-

calving surveys. Fall sex and age ratios were used to derive the calf and bull component for the fall herd size estimate.

Measurable Objectives

The primary objectives for the monitoring described in this protocol are:

- 1) Determine population size and trend of the Mentasta and Chisana Caribou Herds.
- 2) Assess calf recruitment and adult sex ratios for these herds.
- 3) Estimate annual adult female survival.
- 4) Document seasonal distribution of caribou from these herds throughout the year.
- 5) Assess trends in mass and body size of adult females.

Sampling Design

Rationale for Sampling Design Selection

Caribou herd size estimates are generally derived from fixed-wing or helicopter aerial surveys, either by directly counting animals that are observed or by photographing post-calving aggregations (i.e. photocensus; Davis et al. 1979; Rivest et al. 1998; Valkenburg et al. 1985). The photocensus approach is most effective for large caribou herds that form dense aggregations during late-June and early-July. The Mentasta and Chisana Caribou Herds are small herds inhabiting mountainous terrain. While postcalving groups can be found in open terrain, a sizable proportion of adult females are scattered in small groups throughout both herd's summer ranges and bulls tend not to associate with females.

To overcome these challenges, herd size estimates for the Mentasta and Chisana Caribou Herds have been derived from aerial surveys using the sightability-model approach (Samuel et al. 1987; Bodie et al. 1995; Udevitz et al. 2006) to account for individuals missed during the surveys and to estimate the number of caribou outside the survey area based on detection and distribution of radio-collared animals during the surveys (Adams 2003, Adams and Roffler 2005, 2007). This approach provides objective estimates of herd size with measures of precision. Radiocollared individuals also provide the basis for assessing survival and seasonal distribution, and greatly facilitate locating caribou for sex and age composition surveys.

For small caribou herds like the Mentasta and Chisana, calf recruitment is an important determinant of population trend (Adams et al. 1995a,b; Farnell and Gardner 2002; Jenkins and Barten 2005) and is commonly assessed annually by determining calf:cow ratios during fall composition surveys. These fall surveys also provide estimates of adult sex ratios, important for guiding harvest management decisions. Adult female survival is also an important vital rate contributing to herd trends and can be estimated by regular monitoring of radiocollared individuals. During captures to attach radiocollars on to caribou, immobilized individuals can be easily weighed, measured, and blood-sampled to provide information on trends in body size.

The basic caribou monitoring design for this protocol involves maintaining a sample of radiocollared adult female caribou in each herd, locating those caribou periodically throughout the year to assess herd distribution and adult female survival, and conducting aerial surveys to estimate herd size and composition (adult sex ratio; calf:cow ratio). Radiocollared cows are used to determine sightability and adjust the herd size estimate. Caribou are captured via helicopter darting or netgunning; instrumented with radiocollars; weighed, measured, and blood-sampled, then released.

Identifying the Survey Area

The Mentasta Caribou Herd range includes the north Wrangell Mountains from the Cheshnina River north and east to the upper Copper River, and as far east as the Canadian border (Figure 1). Surveys to determine Mentasta Caribou Herd size estimates will be conducted on calving and summer range on the western and northern slopes of Mount Drum and Mount Sanford within WRST. Early fall composition counts and efforts to capture and radiocollar caribou will be conducted within the same survey area. Mentasta Herd caribou may winter within WRST or outside as far east as the Canadian

border and along the Taylor Highway (Figure 1). Seasonal radiotracking flights and GPS radiocollar locations will occur or be collected, respectively, throughout all seasonal ranges.

The Chisana Caribou Herd ranges primarily within a 13,200 km² area throughout the Nutzotin and north Wrangell Mountains from the Nabesna River east into Yukon, Canada (Figure 1). The herd's range is drained by the Donjek, Generc, White, Chisana, and Nabesna rivers. The summer range is predominantly within WRST where calving females disperse up in elevation and away from other calving females as an anti-predation strategy. During winter much of the herd moves into lowland spruce (*Picea* spp.) forest in the Asi Keyi Natural Environment Park, Yukon where about 70% of collared caribou are found each winter. Unusual winter movements north to the Beaver Creek area have occurred when the much larger Nelchina Caribou Herd was present in varying abundance between 1989 and 1995.

Herd size estimates, fall sex and age composition counts, and radiocollaring, will occur within the primary range of both herds in WRST. These monitoring activities that take place in the Yukon portion of the Chisana herd's range will be conducted under direction of biologists from YDE. Radiotracking flights and collection of GPS radiocollar locations will encompass all seasonal ranges inside and outside the WRST boundary.

Field Methods

All survey methods in this protocol require the use of aircraft. Caribou monitoring efforts that serve as the basis of this protocol are currently being conducted in WRST, so basic equipment for animal darting and radiotelemetry are available. In brief, any animal immobilization and radiotelemetry project requires substantial planning, advance purchasing of equipment and supplies, and arranging of aircraft logistics well in advance of field operations. In particular, the capture and handling of wildlife carries with it the ethical responsibility that project staff are well-trained and have appropriate experience to carry out the capture operations safely, humanely, and efficiently. Caribou monitoring programs require appropriate NPS and NEPA compliance. Animal handling procedures outlined in this protocol require review and approval by the NPS Institutional Animal Care and Use Committee (IACUC). Monitoring of the Mentasta and Chisana Caribou Herds are cooperative efforts with ADFG and YDE and therefore require regular coordination between involved agencies. Procurement of radiocollars and immobilizing drugs must be initiated several months before any planned capture operation. Arrangements to line up skilled pilots, particularly helicopter pilots adept at animal capture, must also occur well in advance.

Capture and Radiocollaring of Caribou

The caribou monitoring design requires maintaining a sample of radiocollared female caribou in each herd. Previous monitoring activities have employed the standard conventional VHF radiocollar, many of which are currently worn by caribou. Deployment of GPS Satellite radiocollars will replace conventional VHF radiocollars that have ceased to function or were retrieved from caribou mortalities. Methods to determine the number of radiocollars to maintain in each herd will be based on computer simulations using numbers of groups and proportional group distributions from previous surveys (Retti 2017). The number of annual mortalities will dictate the frequency of collaring efforts. In general, caribou are captured during September-November or February-March when air temperatures are cooler and to avoid late pregnancy. Captures in the Mentasta Caribou Herd are limited to the first half of September because they are commonly mixed together with the much larger Nelchina Caribou Herd during mid-September to early May. For the Chisana Caribou Herd, captures can be conducted in early October, before or after the fall sex and age composition survey or herd size estimate, or during late March-early April. Captures of new caribou should be well distributed among caribou groups throughout the range of the herd.

Adult female caribou are captured by helicopter darting (chemical immobilization) or net gunning operations, depending on the availability of capture drugs. Typically, a smaller helicopter such as an R-44 or Hughes 500 are best suited for the operation. A small tandem aircraft (PA-18 supercub or Aviat Husky), working closely with the capture helicopter, locates caribou for darting, monitors darted caribou during chemical induction, and checks on caribou that have been captured on previous days. Once a caribou is immobilized, it is fitted with a mortality-sensing radiocollar that has a colored and numbered vinyl marker. Standard body measurements are taken and a blood sample is drawn. Blood samples collected during the day are centrifuged each evening and the serum from each is removed and stored frozen until shipped to the appropriate lab for analysis. Caribou are weighed by placing the caribou in a weighing net and lifting with a weighing bar or tripod/come-a-

long combination attached to a digital load cell (a strain gauge will be used if there is a failure with the load cell). Once processing is complete, caribou are given antagonist drugs to reverse the effects of chemical immobilization. Each caribou that is handled must be relocated within 3 days of capture to determine that they survived the capture event.

Estimation of Herd Size

Herd size will be estimated by applying the sightability-model approach to account for detection probabilities that vary with group size, given an adequate number of radiocollared caribou (Samuel et al. 1987; Udevitz et al. 2006). Currently, this method is best suited to these small caribou herds that lack large post-calving aggregations and inhabit mountainous terrain (Adams 2003; Adams and Roffler 2005, 2007). In brief, the method requires that aerial surveys are conducted without the aid of radio-telemetry to locate groups and at sufficient intensity for sightability to be generally high. Marked groups (i.e. those containing ≥ 1 radio-collared caribou) missed during the regular survey are located and counted shortly after the survey is completed. Group size of marked groups and whether each group was observed or missed during the survey is used to determine the relationship between sightability and group size via logistic regression, to arrive at detection probabilities relative to group size. With that information, caribou missed in unmarked groups can be accounted for in a population estimate for the survey area. Further, a variance and confidence interval can be derived via jackknife (Manley 1991), bootstrap (Udevitz et al. 2006), or Monte Carlo methods. Software is available, utilizing the R platform (R Development Core Team 2006) to apply the logistic regression sightability model to aerial survey data to derive population estimates, and associated standard errors and confidence intervals (Debevec and Udevitz 2008; Fieberg 2012). Aerial surveys to estimate herd size should be conducted every year for the Mentasta Caribou Herd. The cost, remote location, and multi-agency, international logistics involved with the Chisana Caribou Herd prohibits an annual herd size estimate. The Chisana Caribou Herd working group has agreed upon conducting a herd estimate at least every 3 years.

Mentasta Caribou Herd

Censuses are conducted in late June, at the traditional time for conducting post-calving counts for caribou. At this time of year, caribou tend to be in open, high-elevation habitats, particularly on warm days with little wind. A day or 2 prior to the census, all caribou are radio-located to provide an assessment of their distribution. During the census, 3 tandem fixed-wing aircraft, with a biologist on board, are used to search the herd's summer range above 4,000 feet on the flanks of Mount Sanford and Mount Drum from the Cheshnina River on the south to the upper Copper River/Copper Glacier on the north and east. Each aircraft crew searches for caribou, without the aid of telemetry, in a pre-assigned sector (see SOP 3), expending 4-5 hours of survey time. Caribou groups that are observed are counted and classified as cows, calves, and obvious bulls (small bulls that are indistinguishable from cows fall in the "cow" class). Observers use radiotelemetry to determine whether a group is marked (includes ≥ 1 radioed caribou) and the identity of all radioed caribou in each marked group. Once the survey is completed, the aircraft crews compare their results to determine which radiocollared caribou were missed during the survey. Immediately following the survey, caribou that were unaccounted for during the survey are radio-located and their groups counted and classified. The group's location determines whether they were in the survey area and missed or outside the

survey area and not available to be observed. Groups located outside the survey area are accounted for in the population estimate. The final fall herd size estimate is derived using the estimated number of cows during the June census and the number of calves and bulls per 100 cows observed during the fall composition count.

Chisana Herd

Censuses employing the sightability-model approach are conducted in October. During this time of the year, caribou are in rutting aggregations and predominantly inhabiting the open, upland habitats. Sightability is generally high, but can be adversely affected by incomplete snow cover. A further advantage is that fall population size can be directly estimated rather than extrapolated from early summer counts. During other seasons, Chisana Herd caribou are either in small, scattered groups (summer) or commonly found in forested areas in loose aggregations (winter), both resulting in poor sightability.

A day or 2 prior to the census, all caribou are radio-located using a fixed-wing aircraft to provide an assessment of their distribution. A survey area is then delineated that encompasses the region inhabited by nearly all the radiocollared caribou with a reasonable buffer and bounded by obvious geographic features and treeline (see SOP 3 for details). During each census, a helicopter, with 1-2 observers in addition to the pilot, searches habitats within the survey area without the aid of radiotelemetry. The number of cows, calves, and small, medium, and large bulls is determined and recorded for each caribou group encountered. The occurrence of marked individuals within each group is determined via radiotelemetry immediately prior to conducting the classification count of the group. Simultaneously, a Supercub locates radiocollared caribou to determine their locations and group sizes. Following the survey, the crews determine which radiocollared animals were missed by the helicopter, and those groups are then located by the helicopter and classified. With information on marked groups observed and missed by the helicopter crew, the relationship between sightability and group size (total caribou in each group) is determined via logistic regression. Corrections for unmarked groups missed during the survey will be used to arrive at an estimate of total caribou in the survey area.

In most years for both herds, a few radiocollared females (0-6%) may be widely scattered outside the survey area. The survey area cannot be expanded to include these individuals because the resulting survey area would be too large to adequately survey with the time and money available. To account for caribou outside the survey area, we assume that the proportion of radiocollared females in the survey area is similar to that of the population and divide the survey area estimate by the proportion of radiocollared females that were within the survey area.

Fall Sex and Age Composition

Fall sex and age composition surveys are conducted during the rutting period when adult cows and bulls are well mixed. Composition surveys provide data to assess fall calf recruitment (calf:cow ratio) and adult sex ratios (bull:cow ratio) used in estimating herd size and evaluating bull survival. Helicopter surveys to assess age/ sex ratios should be conducted annually. Required resources include a helicopter and 1-2 biologists to conduct the composition count and a fixed-wing aircraft and pilot to help locate caribou groups. If funding is available, radiocollared caribou can be located

via fixed-wing aircraft a few days prior to the composition count to increase efficiency during the count. Starting at one end of the survey area, the fixed wing aircraft should fly ahead of the helicopter with the telemetry receiver on, scanning for radio-collared caribou. As caribou groups are located using telemetry, the fixed-wing aircraft directs the helicopter to each group for classification. Large groups should be herded into smaller groups so that animals are easier to sex and age, and are not missed or double counted. All caribou encountered are classified as cows, bulls, or calves based on their appearance and external sex characteristics. Bulls are further classified as small (antlers and body size indistinguishable from cows), medium (antlers and body size larger than adult cows, but with smaller beam diameter, shorter length, and fewer points than fully-mature bulls), or large (large-bodied individuals with fully developed antlers (3+ feet) with thick beams, long antler length, and many points).

Radiotelemetry: Survival and Seasonal Distribution

All radiocollared caribou are relocated by aerial radiotracking from fixed-wing aircraft at intervals throughout the year to evaluate survival patterns of adult females, provide an assessment of the herd's season distribution and to aid in conducting herd size estimates. Ideally, caribou should be radiotracked approximately every 2 months, however budgets probably cannot accommodate this intensity. The minimum annual radio tracking schedule is 1) mid-June to determine post-calving distribution as part of the post-calving census (Mentasta Caribou Herd), 2) late September to mid-October to assess distribution for fall composition surveys, survival over the summer, and rutting distribution, 3) late January to document survival and midwinter distribution, and 4) mid-March to determine late winter distribution and survival. As funding allows, additional radiotracking flights should be conducted in 1) mid-May to determine productivity of radiocollared females by observation of calves at heel, retained hard antlers, or distended udders, 2) late July to determine survival and summer distribution, and 3) late November to determine survival and early winter distribution. As VHF radiocollars are replaced with GPS Satellite collars, radiotracking and associated costs will be shifted to GPS location data acquisition and fees. GPS location data will provide ample data to determine seasonal home ranges and female survival.

Information collected for each caribou as it is located includes the date and time located, the mode of the signal (active or mortality), estimated group size, sex and age composition of animals if possible, and coordinates of the location or waypoint number from the onboard GPS. For mortalities it is useful to take a close look from the air to determine if a carcass or evidence of a kill can be seen and to determine whether the location of the mortality can be easily accessed by helicopter. In order to accurately determine the distribution and survival of caribou within a herd, it is very important to locate all the caribou during each radio-tracking effort if at all possible. On occasion, a few caribou will be difficult to locate and invariably some will be missed. Commonly, these animals either determine the extremes of the herd's distribution, are dead in areas where the radio-signal range is limited due to terrain, or their radiocollar has failed. It is imperative that the number of missed animals is kept to a minimum and that they are noted and additional efforts are made to locate them in the subsequent radiotracking bout.

Data Management

Data Management Life Cycle

Data management for the WRST caribou monitoring program will proceed through an ongoing life cycle as shown in Figure 2. Major stages of the life cycle include:

- Data collection
- Data entry and importing
- Quality control
- Dataset certification
- Data analysis and reporting
- Dataset documentation, archival and publication
- Standard operating procedures revision.

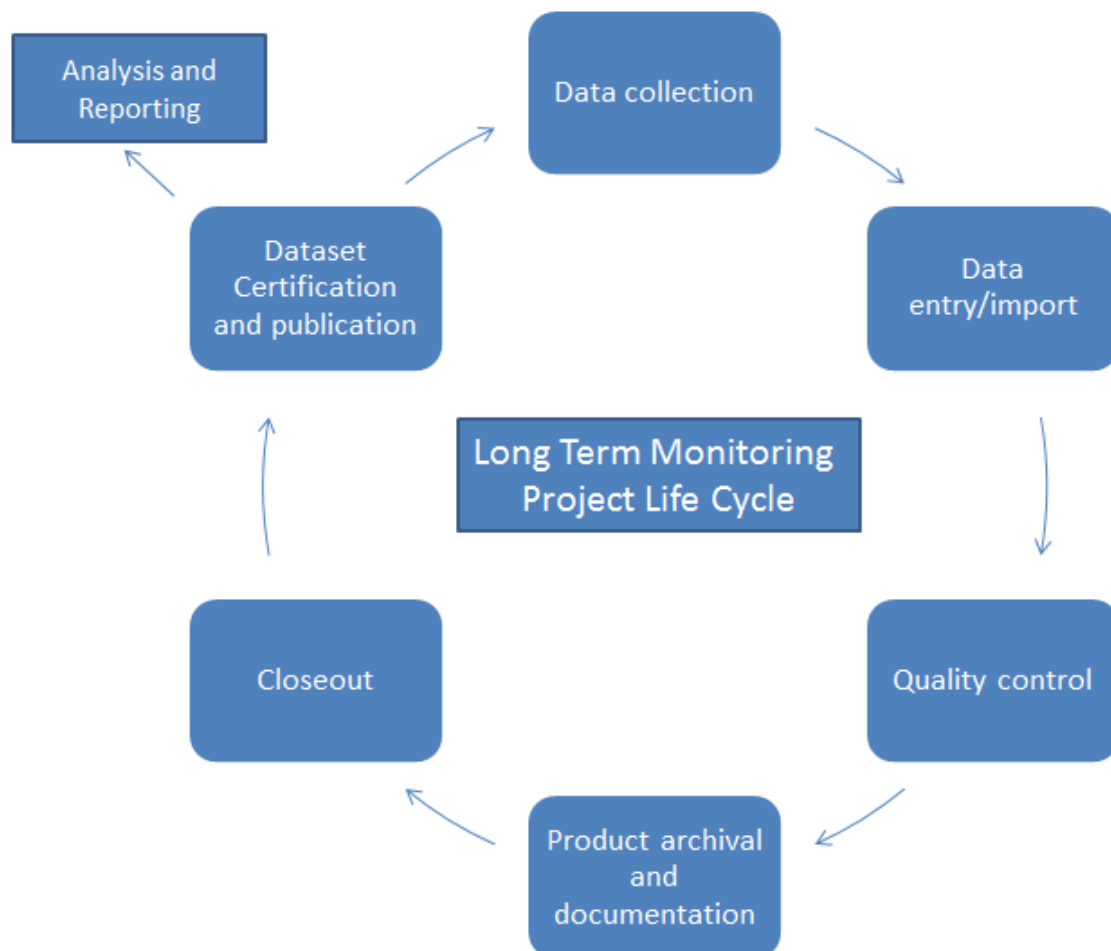


Figure 2. Long term monitoring project life cycle.

Each of these topics is covered in the sections below with specific guidance provided in standard operating procedures.

NPS Standards

Data Quality

Director's Order #11 mandates a high level of information quality from the service's scientific programs:

"The NPS will ensure that information it releases to the public or utilizes in management decisions will be developed from reliable data sources that provide the highest quality of information at each stage of information development. The NPS's methods for producing quality information will be made transparent, to the maximum extent practicable, through accurate documentation, use of appropriate internal and external review procedures, consultation with experts and users, and verification of the quality of the information. The NPS will also keep users informed about corrections and revisions.

Information will be developed only from reliable data sources based on accepted practices and policies, utilizing accepted methods for information collection and verification. To ensure high quality, information should be peer reviewed at an appropriate level and at appropriate times. Data will be reproducible to the extent possible. Influential information will be produced with a high degree of transparency about data and methods. The information should include all pertinent information to allow the public to understand the park's legislative authorities, mission, activities, organization, strategic plan, performance plan, and performance accomplishments."

Adherence to the data management procedures in this monitoring protocol will ensure compliance with DO#11.

Freedom of Information Act

The Network will comply with all FOIA restrictions regarding the release of data and information as instructed in NPS Director's Order #66

Records Management

Direction for managing physical and digital materials is provided in NPS Director's Order 19: Records Management (2001) and its appendix, NPS Records Disposition Schedule (NPS-19 Appendix B, revised 5- 2003) (<http://www.nps.gov/policy/DOrders/DOrder19.html>). Director's Order NPS-19 states that all records of natural and cultural resources and their management are considered mission-critical records, that is, necessary for fulfillment of the NPS mission. NPS-19 further states:

"Mission critical records are permanent records that will eventually become archival records. They should receive the highest priority in records management activities and resources and should receive archival care as soon as practical in the life of the record."

Core Functional Model

Data generated by the WRST caribou monitoring program are managed according to the Core Functional Model described in Figure 3.

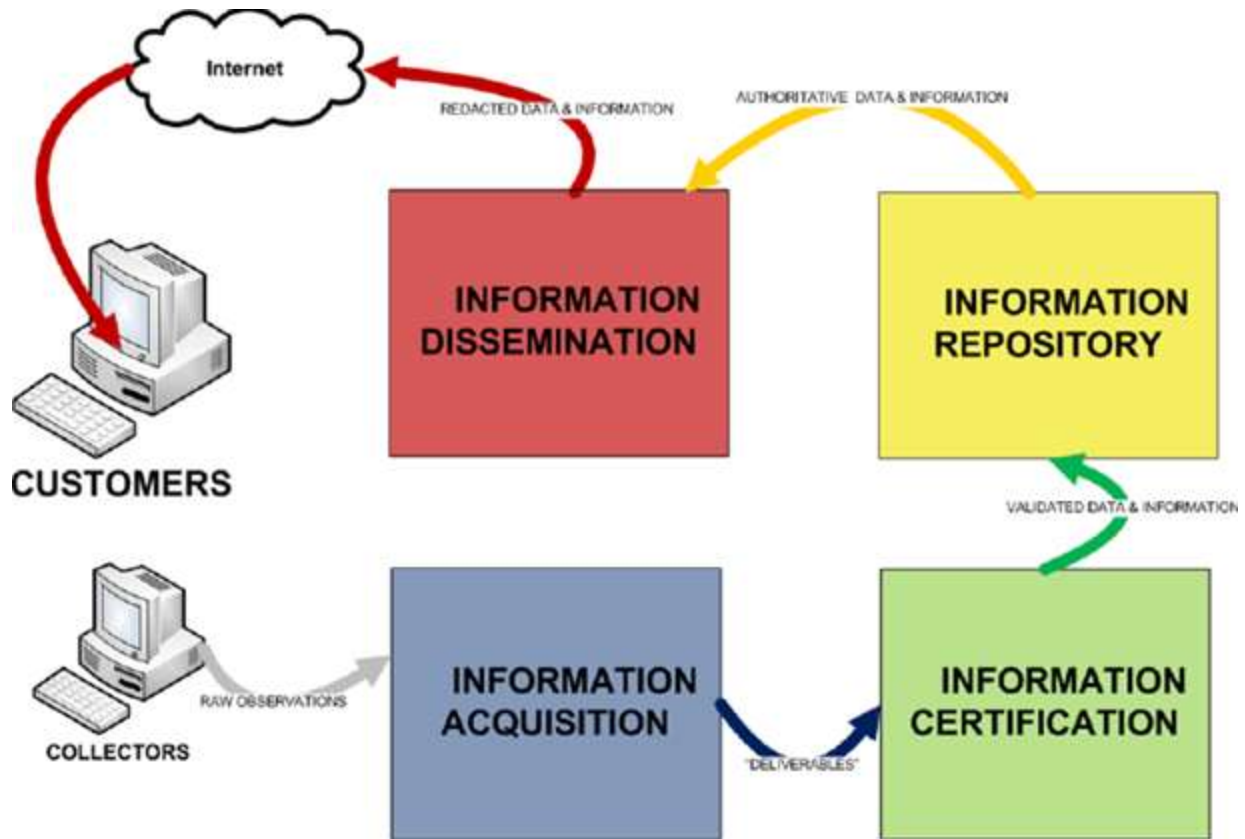


Figure 3. The CAKN Core Functional Model overview.

Dissemination services (red, Figure 3) provide all deliverables to all customers using Internet web services through the NPS Integrated Resource Management Applications (IRMA) Data Store. Repositories (yellow) store the certified inventory and monitoring products called for in the protocols. Certification processes (green) assure repositories have the highest quality data and that sensitive items are restricted to authorized users. Data acquisition processes (blue) led by park staff and cooperators include a wide array of tasks, ranging from collecting raw data to composing reports on long-term trends.

Data Sensitivity Statement

The NPS is directed to protect information about the nature and location of sensitive park resources under one Executive Order and four resource confidentiality laws:

- Executive Order No. 13007: Indian Sacred Sites
- National Parks Omnibus Management Act (NPOMA; 16 U.S.C. 5937)
- National Historic Preservation Act (16 U.S.C. 470w-3)
- Federal Cave Resources Protection Act (16 U.S.C. 4304)
- Archaeological Resources Protection Act (16 U.S.C. 470hh)

When any of these regulations are applicable, public access to data can be restricted. If disclosure could result in harm to natural resources, the records may be classified as ‘protected’ or ‘sensitive’. The NPS recognizes the following resources as sensitive:

- Endangered, threatened, rare, or commercially valuable National Park System resources
- Mineral or paleontological sites
- Objects of cultural patrimony
- Significant caves

The CAKN caribou monitoring protocol defines the collection of sensitive data and requires special handling procedures.

The justification for this declaration of sensitivity is that the data deals with ‘rare, threatened, endangered, or commercially valuable species’. Network staff must ensure that all references to protected information are removed or obscured in any reports, publications, maps, or other public forum. Following the standard for Freedom of Information Act (FOIA) requests, the Network will segregate the non-releasable information and where practical will not withhold associated releasable information. Metadata for that dataset and the IRMA citation must also be updated to reflect that the associated data is sensitive. Network staff must ensure that all references to protected information are removed or obscured in any reports, publications, maps, or other public forum.

The project leader is responsible for maintaining the security of data released to any NPS dataset catalog and ensuring confidentiality agreements are in place before sharing data with any non NPS entity.

System Architecture

The WRST caribou monitoring data management system has many components. Files related to day to day operations as well as raw and working data files reside in the WRST Caribou monitoring directory on the dedicated CAKN shared drive. GPS collar data is stored in the Alaska Region GIS team’s Animal Movement database. Caribou capture and survey data is stored and accessed through the WRST_Caribou SQL Server database at the Fairbanks Administrative Center. Raw and processed data deliverables from the deliverables schedule (Table 1), certified datasets and related data products such as reports and analyses are archived with metadata in the IRMA Data Store (Figure 4).

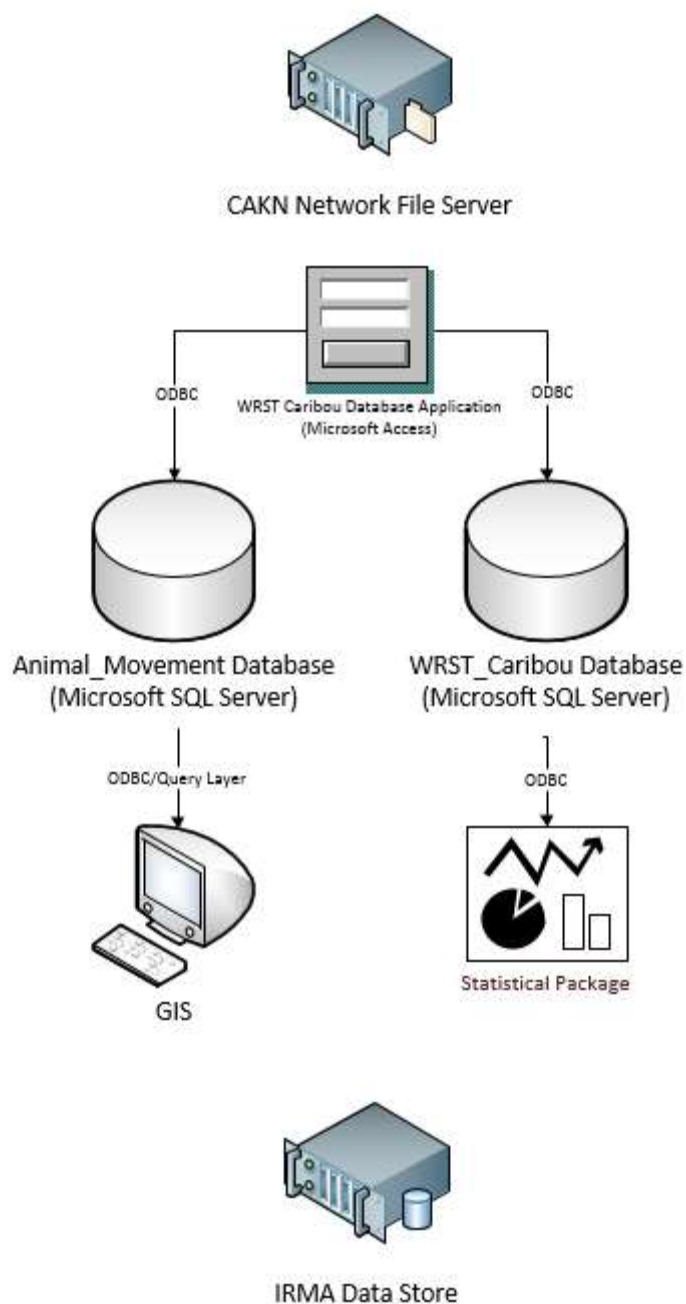


Figure 4. WRST Caribou data management system components.

Deliverables Schedule and Roles and Responsibilities

The caribou monitoring program creates and maintains specific data deliverables that are describe in Table 1. Deliverables are integrated with the caribou monitoring databases at which time they are documented with metadata and archived as private Dataset references in the IRMA Data Store. While data products may reside in the CAKN shared drive for convenience while processing for quality and integrating with master databases, the single authoritative source for certified and

documented data products is always the IRMA Data Store. In the event that a data product ever diverges from that in the IRMA Data Store the latter version should be considered authoritative.

Deliverables Schedule

The caribou monitoring program will create and maintain the data deliverables shown in Table 1.

Table 1. Caribou monitoring data deliverables schedule.

Data Type	Identifier	Deliverable	Format	Schedule	Responsibility*
Capture	CPT-01	Scanned capture data sheets	Physical forms and scans	Annual	PI
	CPT-02	Capture photographs	Jpeg images	Annual	PI
	CPT-03	Capture specimens, swabs, blood, hair, etc.	Physical specimens	Annual	PI
	CPT-04	Capture waypoints CSV file	CSV file	Annual	PI
	CPT-05	Blood sample analysis results	Results as received from lab	Annual	PI
Chisana composition count	CC-01	Chisana composition count survey data forms	Physical forms (scanned pdf)	Annual	PI
	CC-02	Chisana composition count survey waypoints CSV file	CSV file	Annual	PI
	CC-03	Chisana composition count survey tracklog CSV file	CSV file	Annual	PI
	CC-04	Photographs	TIFF or JPG	Annual	PI
Chisana population	CP-01	Chisana population survey data forms	Physical forms (scanned pdf)	Annual	PI
	CP-02	Chisana population survey waypoints CSV file	CSV file	Annual	PI
	CP-03	Chisana population survey tracklog CSV file	CSV file	Annual	PI
	CR-01	Chisana radiotracking survey data forms	Physical forms (scanned pdf)	Annual	PI
Chisana radiotracking	CR-02	Chisana radiotracking survey waypoints CSV file	CSV file	Annual	PI
	CR-03	Chisana radiotracking survey tracklog CSV file	CSV file	Annual	PI

*PI=Principle Investigator, DM = Data Manager

Table 1 (continued). Caribou monitoring data deliverables schedule.

Data Type	Identifier	Deliverable	Format	Schedule	Responsibility*
Mentasta composition count	MC-01	Mentasta composition count survey data forms	Physical forms (scanned pdf)	Annual	PI
	MC-02	Mentasta composition count survey waypoints CSV file	CSV file	Annual	PI
	MC-03	Mentasta composition count survey tracklog CSV file	CSV file	Annual	PI
Mentasta population	MP-01	Mentasta population survey data forms	Physical forms (scanned pdf)	Annual	PI
	MP-02	Mentasta population survey waypoints CSV file	CSV file	Annual	PI
	MP-03	Mentasta population survey tracklog CSV file	CSV file	Annual	PI
Mentasta radiotracking	MR-01	Mentasta radiotracking survey data forms	Physical forms (scanned pdf)	Annual	PI
	MR-02	Mentasta radiotracking survey waypoints CSV file	CSV file	Annual	PI
	MR-03	Mentasta radiotracking survey tracklog CSV file	CSV file	Annual	PI
Certified dataset	CD-01	Certified dataset	SQL Database restoration script – human readable text file	Annual	DM

*PI=Principle Investigator, DM = Data Manager

Master Database

Field deliverables are collected, processed for quality and then integrated into the master caribou monitoring database. This database is built on a two-tiered model consisting of a single client-server back-end database named 'WRST_Caribou' (Microsoft SQL Server 2008R2) serving multiple front end analytical and data management applications (e.g., Microsoft Access, ArcGIS, R). Contact the Network data manager or PI for database access and connection information. The database is situated behind the NPS firewall and access is limited to NPS staff with appropriate permissions managed by the data manager. The master working database is used for assessing and improving data quality until such time that it is certified. At that time a certified copy is archived in the IRMA Data Store and the master dataset's reference in IRMA updated with metadata and access information.

Quality Control and Assurance

Data entry and quality control operations occur primarily using GIS and database applications to visually inspect spatial and tabular data. Python, Transact-SQL and R scripting are used to import data into the main monitoring database and perform automated quality control checks. Database and statistical scripts change and improve frequently. We will store them in GitHub, a public source

code repository (<https://github.com/NPS-ARCN-CAKN/WRST-Caribou>), where they are readily accessible, documented and versioned.

Certification

Certification is the last step in the data management lifecycle and indicates that the monitoring dataset is ready for analysis. Certification does more than indicate that a set of records is complete it also indicates that the related protocol, standard operating procedures and data products are properly documented and archived in good order.

Certification communicates to the data consumer that they may be confident that the data is of excellent quality:

- The monitoring protocol and all standard operating procedures are complete and up to date
- Each data record is traceable to the protocol version and SOP version that guided its collection.
- The data being published has undergone quality control and assurance procedures and has been deemed as free of errors as reasonably possible and to the best abilities of the scientist or their designees for data management.
- All dataset closeout activities have been performed. Such activities include archiving all raw, intermediate and finished data processing files with metadata or written documentation in the IRMA Data Store
- Products are linked to the main monitoring project's IRMA reference in a logical and traversable way that provides for discovery of such products from the main project reference.
- The scientist in charge of the data has signed that the dataset is of sufficiently high quality that analyses may be performed on it and the results published.

Reporting

Master IRMA Project Reference

The NPS IRMA Data Store is the primary organizational repository and publication platform for information related to the WRST caribou monitoring program. A single IRMA project reference (<https://irma.nps.gov/App/Reference/Profile/2220179>) serves as the master reference for the Vital Sign. All deliverables and raw data products are archived in IRMA where possible and linked to the master project reference. This architecture guarantees that discovering any individual product leads to discovery of all the other products (Figure 5 and see Figure 6 in the Line of Sight section below).

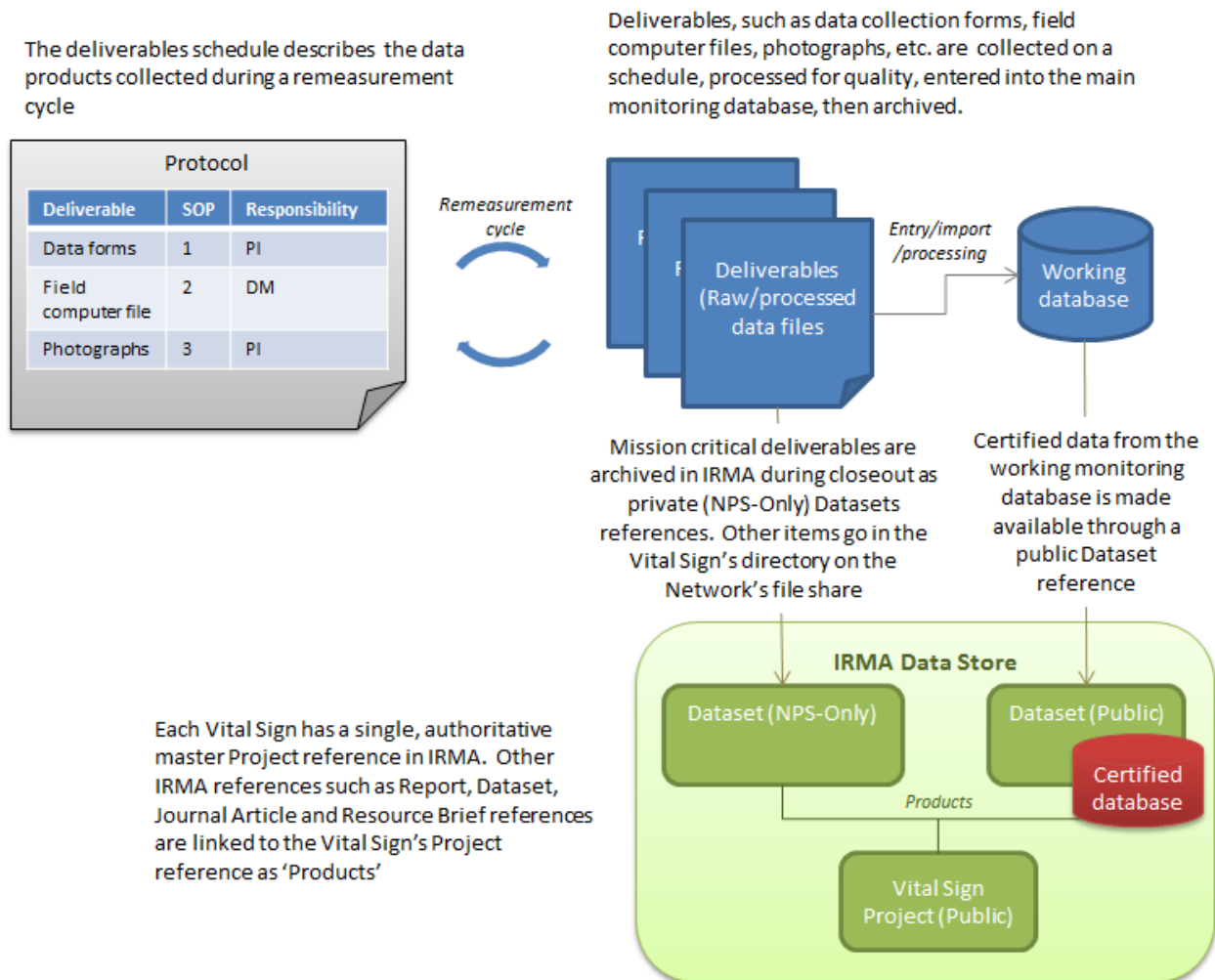


Figure 5. Overview of data collection and archival process.

Data quality improves as it moves from collection of raw data deliverables through quality control and database integration procedures and into a series of well-documented IRMA Data Store references. All Data Store references are linked to a single, authoritative Vital Sign master Project Reference.

Protocols and Standard Operating Procedures

The monitoring protocol and standard operating procedures are stored and versioned in IRMA and linked to the master IRMA project reference. The national I&M office maintains a directory of monitoring protocols and SOPs and this protocol will integrate with their system.

Website

The public caribou monitoring web profile (<https://www.nps.gov/im/cakn/caribou.htm>) will publish the releasable contents of the WRST caribou Vital Sign's master Project reference using IRMA's web services. The website pulls data from the master Project reference for display. It is the joint responsibility of the PI and the data manager to keep the system of related IRMA references up to date.

Reports

Reports are published in the form of NPS Natural Resource Reports (NRR), Natural Resource Data Series (NRDS) Reports (<https://www.nps.gov/im/publication-series.htm>) or professional journal articles. Data are published with reports and archived in tandem in the IRMA data store.

All reports providing statistical results will also publish the dataset with metadata on which they were based, as well as link to the certified original dataset, i.e. ‘publish the data with the report’.

Resource Brief

The I&M resource brief is the primary outreach document for the WRST caribou monitoring program. The principal investigator revises and publishes the resource brief after new findings to reflect current understanding of the resource’s trend and implications for park management. The resource brief is archived in the IRMA Data Store and linked as a product of the Vital Sign master Project reference.

Product Archival and Documentation

NPS Director’s Order 19 states that all records of natural and cultural resources and their management are considered mission-critical records (necessary for fulfillment of the NPS mission) and must be permanently archived.

Deliverables are not considered delivered until they exist in the IRMA data store with complete metadata. IRMA is the only authoritative repository for mission critical I&M products. Details of the metadata procedures for the WRST caribou monitoring protocol are in SOP 6.

Data archiving is done in concert with seasonal close out and data certification (SOP 6). All data are archived in the following ways:

- Within our SQL Server database
- Within CAKN’s database backup files
- In WRST Caribou monitoring directory on the CAKN shared drive
- In the IRMA Data Store.

The network data manager and project manager(s) develop metadata for archived data products. Data deliverables that are ancillary to published products but valuable to in-house operations are archived in the WRST caribou monitoring directory on the CAKN shared network drive.

Caribou monitoring program data are maintained on a network file share and SQL Server database located in the Fairbanks Administrative Center (FAC) in Fairbanks, Alaska. The database is backed up off-site. The NRSS and FAC use enterprise-level business continuity processes to maintain data security.

Metadata

Documentation is a critical component of I&M goals of preserving information over long periods of time. Metadata is ‘data about data’ and should provide all the information a future data consumer

should know in order to use a dataset. Metadata describes the attributes of any data resource as well as background information needed to understand and interpret it. Metadata formats that are used by the WRST caribou monitoring protocol include Federal Geographic Data Committee (FGDC, 1998) for spatial data and Ecological Metadata Language (<https://knb.ecoinformatics.org/#external//emlparser/docs/index.html>) for tabular data. These formats are text based and reflect current industry standards.

Line of Sight

Line of Sight is the informal name given to the I&M program's philosophy that every data record should be inextricably and traversably linked to the standard operating procedure and protocol version that guided its collection (Figure 6). This metadata chain is maintained through metadata columns in the main monitoring database coupled with metadata maintained in each protocol and standard operating procedure's IRMA reference. A data consumer will reliably be able to access a data record and discover the standard operating procedure version that defined its collection and processing and vice versa.



Figure 6. Line of Sight relationships between vital sign data records and supporting documents within the IRMA Data Store. Each component informs and is informed by other components. Discovery of one component leads to discovery of all other components in a formalized data management chain of custody.

Data and Information Security

Digital products are stored in the IRMA Data Store, SQL Server databases on I&M servers and/or local servers and the Network file server in descending order of preference. Under no circumstances will any mission-critical information permanently reside anywhere but on I&M shared network drives or database servers. Project materials must be secured and available on I&M servers at all times. The data manager, in conjunction with IT staff at FAC and with the Network support office in Ft. Collins, CO is responsible for backups, security and longevity of monitoring data.

Analysis and Reporting

A sightability model approach will be used to estimate the herd size. A caribou group is the basic unit for analysis and the probability of observing a marked (containing at least one radiocollared animal) group is modeled as a function of covariates. The statistical methods are described for implementation with the statistical freeware R (version 3.4.2) and the R Sightability Model Package (version 1.3, Fieberg 2014). The SightabilityModel package implements a logistic regression sightability abundance estimator (Steinhorst and Samuel 1989) via the Sight.Est function. The package assumes that a set of sightability trials are performed using radiocollared animals and the resulting logistic regression model is applied to future operational surveys in which the same covariates, used to model detection probabilities from the trail data, are collected. For the Chisana herd, the sightability trial data will be collected during the operational survey. For the Mentasta herd, it may be necessary to pool sightability data from previous herd size estimates to model detection probabilities. Covariates include group size and survey crew.

As with the Chisana caribou herd, the sightability model approach will be used to estimate the Mentasta caribou herd size. However, the Mentasta herd estimate is based on a postcalving (late June) census and a fall sex and age composition survey. The analysis may be complicated by low June caribou numbers and incursion of bulls from the neighboring Nelchina caribou herd during the fall composition survey. The basic approach will be to estimate the number of cows during the June census and add bulls and calves to the estimate based on the fall bull:cow and calf:cow ratios.

Fall sex and age composition count data will be reported as the number of calves per 100 cows and the number of bulls per 100 cows for each herd. Fall sex and age ratios for the Mentasta herd will also be used to determine the Mentasta herd size estimate.

A report will be prepared for publication within one calendar year from the completion of a census or each March, reporting the results of caribou monitoring efforts the previous calendar year. All summary reports and resource briefs will be made available on the CAKN and park unit websites and on the IRMA data store.

The annual report will provide a summary of all caribou monitoring activities and data for the year, and describe the current condition of the each caribou herd monitored. Annual reports should present the dates, number of hours flown, and conditions for all tracking flights, composition counts, and herd size estimates. Other parameters to report include the number of caribou groups seen, the number of caribou classified, the number of calves, cows, and small, medium, and large bulls, the number of calves and bulls per 100 cows, and percent calves and bulls in the herd. For herd size estimates, report the number of radiocollared caribou in the herd and in the survey area, number of marked groups in the herd and in the survey area, and the number of marked groups and total number of caribou in the survey area observed by the survey crews. The report will also identify any data quality concerns and/or deviations from protocols that affect data quality and interpretation, and identify suggested or required changes to the protocol. Any changes in monitoring protocols will be documented and SOPs will be altered as necessary. The intended audience for the annual report

includes park resource managers, network staff, and external scientists. The report will be written with the input of the park biologist.

Personnel Requirements and Training

Roles and Responsibilities

The WRST wildlife biologist will serve as principal investigator for caribou monitoring in WRST. As these caribou herds are managed under multi-agency, international management plans and working groups, monitoring will be conducted in collaboration with ADFG and YDE wildlife biologists. For Chisana Caribou Herd monitoring, YDE and ADFG provide agency funding and will assume responsibility for procuring aircraft and personnel resources under agency specific regulations. Radiotracking efforts will be conducted by pilots alone or with wildlife biologists as observers. Personnel must have appropriate training and experience to conduct caribou capture and handling operations.

The individual park biologist is responsible for survey planning and logistics, data collection, data entry, data verification and validation, as well as data summary, analysis and reporting. The network data manager is responsible for data archiving, data security, dissemination and database design. The data manager, in collaboration with the park biologist, also develops data entry forms or electronic data entry systems and other database features as part of quality assurance and automates report generation. The data manager is ultimately responsible to see that adequate Quality Assurance/Quality Control (QA/QC) procedures are built into the database management system and appropriate data handling procedures followed.

Observers are typically the biologists involved in the monitoring efforts. Other observers are asked to fly as they are needed, from NPS or other agency staff with experience as observers on past caribou surveys or with experience as observers in other aerial wildlife survey work (radiotracking is a good example). As surveys typically last only a couple of days, hiring observers specifically for caribou monitoring efforts is not practical, and based on past experience, it is not necessary. Fixed-wing and helicopter pilots experienced in wildlife surveys in mountainous terrain are also required.

Qualifications and Training

Personnel participating in caribou monitoring will review the protocol narrative and SOP's to familiarize themselves with the tasks required and the appropriate training required to perform the tasks. Detailed qualifications and training requirements are found in SOP 1: Preparation and Training Requirements for the Field Season. The most essential components for the collection of credible, high-quality data from caribou surveys are experienced, competent biologists, pilots and observers. Every effort should be made to get the most experienced pilots and observers possible, but the reality is that there will likely be a mixture of both, and the least experienced observers should be teamed up with the most experienced pilots and vice versa. Pilot's flight hours of experience should be evaluated by the amount of time in low level wildlife survey work (caribou surveys, radiotracking or any work that involves spotting and observing wildlife from aircraft), not simple point to point flying.

NPS personnel involved as observers in any type of aircraft must complete aviation training as required in the A-100 Aviation Safety training module. Personnel involved in collecting data from a helicopter must have completed A-100 Aviation Safety and S-271 Helicopter Crew Member training.

Personnel involved in caribou capture work must complete the NPS, Aerial Capture, Eradication and Tagging of Animals (ACETA) training, and animal handling, and wildlife anesthesia training. The helicopter and pilot must be specifically approved by the Office of Aircraft Services (OAS) for ACETA operations. Pilots and aircraft used for all phases of caribou monitoring must be certified by Department of Interior, Office of Aviation Services. It is recommended that the Principal Investigator for the project complete training as a Project Aviation Manager, which is required for DOI employees who plan, organize, or manage the aviation operations for a project utilizing aircraft. Interagency Aviation Training (IAT) requirements and courses can be found at <https://www.iat.gov/>.

Operational Requirements

Annual Workload and Field Schedule

As described above, this caribou monitoring protocol includes essentially 4 activities that occur throughout the year:

Capture and radiotagging

Captures generally occur during early September for the Mentasta herd and early to mid-October for the Chisana herd. About 2 days of captures are required for the approximately 10-15 captures per herd per year needed to meet the goals of this monitoring protocol. Captures will require the involvement of a helicopter pilot, a fixed-wing pilot, and 2 biologists.

Herd size estimate

Herd size estimates vary among the 2 herds and have different workloads and timing. Mentasta censuses are conducted on 1 day in late June and utilize 3 pilot-observer teams in fixed-wing aircraft. Chisana censuses are conducted in early October and will require a minimum of 3-4 personnel, including a helicopter pilot, a fixed-wing pilot, and 1-2 biologist-observers.

Fall composition surveys

Conducting annual sex and age composition counts will require 1 day in early September for the Mentasta herd and 1-2 days in early to mid-October for the Chisana herd. The Mentasta herd composition count will require a helicopter and pilot, a fixed-wing aircraft and pilot and 1-2 biologist-observers.

Radiotracking

Radiotracking is expected to occur a minimum of 4 times a year. Although the logistics of completing the radiotracking for each herd are somewhat different, we expect that on average, each bout of radiotracking will take 1- 2 days. In most cases, we expect this workload to be handled by the individual pilots.

Facility and Equipment Needs

Fuel for aircraft will need to be purchased in advance and fuel transfer systems set up and tested. Fuel is available at the WRST Gulkana Flight Operations Base. For the Chisana herd work, fuel can be obtained from the WRST fuel tanks at the Chisana airstrip. During Mentasta herd captures, 55 gallon drums of fuel can be temporarily placed at the Chistochina air strip.

Most of the equipment needed in survey aircraft is required by OAS certification and contracting procedures. Aircraft must have functional radios for communication and coordination, automated flight following capability, adequate heaters for comfort in cold weather, and functioning GPS units for marking caribou locations. A very valuable, though not absolutely necessary piece of equipment is a moving-map GPS unit like the Garmin GPSMAP 296.

Budget

Personnel expenses for field work are assumed to be covered by WRST base funds. ADFG and YDE will cover the costs of their personnel who assist with monitoring efforts. Over 95% of the cost for

conducting caribou surveys is aircraft rental and fuel. The amounts listed in Table 2 are the estimated costs for accomplishing the monitoring objectives. Capture costs are calculated based on capturing 10 caribou. Note that captures could be conducted on a rotating basis each year for each herd depending on mortality rates and numbers of radiocollars currently in the herd. Radiocollars can be refurbished, lowering radiocollar costs.

Table 2. Estimated costs to accomplish caribou monitoring objectives

Estimated Costs	Mentasta Herd	Chisana Herd
Herd Size Estimate – flight time	\$6000.00	\$7000.00 ¹
Caribou Capture – helicopter flight time	\$12500.00	\$12500.00
Caribou Capture - immobilization drugs	\$3600.00	\$3600.00
Caribou Capture – darts, charges, ect.	\$750.00	\$750.00
Radiocollars (VHF)	\$3000.00	\$3000.00
Radiotracking Flights (4 flights per year)	\$8000.00	\$12000.00
Composition Survey	\$6500.00 ²	(\$7000.00 ¹)
Total	\$40350.00	\$38350.00

¹WRST share for conducting either the herd size estimate or composition survey. ADFG and YDE cover the remaining costs. The herd size estimate is conducted once every 3 years and the composition survey is conducted each year between the population estimates.

²Cost of composition survey if captures are not conducted. If captures are conducted, the composition survey is part of the cost of the capture operation.

Protocol Revisions and Archiving

All edits and amendments made to the protocol narrative should be recorded in the revision history log table at the beginning of this document. Edits and amendments made to the SOPs should be recorded in the revision history log at the beginning of each SOP. Users of this protocol should promptly notify the project managers of recommended edits or changes. The project managers will review and incorporate suggested changes as necessary, record these changes in the revision history log(s), and modify the date and version number on the title page of this document to reflect these changes. This protocol and any future versions will be archived in the CAKN SQL Server database, database backup files and in the IRMA data store. The most up-to-date protocol document will be available on the websites for both networks. The rationale for dividing a sampling protocol into a protocol narrative with supporting SOPs is based on the following:

- The Caribou Monitoring Protocol narrative is a general overview of the protocol that gives the history and justification for doing the work and an overview of the sampling methods, but that does not provide all of the methodological details. The Protocol narrative will only be revised if major changes are made to the protocol.
- The SOPs, in contrast, are very specific step-by-step instructions for performing a given task. They are expected to be revised more frequently than the Protocol narrative.
- When an SOP is revised, in most cases it is not necessary to revise the Protocol narrative to reflect the specific changes made to the SOP.
- All versions of the Caribou Monitoring Protocol narrative and SOPs will be archived in the IRMA Data Store.

The steps for changing the Protocol (either the Protocol narrative or the SOPs) are outlined in SOP #9, “Revising the Protocol”. Each SOP contains a Revision History Log that should be filled out each time a SOP is revised to explain why the change was made, and to assign a new Version Number to the revised SOP. The new version of the SOP and/or Protocol narrative should then be versioned in the IRMA Data Store. Old versions of protocol narratives and standard operating procedures must be retained to inform future scientists on how data has been handled over time.

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