Central Arctic Caribou Herd Management Report and Plan, Game Management Units 24A, 24B, 25A, 26A, 26B, and 26C:

Report Period 1 July 2017–30 June 2022, and

Plan Period 1 July 2022–30 June 2027

Jordan Pruszenski



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Species Management Report and Plan ADF&G/DWC/SMR&P-2026-29

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Species management reports and plans provide information about species that are hunted or trapped and management actions, goals, recommendations for those species, and plans for data collection. Detailed information is prepared for each species every 5 years by the area management biologist for game management units in their areas, who also develops a plan for data collection and species management for the next 5 years. This type of report is not produced for species that are not managed for hunting or trapping or for areas where there is no current or anticipated activity. Unit reports are reviewed and approved for publication by regional management coordinators and are available to the public via the Alaska Department of Fish and Game's public website.

This species management report and plan was reviewed and approved for publication by Jason Caikoski, Management Coordinator for Region III for the Division of Wildlife Conservation.

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Purpose of this Report

This report provides a record of survey and inventory management activities for the Central Arctic caribou herd (CAH; *Rangifer tarandus granti*) in portions of Game Management Units 24A, 24B, 25A, 26A, 26B, and 26C during the 5 regulatory years 2017–2021, along with plans for the next 5 regulatory years 2022–2026. A regulatory year (RY) begins on 1 July and ends on 30 June (e.g., RY17 = 1 July 2017–30 June 2018). This report is primarily produced to provide agency staff with data and analysis to help guide and record agency efforts. It is also made available to the public to inform them about wildlife management activities. The Alaska Department of Fish and Game's (ADF&G, the department) Division of Wildlife Conservation (DWC, the division) publishes these reports on a 5-year cycle to document trends and describe potential changes in data collection activities for caribou.

I. RY17–RY21 Management Report

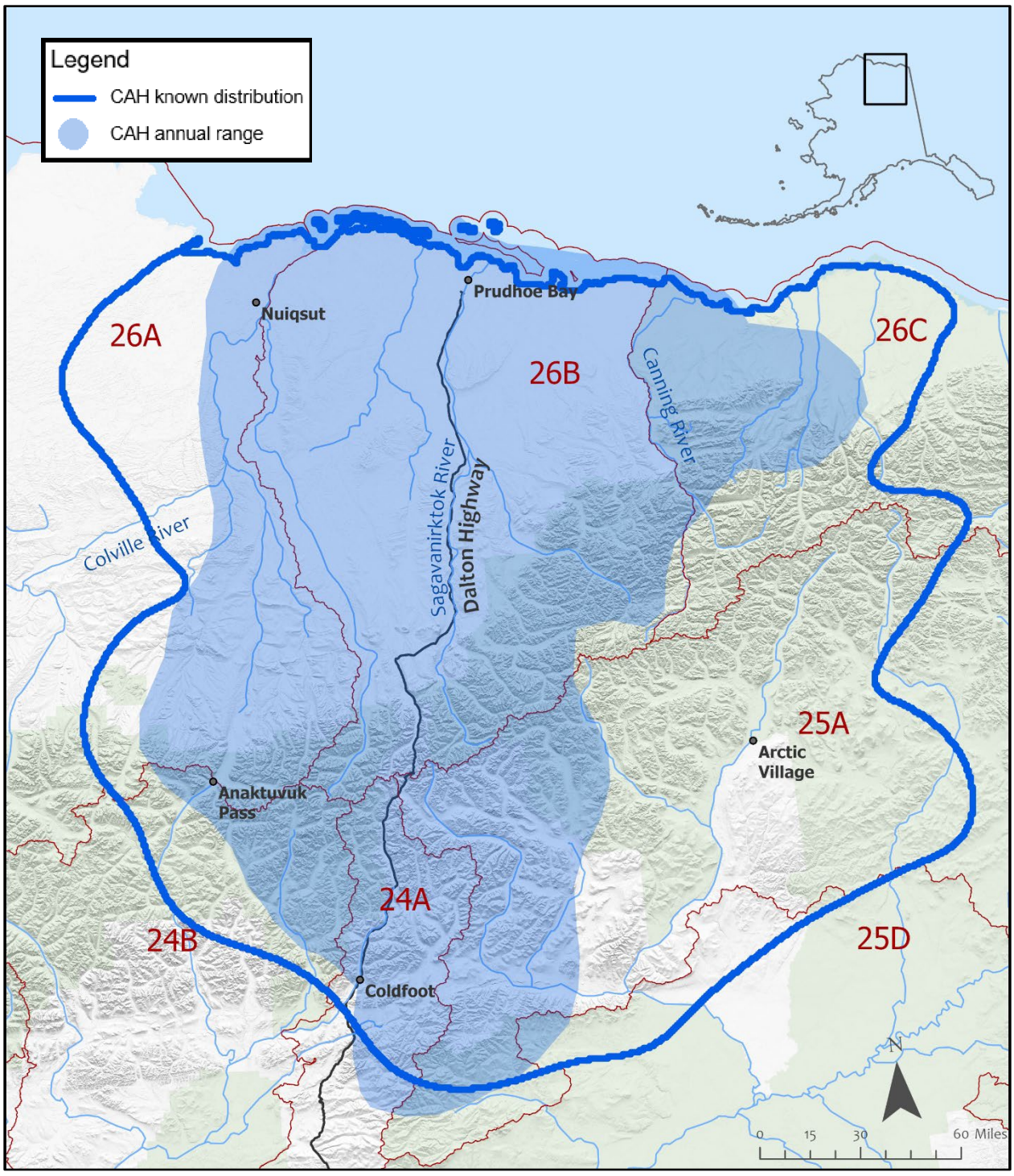
Management Area

The management area for the CAH includes all of Unit 26B and portions of Units 24A, 24B, 25A, 26A, and 26C (52,191 mi^2). The previous species management report and plan for the CAH included only Unit 26B in its title. To more accurately reflect the full extent of the CAH management area, this report and plan include all units covered by the CAH annual range in its title. The CAH has had a long-term known distribution in Unit 26B and portions of Units 24A, 24B, 25A, 26A, and 26C, and its annual range during the reporting period also occurred in the same area (Fig. 1).

The CAH management area covers eastern portions of the Arctic Slope, Brooks Range, and northeastern Interior Alaska. The herd's range encompasses the eastern North Slope coastal plain from just west of the Colville River to the Canadian border, the north side of the Brooks Range from the Itkillik River to the Canadian border, the south side of the Brooks Range from approximately the North Fork Koyukuk River to the East Fork Chandalar River, and as far south as the Chandalar River valley (Fig. 1).

Summary of Status, Trend, Management Activities, and History of the Central Arctic Caribou Herd in Units 24A, 24B, 25A, 26A, 26B, and 26C

In the mid-1970s, the CAH was recognized as a discrete herd, and in 1975, it had an estimated population of 5,000 caribou (Cameron and Whitten 1979). The herd continued to grow, peaking at an estimated 68,422 caribou in 2010 (Fig. 2). The population growth from 2000 to 2010 was due to low adult mortality, high parturition rates (≥91%), and strong fall calf recruitment. By 2016, the population had decreased to 22,630 caribou (Fig. 2). In 2017 and 2019, composition surveys using new digital camera technology confirmed that the population decreased but was stable. This decline was thought to be largely due to higher adult mortality rates during 2012–2015 (mean = 25%; range = 20–33%) and herd switching. In 2022, the population had rebounded to 34,642 caribou (Fig. 2), which was consistent with high adult survival rates during 2017–2021 (mean = 87.1%; range = 82–93%).



Map data source: ADF&G, DOT&PF, ESRI, USGS.

Figure 1. Annual range (blue shaded area) of the Central Arctic caribou herd (CAH) during regulatory years 2017–2021 compared to its long-term known distribution (thick, blue solid line), Alaska. Data are from kernel density analysis of locations of satellite-radiocollared caribou at the 95% utilization distribution contour.

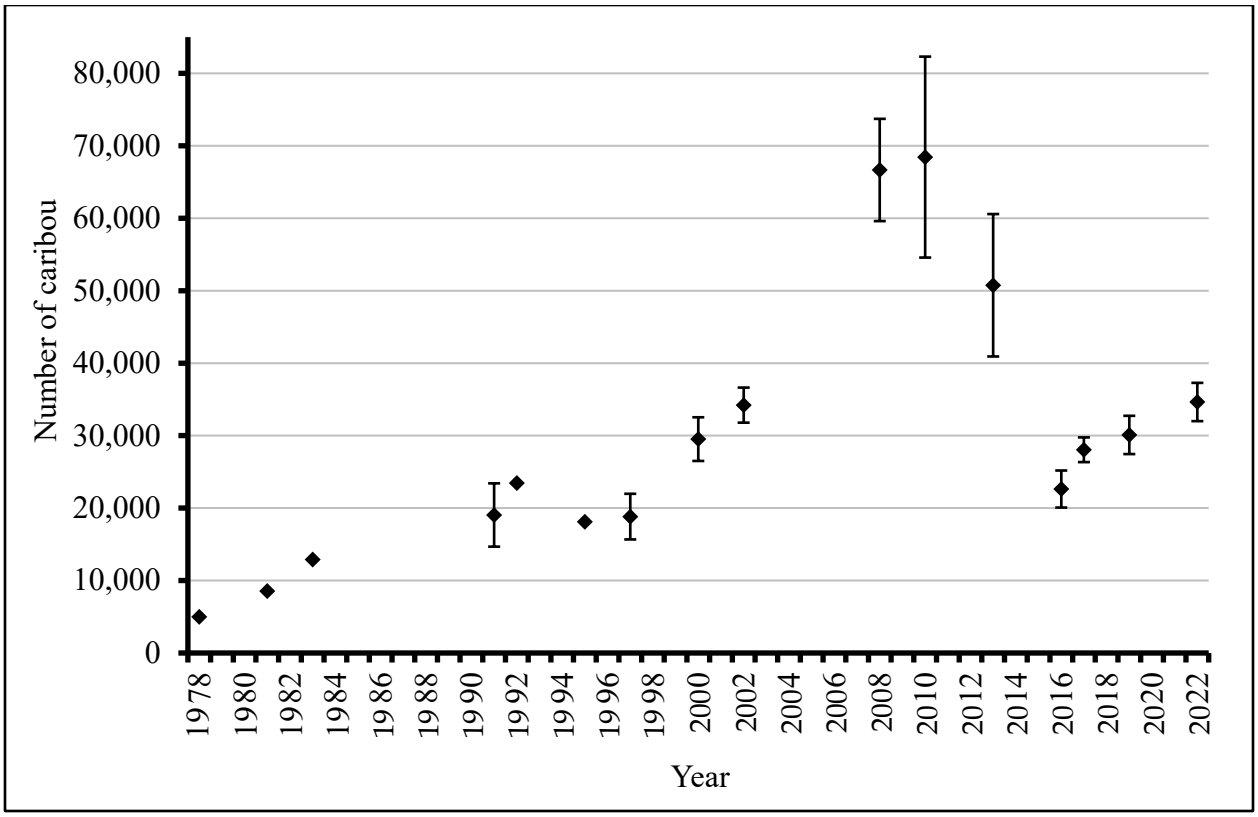


Figure 2. Central Arctic caribou herd population size, 1979–2022, Alaska. Black diamonds for years 1997–2022 represent Rivest population estimates with 95% confidence intervals (shown by solid error bars). The point estimate for 1991 is based on a random stratified quadrat survey with a 95% confidence interval. All other years represent minimum counts of caribou observed from a photocensus.

The CAH traditionally calves between the Colville and Kuparuk rivers on the west side of the Sagavanirktok River and between the Sagavanirktok and the Canning rivers on the east side (Fig. 1). In the early 1990s, the greatest concentration of caribou that calved in western Unit 26B shifted southwest as development of infrastructure related to oil production occurred in what was originally a major calving area (Lawhead and Johnson 2000, Wolfe 2000). No directional shift in the distribution of caribou that calved east of the Sagavanirktok River was noted (Wolfe 2000).

The CAH summer range extends from just west of the Colville River, eastward along the coast (and inland approximately 30 mi) to the Canadian border (Fig. 1). The herd mostly winters in the northern and southern foothills and mountains of the Brooks Range; some caribou winter on the coastal plain. Its range often overlaps with the summer and winter ranges of the Porcupine caribou herd (PCH) to the east and with the summer and winter ranges of the Western Arctic and Teshekpuk caribou herds to the west.

Oil exploration and development within the CAH's range began in the late 1960s and remains active today. Beginning in the late 1970s, ADF&G implemented long-term studies on population dynamics, distribution, movements, and effects of development on the herd. During the 1980s, calving activity was rare in the Prudhoe Bay oil field, where it was known to occur before

development (Whitten and Cameron 1983). By the mid-1980s, major movements of the CAH through the Prudhoe Bay oil field in summer had ceased, and caribou distribution and movements within the Kuparuk oil field were altered substantially (Smith and Cameron 1983, 1985a, 1985b; Whitten and Cameron 1983, 1985; Curatolo and Murphy 1986).

In the early 1990s, CAH cows and newborn calves were underrepresented along the trans-Alaska pipeline corridor and around oil production facilities (Cameron and Smith 1992, Cameron et al. 1992). During the mid-1990s, research on the CAH was reduced substantially. Efforts then shifted to monitoring population parameters and their relation to management objectives. Based on the hypothesis that displacement of enough magnitude would harm the CAH (Cameron 1983), ADF&G biologists worked with the oil industry to minimize disturbance to caribou movement caused by physical barriers created by oil development. In addition, given that stress is cumulative, the Alaska Board of Game reduced hunting activity in areas adjacent to the oil field and the Dalton Highway.

Management Direction

Existing Wildlife Management Plans

The department has no formal management plans for the CAH in partnership with external agencies or working groups.

Goals

G1. Provide the opportunity for subsistence and other hunting opportunities on a sustained yield basis.

G2. Work with development companies in the management area to mitigate effects on the CAH.

G3. Provide opportunity for viewing and other uses of the CAH.

Codified Objectives

Amounts Reasonably Necessary for Subsistence Uses

C1. The CAH has a positive finding for customary and traditional uses of game populations (5 AAC 99.025) as a population that has been taken or used for subsistence, with the amounts reasonably necessary (ANS) for subsistence set at 250–450 caribou.

Intensive Management

C2. The intensive management (IM) population objective is 28,000–32,000 caribou.

C3. The IM harvest objective is 1,400–1,600 caribou.

MANAGEMENT OBJECTIVES

M1. Maintain a population of at least 28,000–32,000 caribou (G1, G2, and G3).

M2. Maintain a harvest of at least 1,400 caribou if the population is ≥28,000 caribou (G1).

M3. Maintain a bull-to-cow ratio of at least 40:100 (G1).

M4. Maintain accessibility to seasonal ranges of the CAH (G2).

MANAGEMENT ACTIVITIES

1. Population Status and Trend

ACTIVITY 1.1. Capture and deploy 10–20 radio collars on yearling cows and 10–20 on both adult cows and bulls combined annually. Maintain at least 30 radio collars on adult cows and 10 radio collars on adult bulls. Conduct disease assessment (M1, M2, M3, M4, C1, C2, and C3).

Data Needs

Deploying radio collars on the CAH is necessary for activities related to monitoring population growth, the accessibility of historical seasonal ranges, and bull-to-cow ratios. These activities include determining mortality and survival rates, mapping the seasonal distribution of caribou, and locating caribou for photocensuses, parturition surveys, and fall composition surveys. Capturing CAH caribou also provides the opportunity to collect blood and feces, which will help develop a disease monitoring program for the CAH in the future.

Methods

Caribou were captured using a handheld netgun operated from an R-44 helicopter. Captured caribou were manually restrained with hobbles and a blindfold-hood while ADF&G staff collected measurements and fitted radio collars. Captures were conducted in mid to late June during RY17–RY21, except in RY19 when no captures occurred due to the COVID-19 pandemic. We assessed the general body condition of all caribou as very poor, poor, average, good, or very good. Also, we recorded sex (male or female); age (short yearling [11-month-old calf], yearling, or adult); and the latitude, longitude, and general location of each capture.

Results and Discussion

Captures

REGULATORY YEAR 2017

During 20–23 June 2018, 48 radio collars were deployed on 19 adult cows (including 16 recaptures and 3 random unknown-aged cows), 20 yearling cows (all random), and 9 adult bulls (all random unknown-aged bulls). All radio collars were deployed in Unit 26B near the Kuparuk River, White Hills, Itkillik Hills, and Franklin Bluffs.

Regulatory Year 2018

During 19–21 June 2019, 50 radio collars were deployed on 14 adult (>1-year-old) cows[1], 20 random yearling cows, and 16 random adult (>2-year-old) bulls. In collaboration with ConocoPhillips, 10 GPS radio collars were deployed on adult cows ≥3 years old. These collars had a fixed transmission rate of 15 minutes when within 8 km (approximately 5 mi) of the Prudhoe Bay oil field. In collaboration with the U.S. Geological Survey, 4 satellite radio collars were deployed on adult cows ≥3 years old, with a fixed transmission rate of 15 minutes on certain days in the summer. All radio collars were deployed in Unit 26B. West of Prudhoe Bay, collars were deployed between the Kuparuk River, Beechey Point, and Itkillik Hills; east of Prudhoe Bay, they were deployed near the Badami and Kadleroshilik pingos.

Body condition was assessed for 49 caribou: 18 were rated average, 28 were rated good, and 3 were rated very good. Among the 14 adult cows, 4 were rated average, 8 were rated good, and 2 were rated very good. Of the 20 yearling cows, 14 had average body condition and 6 had good body condition. Of the 16 adult bulls, 14 had good condition and 1 had very good body condition; the body condition of 1 adult bull was not assessed.

Regulatory Year 2019

No captures occurred in RY19 due to the COVID-19 pandemic.

Regulatory Year 2020

During 15–18 June 2021, 65 GPS satellite collars were deployed on 14 yearling cows, 1 unknown-aged cow (possibly 2 years old), 45 adult cows, and 5 adult bulls. Of these 65 collared caribou, 38 were recaptured and 27 were random. Based on the distribution of caribou and recaptures needed, 50 of these radio collars were deployed in Unit 26B, west of Prudhoe Bay and just west of the Kuparuk River. The remaining 15 radio collars were also deployed in Unit 26B, east of Prudhoe Bay, between the Sagavanirktok and Shaviovik rivers (with the exception of a few deployed east of the Shaviovik River).

Regulatory Year 2021

During 9–12 June 2022, 45 GPS satellite collars were deployed on 15 yearling cows, 23 adult cows (including possibly 3 two-year-olds), and 7 adult bulls. Among these 45 caribou, 16 were recaptured and 29 were random. Based on the distribution of caribou and recaptures needed, 38 radio collars were deployed in Unit 26B (west of Prudhoe Bay and just west of the Kuparuk River). The remaining 7 radio collars were deployed east of Prudhoe Bay between the Sagavanirktok River and just east of the Kavik River. All bulls were captured in the Itkillik Hills. No yearlings were weighed.

Body condition was assessed for 44 caribou: 33 were rated as average, 10 as good, and 1 as poor to average. Among the 23 adult cows >1 year old, 19 were rated as average, 3 as good, and 1 as poor to average. Of the 15 yearling cows, 10 had average body condition and 5 had good body condition. Of the 7 adult bulls ≥2 years old, 4 had average body condition and 2 had good body condition; the body condition of 1 adult bull was not assessed.

[1] These 14 adult cows consisted of 4 random unknown-aged adult cows and 10 recaptures (7 three-year-olds, 1 four-year-old, 1 seven-year-old, and 1 unknown-aged adult).

Thirteen-Month-Old Calf and Yearling Weights During Regulatory Years 2017–2018

Weights of 13-month-old cows ranged from 37.9 to 52.4 kg (83.6–115.5 lb) with an average of 45.0 kg (99.2 lb; $n = 20$) in June 2018 and ranged from 41.7 to 53.5 kg (91.9–117.9 lb) with an average of 45.8 kg (101.0 lb; $n = 13$) in June 2019. These capture weights are not comparable to those from prior years because they were collected in April or May when food availability and energy requirements differ from those in June.

Pathogen Exposure and Mineral Analyses

To investigate the health status of the CAH population, ADF&G monitored potential virus exposure by measuring antibodies using accredited veterinary diagnostic laboratory tests validated for cattle. We recognized that we lacked validated tests for caribou, and some of the assays detected cross-reacting antibodies for other potential pathogens; however, this investigation provided baseline data, which is important to acquire when assessing wildlife disease or exposure to domestic animal or wildlife pathogens. With this baseline data, we can investigate disease events or population changes over time, determine if a specific pathogen is involved, and evaluate new and specific biomarkers that serve as health indicators. Once a baseline is established, we can examine the tests for significant changes in the prevalence of antibodies, the introduction of pathogens not previously detected, or increasing inflammatory indicators. From there, we could compare CAH data with data from other caribou herds that are known to be increasing in size or have known health issues. In the future, we will evaluate trends and changes in prevalence or health status over time to determine if a pathogen or disease is having a population-level effect.

Samples were collected only in 2018 and 2019 because the field season was missed in 2020 due to the COVID-19 pandemic. Consequently, the focus in 2021 and 2022 was on deploying the required number of collars to monitor the herd. Overall, the results indicated no significant changes in the parameters, and the measured antibodies are not concerning.

Chlamydophila spp., Contagious Ecthyma, and *Coxiella burnetii*

Samples were only taken in 2018. Of the 16 adult cows tested, 1 tested positive for chlamydia, 1 tested positive for contagious ecthyma, and 1 tested positive for *Coxiella burnetii*. The prevalence of antibodies found for *Chlamydophila* spp. and *C. burnetii* was within the expected range for caribou in Alaska that were previously monitored (K. Beckmen, Doctor of Veterinary Medicine [DVM], Wildlife Veterinarian, ADF&G, personal communication, 2023). These diseases can affect reproduction by causing abortion or predisposing the cow to mastitis.

Leptospirosis

In 2019, 16 caribou were tested for 5 types of *Leptospira serovars*: *L. canicola*, *L. grippo*, *L. hardjo*, *L. ictero*, and *L. pomona*. All test results (<1:100) were within the expected range (>1:5 is considered positive; K. Beckmen, DVM, Wildlife Veterinarian, ADF&G, personal communication). These bacteria can cause kidney disease, liver disease, and abortion.

Respiratory Viruses

In 2019, 15 caribou were tested for antibodies against bovine viral diarrhea virus (BVDV) type 1 (*Pestivirus A*), BVDV type 2 (*Pestivirus B*), infectious bovine rhinotracheitis (which was documented as a cross-reaction detecting an alpha herpes virus and cervid herpesvirus 2 [CvHV2]), parainfluenza 3 (PI3), and respiratory syncytial virus (RSV). A positive antibody titer indicates exposure to and an immune reaction to an antigen but does not necessarily indicate that disease occurred. These assays have not been validated in caribou, so it is not known which virus exposure is causing the immune response, except for CvHV2. Therefore, linear trends in the prevalence of exposure have been traditionally monitored.

Pestivirus A by Serum Neutralization

Of the 15 caribou tested, none had antibody titers indicative of exposure to *Pestivirus A* (≥1:128 is considered positive). This is a decrease from 10.3% of caribou tested (n = 39) in the RY12–RY16 reporting period. It is unknown which *Pestivirus* was detected in RY12–RY16, but it was a *Pestivirus* most similar to Border disease virus, now referred to as *Pestivirus C*. Wildlife Health and Disease Surveillance Program staff at ADF&G have indicated there was an increased exposure to *Pestivirus* during 2007–2010, and possibly a disease outbreak just before 2007 (K. Beckmen, DVM, Wildlife Veterinarian, and C. Lieske, DVM, Master of Preventative Veterinary Medicine [MPVM], Wildlife Veterinarian, ADF&G, personal communication).

Pestivirus B by Serum Neutralization

Of the 15 caribou tested, 1 individual (6%) had antibody titers (≥1:128 is considered positive). Although we do not know for certain which *Pestivirus* was detected, it appears to be similar to BVDV type 2 (*Pestivirus B*) serum neutralization. The value falls within the expected range of prevalence (K. Beckmen, DVM, Wildlife Veterinarian, and C. Lieske, DVM, MPVM, Wildlife Veterinarian, ADF&G, personal communication, 2023).

P13 by Serum Neutralization

Of the 15 caribou tested, 1 individual (6%) had titers indicative of exposure to P13 (≥1:128 is considered positive), a decrease from the prevalence in RY12–RY16 (10.3%; n = 39). Values from both survey periods are within the range of prevalence found in 1988, when antibodies were first detected (n = 38; 10.5%). The herd had been negative for P13 from 1975 until 1988. The prevalence dropped dramatically to 1.6% in 1989 and 2.4% in 1990. This increase in exposure or susceptible animals is indicative of a disease outbreak that likely occurred in 1988. P13 was probably introduced from cattle and is now enzootic in most Alaska bison, caribou, and moose populations; increased stressors, additional pathogens, or parasites are likely a contributing factor to this disease.

Bovine RSV by Serum Neutralization

Of the 15 caribou tested, none had a positive antibody titer indicative of exposure to bovine RSV (≥1:32 is considered positive). This is a decrease in prevalence compared to results from RY12–RY16, when there was a 10.2% prevalence (n = 39). Bovine RSV was not a concern during this reporting period (RY17–RY21).

Brucella

In 2019, 6 adult cows were captured and tested for Brucella. All 6 of these caribou tested negative. Brucella can cause a decrease in reproduction.

Trace Minerals

Serology from 16 cows captured in 2018 and 15 cows captured in 2019 were tested for the trace minerals selenium, iron, copper, zinc, manganese, phosphorus, and calcium (Table 1).

Table 1. Trace mineral serology results for Central Arctic caribou herd cows, 2018–2019, Alaska.

Trace mineral	Year[a]	Reference range (ppm)[b]	Range (ppm)[b]
Selenium	2018	>0.100	0.12–0.23
	2019	>0.100	0.1–0.34
Iron	2018	1.3–20.5	1.3–2
	2019	1.3–20.5	0.87–2.3
Copper	2018	0.7–1.8	0.2–0.86
	2019	0.7–1.8	0.25–0.62
Zinc	2018	1.10–2.5	0.4–0.67
	2019	1.10–2.5	0.42–0.72
Manganese	2018	18–25	21–27
	2019	18–25	18–27
Phosphorus	2018	40–90	33.3–89.7
	2019	40–90	46.5–93.2
Calcium	2018	75–125	88.7–107
	2019	75–125	68.5–102

[a] Tests were conducted on 16 cows in 2018 and 15 cows in 2019.
[b] The abbreviation ppm stands for parts per million.

Haptoglobin, Ceruloplasmin

In 2019, 15 cow blood plasma samples were sent to the Kansas State Veterinary Diagnostic Laboratory, where they were tested for haptoglobin and plasma ceruloplasmin. Results from the plasma haptoglobin test indicated that all levels were within a normal range of haptoglobins (>60 mg/dL). Results from the ceruloplasmin test indicated that 1 caribou (6%) had elevated ceruloplasmin (>8 mg/dL). Although these caribou were captured in late June and would not have been pregnant at the time, it is worth noting that pregnancy can elevate numbers in both haptoglobins and ceruloplasmin (K. Beckmen, DVM, Wildlife Veterinarian, and C. Lieske, DVM, MPVM, Wildlife Veterinarian, ADF&G, personal communication).

Serum Amyloid A and Total Protein

In 2019, protein was extracted from the serum samples of 15 caribou at the Acute Phase Protein Laboratory, University of Miami, to determine serum amyloid A (an acute protein) and total protein. Results from the serum amyloid A assay indicated that 2 caribou had measurable serum amyloid A, which fell within the expected range for caribou (C. Lieske, DVM, MPVM, Wildlife Veterinarian, ADF&G, personal communication, 2023).

MYCOPLASMA OVIPNEUMONIAE

In June 2018, *Mycoplasma ovipneumoniae* was detected in 8 caribou (17%, $n = 48$); in June 2019, none tested positive (0%, $n = 51$). During the previous reporting period (RY12–RY17), none tested positive (0%, $n = 41$). There have been positive PCR (Polymerase Chain Reaction) tests that confirmed the CAH has been exposed to *M. ovipneumoniae* (Lieske et al. 2022). It is not a major health concern for caribou, but it can be an additive stressor.

FECAL ANALYSIS

In 2019, fecal samples from 42 caribou[2] were tested for parasitic larvae using a fecal Baermann test. Eleven caribou tested positive (26%, $n = 42$). Among these 11 caribou, 10 carried *Dictyocaulus* (lungworm), with a range of 1–5 larvae per gram of feces, and 7 carried dorsal spine larvae (tissue nematode), with a range of 3–12 larvae per gram of feces. Six of the 11 caribou carried both *Dictyocaulus* and dorsal spine larvae.

The 42 fecal samples were also tested for gastrointestinal nematode eggs using a fecal flotation test. Among the 42 caribou, 34 (81%) tested positive for gastrointestinal nematode eggs. Additionally, 32 (76%) were detected with strongyles (*Trichostrongyles* or round worms), with a range of 1–20 eggs per gram of feces. Only 1 sample with strongyles contained 20 eggs per gram of feces. Generally, a value over 20 eggs per gram of feces indicates a high rate of shedding outside of midsummer (K. Beckmen, DVM, Wildlife Veterinarian, ADF&G, personal communication, 2023). Furthermore, among the 42 samples, 1 contained *Nematodirus* (large stomach worm) and 1 contained *Moniezia* (tapeworm). One of the animals tested had both strongyles and *Nematodirus*, and one other animal tested had both strongyles and *Moniezia*.

Recommendations for Activity 1.1

Continue deploying 15 radio collars on yearlings annually to determine age-specific parturition rates and maintain a representative age structure and sample size. Age-specific data are rare and valuable for wildlife monitoring. In the past, adult cows of unknown age were captured to maintain an adequate sample of caribou >4 years old. That said, ADF&G biologists should assess whether deploying collars on unknown-age adult cows is necessary to maintain 60 collars on cows ≥1 year old.

In addition to the 15 collars deployed on yearlings, 10–20 GPS radio collars are deployed annually on recaptured adult cows. These radio collars are currently programmed to last 5 years to obtain frequent movement data but are replaced every 3 years to ensure continuous data collection. If funding and collaboration decrease, we should either program the radio collars to last longer than 5 years or allow a 4-year interval between recaptures to reduce the frequency of recaptures. Additionally, we should investigate the sample size needed to obtain movement data and reduce the total number of radio collars from 100 to 80 (including bulls), while maintaining approximately 60 radio collars on cows greater than or equal to 1 year old and 10–20 radio collars on bulls, which is important for conducting photocensus and composition surveys.

Captures should be conducted until the end of June if Porcupine and Teshekpuk caribou are wintering in the same area as CAH caribou, to ensure that the captured caribou are CAH animals.

[2] Of the 42 caribou, 15 were yearling cows, 17 were adult cows (>1 year old), and 10 were adult bulls.

Although the utility of weights as a measure of nutritional index is not yet clear, we should continue weighing yearling and 13-month-old cows to build a larger dataset for analysis. This is especially important because weights from captures before June are not comparable to those collected in June due to green-up and increased food availability.

Continue annual work with the DWC wildlife health and disease veterinarian to implement an Arctic caribou disease monitoring program.

ACTIVITY 1.2. Conduct a photocensus every 2–3 years (M1, M3, C1, C2, and C3).

Data Needs

Abundance is the primary metric used to monitor herd status and estimating it through a photocensus is important for evaluating IM and ANS objectives. Estimates of population size provide regulatory boards and advisory committees with information to make informed decisions or recommendations regarding regulatory actions.

Methods

Survey and Enumeration Methods

ADF&G staff conducted photocensuses on the CAH on 9 and 13 July 2019 and on 30 June 2022. We used the modified aerial photo-direct count technique (Davis et al. 1979, Valkenburg et al. 1985), which involves locating post-calving aggregations of caribou by radiotracking radiocollared animals. Groups of caribou were photographed from a DeHavilland DHC-2 Beaver aircraft (photo plane) with a custom digital aerial camera system consisting of 3 medium-format, 100-megapixel cameras mounted in a gyrostabilized mount. Two cameras were oriented partially oblique (50 mm), and one was oriented at nadir (90 mm). The system was equipped with a differential GPS and IMU (inertial measurement unit) to record position and attitude (pitch, roll, and yaw). Customized flight management software (SoftNav Systems Inc.) running on a laptop controlled the cameras and navigation system, allowing the pilot and camera operator to see footprints of the imagery in real time, as well as inspect thumbnails of each image as they were captured. The target altitude for photography was 1,500 ft above ground level. Caribou groups were radiotracked and located using a Cessna 182, a Piper Super Cub, or a Cessna 206.

Flight data from the GPS and IMU were post-processed using differential correction or precise point positioning, depending on the proximity to continually operating reference stations. Images were individually inspected and adjusted for exposure before being exported from raw format. Exterior orientation information (position, elevation, and attitude) and imagery were then processed through photogrammetry software using automated tie point extraction and bundle adjustment to produce digital terrain models, which were then used to orthorectify individual images. Once orthorectification was completed, the oblique and nadir orthophotos were mosaicked separately.

Enumeration of caribou from image mosaics occurred within GIS (geographic information system) software, which has a customized tool that allows users to count and classify caribou by placing colored points on top of each animal. Point data were stored in file geodatabases and archived. One to two counters enumerated caribou in all photographs.

Population Estimate Methods

We used a method described by Rivest et al. (1998) to estimate herd size and provide a measure of uncertainty. The estimator is a summation of group sizes divided by the probability of each group having at least 1 radiocollared caribou (only groups with radio collars present are used in this estimator). The estimator is based on a 2-phase sampling design. Phase 1 sampling considers how collared caribou are distributed among groups of known size and assumes the collared caribou randomly distribute themselves. Phase 2 involves detecting those groups using radiotelemetry.

Rivest et al. (1998) describe 3 detection models for use in phase 2. Of these models, the homogeneity method has been most frequently applied (Couturier 1996, Patterson et al. 2004) and is best suited for CAH data. In the homogeneity model, each group has the same probability of being detected in the survey. This model assumes that all active collars are identified in observed groups and that unobserved groups with collared caribou are missed because they are outside the surveyed area or natural obstacles prevent the radio signal from reaching the aircraft. It is important to note that phase 2 calculations are not necessary if all collars are located and associated groups are counted. Also, the consequences of not meeting the assumptions of phase 2 are greatly mitigated when a high proportion of the active collars are detected and associated groups counted.

Finally, the estimator assumes a random distribution of collars among caribou. This assumption can be tested by visualizing the relationship between the group size and the associated number of radiocollared caribou in a graph. A statistical test for this assumption is suggested by Rivest et al. (1998), where the number of collars in each group is approximately Poisson distributed. Specifically, a score test to evaluate overdispersion in a Poisson model is provided to assess this assumption (Dean and Lawless 1989).

Results and Discussion

2019

Using the Rivest et al. (1998) method, the CAH population was estimated at 30,096 caribou (standard error [SE] = 1,266.2; 95% confidence interval [CI] = 27,455–32,738; Table 2). For the phase 2 calculations of the probability of detecting groups via radiotelemetry, we assumed the homogeneity model because undetected collars were likely outside the study area. Our assumption of a random distribution of radio collars in the survey was supported ($P = 0.2649$). The Rivest method uses only those groups of caribou with radio collars. Using this method on the 17 groups of caribou containing radio collars, we estimated an additional 2,987 caribou not found in groups with radio collars (Table 3).

For the minimum count, we enumerated caribou from all groups located, including those visually counted from the photo plane that were outside a photograph and miscellaneous small groups of caribou visually counted from the photo plane when flying between groups. The minimum count resulted in 28,232 caribou in 21 groups (Table 2).

Table 2. Central Arctic caribou herd estimated population size, 1978–2022, Alaska.

Year	Date	Collars		Groups			PCH collars[b]	TCH collars[b]	Min. count[c]	Est. pop. size[d] (standard error)	Confidence interval (population range)
		Located	Missing	Photographed	Located[a]	w/ collars					
1978[e]	Jul	–	–	Unk	Unk	Unk	Unk	Unk	5,000	–	–
1981[e]	Jul	–	–	Unk	Unk	Unk	Unk	Unk	8,537	–	–
1983[e]	21 Jul	–	–	Unk	Unk	Unk	Unk	Unk	12,905	–	–
1991	18–20 Jun	Unk	Unk	Unk	Unk	Unk	Unk	Unk	–	19,046 (N/A)	90% (14,667–23,414)
1992	8–9 Jul	Unk	Unk	9	10	Unk	Unk	Unk	23,444	–	–
1995	13 Jul	Unk	Unk	12	42	Unk	Unk	Unk	18,100	–	–
1997	19–20 Jul	41	3	22	22	12	0	0	19,730	18,824 (1,431)	95% (15,674–21,974)
2000	21 Jul	81	4	22	24	22	0	0	27,128	29,519 (1,449)	95% (26,504–32,533)
2002	16 Jul	76	4	9	9	9	0	0	31,857	34,211 (1,050)	95% (31,790–36,361)
2008	2–3 Jul	62	0	14	18	12	2 (3,379)	0	66,772	66,666 (3,206)	95% (59,609–73,722)
2010	9 Jul	57	2	16	18	14	2 (3,379)	2 (1,916)	70,034	68,442 (6,420)	95% (54,571–82,312)
2013	4–5 Jul	54	0	10	12	10	10 (21,914)	0	70,364[f]	50,753 (4,345)[f]	95% (40,924–60,582)
2016	12 Jul	49	2	7	10	8	0	0	21,186	22,630 (2,556)	95% (20,074–25,186)
2017[h]	7 Jul	82	1	10	11	11	1 (0)	0	27,115	28,051 (765.4)	95% (26,346–29,757)
2019	9 & 13 Jul	91	1	19	21	17	1 (0)	0	28,232	30,096 (1,266.2)	95% (27,455–32,738)
2022	30 Jun	79	0	17	17	12	0	0	34,388	34,642 (1,134)	95% (32,419–36,866)

Note: A systematic transect survey method was used in 1978. An aerial count method was used in 1981. An aerial photo direct count extrapolation method (Davis et al. 1979) was used in 1983, 1992, 1995, 1997, 2000, 2002, 2008, 2010, 2013, 2016, 2017, 2019, and 2022. No estimated population size or population range is available for 1978, 1981, 1983, 1992, and 1995. A random stratified quadrat survey (Valkenburg 1993) method was used in 1991, and no minimum count is available for 1991.

Note: Collars refer to radio collars. Unk stands for unknown, PCH stands for Porcupine caribou herd, and TCH stands for Teshekpuk caribou herd.

[a] Groups located include single caribou.

[b] Numbers in parentheses represent the estimated number of caribou from the PCH or TCH.

[c] Minimum count refers to the number of caribou observed during the survey; it may include caribou from other herds.

[d] In 1991, the analysis used was from Gasaway et al. (1986). During 1997–2013, the analysis used was that of Rivest et al. (1998). In years that PCH or TCH radio collars were present, we adjusted the "Rivest" estimate to account for PCH or TCH radio collars.

[e] No radio collars were deployed.

[f] Minimum count includes an estimated 20,000 PCH caribou and was excluded for the estimated population size.

[h] Digital cameras were used in 2017, whereas film cameras were used in previous years. The 2017 survey was conducted after the 2016 regulatory year, which ended on 30 June 2017.

Table 3. Abundance estimate statistics from the 2019 Central Arctic caribou herd photocensus survey, Alaska.

Statistic	Value
a) Located Central Arctic caribou herd (CAH) radio collars	91
b) Missing CAH radio collars	1
c) Minimum count	28,232
d) Count of all caribou from the 21 groups with radio collars	27,109
e) Population estimate using Rivest's method (homogeneity model)	30,096
f) Number of caribou added via Rivest's method to account for those not associated with radio collars = e) – d)	2,987
Abundance estimate for CAH	30,096 ± 2,642
g) Standard error	1,266.2
h) *t*-value (degrees of freedom are based on 21 groups minus 1)	2.086
i) 95% confidence interval	27,455–32,738
j) Test of randomness (*P*-value > 0.05 fails to reject randomness)	0.2649

On 9 July 2019, 2 radiocollared PCH caribou (1 bull and 1 cow) were located in 2 different groups near the Canning Delta. The cow had been with the CAH since July 2017. The bull's satellite had stopped transmitting, and based on movements before transmission failure, we determined that few, if any, PCH animals were with this bull. No other PCH radio collars were detected with the CAH. We determined that no or minimal mixing of herds had occurred; therefore, we did not adjust the CAH population estimate for these 2 PCH radio collars. These 2 radio collars were considered part of the CAH and were included in the Rivest estimate. No Teshekpuk caribou herd (TCH) radio collars were detected during the photocensus.

We calculated the difference in caribou enumerated on photographs by dividing the total number enumerated by counter 1 (less experienced counter) on 4 photographs by the total number enumerated by counter 2 (more experienced counter) on the same photographs. The resulting difference was 1.5%.

Comparing results of the 2017 population estimate to the 2019 population estimate indicated there was no change in the CAH population size from 2017 (28,051, 95% CI = 26,346–29,757) to 2019 (30,096, 95% CI = 27,455–32,738; Table 2).

2022

Using the Rivest et. al. (1998) method, we estimated the CAH population at 34,642 caribou (SE = 1,134, 95% CI = 32,419–36,866). Counts from 12 photographed groups were included in the Rivest estimator because there were radio collars in these groups. For the phase 2 calculations of the probability of detecting groups by radiotelemetry, we assumed the homogeneity model because undetected collars were likely outside the study area. Our assumption of a random distribution of radio collars in the survey was supported ($P = 0.159$). The Rivest method estimated an additional 1,411 caribou not found in groups with radio collars (Table 4).

Table 4. Abundance estimate statistics from the 2022 Central Arctic caribou herd photocensus survey, Alaska.

Statistic	Value
a) Located Central Arctic caribou herd (CAH) radio collars	79
b) Missing CAH radio collars	0
c) Minimum count	34,388
d) Count of all caribou from the 12 groups with radio collars	33,231
e) Population estimate using Rivest's method (homogeneity model)	34,642
f) Number of caribou added via Rivest's method to account for those not associated with radio collars = e) – d)	1,411
Abundance estimate for CAH	34,642 ± 2,642
g) Standard error	1,134
h) *t*-value (degrees of freedom are based on 12 groups minus 1)	2.33
i) 95% confidence interval	32,419–36,866
j) Test of randomness (*P*-value > 0.05 fails to reject randomness)	0.159

For the minimum count, we counted 34,230 caribou from photographed groups (n = 12 groups) and an additional 158 caribou observed that were not in photographed groups, totaling 34,388 caribou (Table 4). No mixing with caribou from the PCH or TCH occurred during the census (Table 2).

Comparing the 2019 population point estimate to the 2022 population point estimate indicated the CAH population slightly increased from 2019 (30,096, 95% CI = 27,455–32,738; Table 3) to 2022 (34,642, 95% CI = 32,419–36,866; Table 4); however, the difference was not significant at the 95% CI level between the survey years.

Recommendations for Activity 1.2

Continue.

ACTIVITY 1.3. Estimate growth rate (lambda [λ]; M1, M3, C1, C2, and C3).

Data Needs

Estimates of abundance trends are important for evaluating IM and ANS objectives. Rates of population growth and decline help to inform the regulatory process.

Methods

We estimated the average multiplicative annual growth rate (λ) for each interval between photocensuses (Fig. 2). For intervals between minimum counts, only a point estimate was computed. Point estimates and CIs for each interval between Rivest estimates were computed using a Monte Carlo approach with 10,000 draws from the likelihood of the true population, based on a normal approximation (Rivest et al. 1998). We did not correct the likelihood using minimum count data because, in many years, minimum counts of the CAH are considered to be

contaminated by temporary immigration from other herds (the PCH to the east and the TCH to the west). In 1991 alone, an abundance estimate was obtained using random stratified quadrat sampling.

Results and Discussion

Growth rate estimates based on Rivest estimates show a trend of moderate growth since 2017, following the rapid population decline between 2010 and 2016 (Fig. 3).

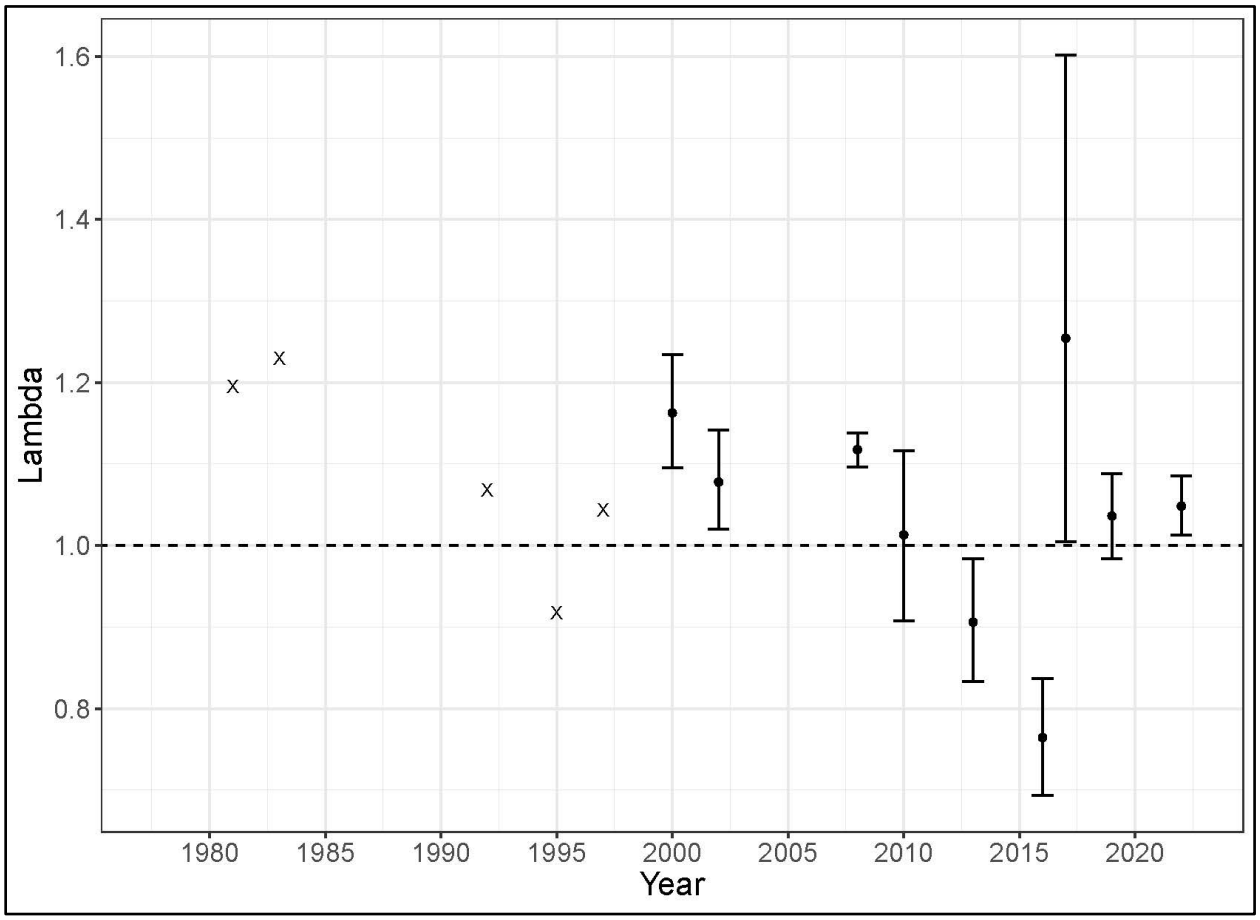


Figure 3. Central Arctic caribou herd population growth rate (lambda) estimates, 1981–2021, Alaska. Estimates with 95% confidence intervals (represented by points with error bars) were estimated from Rivest population estimates. Lambdas from minimum count population estimates are represented by × symbols. The dashed line at 1.0 represents a constant population.

The period between 1997 and 2008 exhibited a high annual growth rate of approximately 1.12 (12.2% annual growth, 95% CI = 1.10–1.14; Fig. 3). High parturition rates, good calf survival, and low adult mortality contributed to this increase in population size. Also, immigration from the PCH and TCH likely played a minor role in contributing to the increase during those years. Similar high annual growth rates ($\lambda = 1.12$) have been reported for other Arctic caribou herds; however, those rates were based on minimum count estimates and used a different method to calculate the annual growth rate (Carroll 2007, Dau 2007).

The decline from 2010 to 2016 is estimated to have had a mean annual growth rate of 0.831 (16.9% annual decline, 95% CI = 0.791–0.872; Fig. 3). This 6-year period of decline resulted in abundance estimates in 2016 similar to those seen before the 11-year period of rapid growth from 1997 to 2008.

Since 2017, the population has returned to a pattern of steady but moderate growth. The mean annual growth rate for RY17–RY21 is estimated to be 1.043 (4.3% annual growth, 95% CI = 1.026–1.061; Fig. 3).

Recommendations for Activity 1.3

Continue estimating abundance trends to evaluate IM and ANS objectives and provide regulatory boards and advisory committees with additional biological information to make informed decisions or recommendations regarding regulatory actions.

The growth rate should be estimated independently for each inter-survey period. Modeling lambda as a response dependent on time is unlikely to provide useful information, given the high volatility of caribou herd populations, and results in inappropriate smoothing unless periods of interest are selected carefully. Mean growth rates over a period longer than 1 inter-survey period may be informative, but these periods must be selected with caution to ensure they are relatively homogeneous in growth rate.

ACTIVITY 1.4. Estimate annual survival rates from radiocollared cows (M1, M3, C1, C2, and C3).

Data Needs

Annual survival is a sensitive biological parameter for understanding population growth or decline, particularly for adult cows. Estimates of annual survival provide an important demographic parameter to evaluate population trajectory in years when abundance is not estimated and corroborate estimates of abundance trends.

Methods

The annual adult cow survival rate for cows ≥1 year old was estimated per RY by calculating the number of radiocollared individuals that survived through the RY (i.e., subtracting known mortalities in an RY) and dividing it by the number of active radio collars at the beginning of 1 July of that RY.

Results and Discussion

The survival rate for CAH cows ≥1 year old was 87% (n = 104) in RY17, 82% (n = 112) in RY18, 93% (n = 105) in RY19, 87% (n = 91) in RY20, and 87% (n = 82) in RY21 (Table 5). The survival rate in RY19 is the highest observed in the past 10 years. Survival rates during RY17–RY21 were similar to those during RY97–RY09 (mean = 89%; range = 80–96%), a period of growth for the CAH. The herd declined substantially during RY12–RY16, when survival rates of adult cows ≥1 year old were considered low (mean = 77%; range = 67–81%). Overall, these survival rates serve as a crude index of survival.

Table 5. Survival rates of radiocollared Central Arctic caribou herd cows ≥1 year old, regulatory years 1997–2021, Alaska.

Regulatory year	No. of mortalities	No. of radio collars[a]	Percent survival	Percent mortality
1997	2	44	95	5
1998	2	53	96	4
1999	7	53	87	13
2000	12	66	82	18
2001	4	64	94	6
2002	11	78	86	14
2003	7	75	91	9
2004	19	96	80	20
2005	8	77	90	10
2006	5	69	93	7
2007	7	64	89	11
2008	9	74	88	12
2009	9	65	86	14
2010	5	58	91	9
2011	10	58	83	17
2012	16	49	67	33
2013	10	44	77	23
2014	12	60	80	20
2015	14	73	81	19
2016	16	85	81	19
2017	14	104	87	13
2018	20	112	82	18
2019	7	105	93	7
2020	12	91	87	13
2021	11	82	87	13

[a] Number of radiocollared cows ≥1-year old known to be alive at the beginning of the regulatory year.

Recommendations for Activity 1.4

Continue collecting survival data for both cows and bulls. Consider using a known-fate survival model, such as Kaplan-Meier, to produce a robust survival rate. Analyze age-class and sex-specific survival rates when sufficient data is available.

ACTIVITY 1.5. Estimate allowable harvest (M1, M3, M4, C2, and C4).

Data Needs

Estimates of annual allowable harvest inform the regulatory process. As population abundance fluctuates each year, it is necessary to adjust the allowable harvest to ensure the number of animals harvested remains sustainable.

Methods

Since the 2017 photocensus documented that the CAH population was at the lower end of the management objective (28,000–32,000 caribou), allowable harvest was held at 3% of the most recent population estimate, and no more than 75 caribou harvested could be cows. Cow harvest was restricted to support herd growth.

Results and Discussion

Based on the July 2017 population estimate of 28,051 caribou, allowable harvest during RY17–RY18 was 840 caribou, with no more than 75 being cows. Based on the July 2019 population estimate of 30,096 caribou, allowable harvest during RY19–RY21 was 840 caribou, with no more than 75 being cows.

Recommendations for Activity 1.5

Continue estimating the annual allowable harvest to inform the regulatory process. As of the 2022 photocensus, the herd population is estimated above the management objectives and is believed to be stable or growing. When the population exceeds the IM objective, a 5% harvest rate can be applied, which includes a 1% harvest rate for cows. If the herd is growing rapidly beyond the IM objective, a higher harvest rate may be applied, including increased cow harvest. However, harvest is limited by access to the CAH, which has historically not reached a 5% harvest rate. Increasing cow harvest not only increases hunter opportunity but also could slow herd growth if the herd is potentially growing past its carrying capacity.

ACTIVITY 1.6. Estimate annual parturition rate from radiocollared cows (M1 and C2).

Data Needs

Estimates of parturition rate provide a direct measure of productivity and can serve as an index of adult cow body condition, particularly for 3-year-old caribou (Boertje et al. 2012). Parturition rate is one of the demographic metrics used to help determine trends in population size during years when abundance is not estimated from a photocensus.

Methods

Parturition rate was estimated by observing radiocollared cows aged ≥3 years from a fixed-wing aircraft during the first half of June, near the peak of calving. Caribou observed with calves, hard antlers, or distended udders were classified as parturient (Whitten 1995).

Parturition rate was calculated as the number of adult cows classified as parturient divided by the total number of adult cows observed. Parturition rates were calculated for cows aged ≥4 years old, 3 years old, and ≥3 years old. Not all caribou observed were of known age, but we included unknown-age caribou in the cows ≥4 years old and cows ≥3 years old categories.

Results and Discussion

Parturition surveys were accomplished in all years during the reporting period (RY17–RY21). The average parturition rate for adult cows (≥4 years old and unknown age) from calendar years 2018 to 2022 was 83%, which was similar to that of the previous reporting period (RY12–RY16) of 85%. However, the parturition rate in 2022 was unusually low (67%), and this will be closely

monitored in the future. Due to COVID-19, collars were not deployed in 2020 on yearlings, and there were no 3-year-old collared adults in our survey in 2022. From 2018 to 2021, the average parturition rate was 83% for 3-year-old cows and 86% for ≥3-year-old cows (Table 6).

Table 6. Central Arctic caribou herd percent parturition of radiocollared cows, 2000–2022, Alaska.

		Percent parturition by age					
Year	Survey date	3 years	(*n*)[a]	≥3 years	(*n*)[a]	≥4 years	(*n*)[a]
2000	6–7 Jun	80	(10)	94	(35)	96	(25)
2001	3–9 Jun	77	(13)	88	(48)	91	(35)
2002	4–7 Jun	75	(12)	89	(62)	92	(50)
2003[b]	30 May–8 Jun	–	–	–	–	96	(54)
2004	31 May–11 Jun	88	(8)	91	(76)	91	(68)
2005	31 May–9 Jun	86	(7)	84	(67)	83	(60)
2006	29 May–8 Jun	71	(7)	93	(61)	96	(54)
2007	2–6 Jun	100	(4)	93	(60)	93	(56)
2008[b]	2–4 Jun	–	–	–	–	98	(46)
2009	1–3 Jun	60	(5)	73	(49)	75	(44)
2010	2–5 Jun	60	(5)	93	(42)	97	(37)
2011	2–4 Jun	50	(8)	83	(42)	91	(35)
2012	3 & 7 Jun	71	(7)	87	(31)	92	(24)
2013	2–6 Jun	75	(4)	79	(29)	80	(25)
2014[c]	2–3 Jun	–	–	–	–	76	(34)
2015	1–8 Jun	75	(4)	84	(57)	85	(53)
2016	2–4 Jun	67	(3)	90	(42)	92	(39)
2017	31 May–7 Jun	100	(5)	91	(65)	90	(60)
2018[d]	31 May–4 Jun	75	(12)	83	(70)	84	(58)
2019	4–6 Jun	89	(9)	92	(65)	93	(56)
2020	1–3 Jun	87	(14)	87	(75)	89	(61)
2021	4–5 Jun	82	(17)	82	(72)	82	(55)
2022[b]	1–3 Jun	–	–	–	–	67	(52)
Average		77	(8)	87	(55)	89	(47)

[a] *n* refers to the sample size of radiocollared cows.
[b] No parturition rates were estimated for 3-year-olds because no 3-year-olds were collared.
[c] No parturition rates were estimated for 3-year-olds because no 3-year-olds were located during the survey.
[d] Five cows determined nonparturient during calving were observed with a calf in late June. The calving survey was considered independent of the later June survey; therefore, the 5 cows were identified as nonparturient during calving.

Recommendations for Activity 1.6

Continue. At least 30 radio collars should remain deployed on cows ≥4 years old to obtain parturition rates. A minimum of 10–15 collars should be deployed on yearling cows to maintain known-age collared cows in the herd for parturition analysis, particularly for obtaining 3-year-old parturition rates and minimizing the effects of bias as a result of a sample size with a skewed age distribution.

Investigate the potential to use movement rates analyzed from GPS radio collars to estimate parturition rate, particularly because our pool of capable pilots available for this survey is diminishing.

ACTIVITY 1.7. Estimate peak of calving from radiocollared cows (M1).

Data Needs

Peak of calving data is a byproduct of estimating parturition rates. It could be important information if the median calving dates change significantly and also coincide with changes in demographics, weather patterns, or habitat.

Methods

Peak of calving, or the median date of calving, was defined as the date on which 50% or more of the radiocollared parturient cows ≥3 years old gave birth. In years when caribou were only located once and the peak of calving had not yet occurred, we estimated the date of peak of calving using the following criteria. The estimate was based on a percentage calculated using the proportion of ≥3-year-old cows with calves to the number of ≥3-year-old parturient cows on the last date of radiotracking (Arthur and Del Vecchio 2009, Lenart 2015). Depending on the result, we adjusted the date as follows:

- ≤25%: Add 3 days after the last radiotracking date.
- 26–39%: Add 2 days after the last radiotracking date.
- 40–49%: Add 1 day after the last radiotracking date.
- 51–59%: Subtract 1 day and include it in the last day of radiotracking.
- 60–74%: Subtract 2 days and include it in the last day of radiotracking.
- ≥75%: Subtract 3 days and include it in the last day of radiotracking.

Results and Discussion

Regulatory Year 2017

Dates were not recorded when caribou were observed, aside from the survey taking place during 31 May–4 June 2018. It is likely that the peak of calving was not early and occurred around 4 June (Table 7).

Regulatory Year 2018

By 5 June 2019, 78% of cows ≥3 years old considered parturient (n = 50) had a calf; therefore, the peak of calving was estimated to be on 2 June 2019 (Table 7). On 4 June 2019, 21 cows were with a calf and 2 were parturient; on 5 June 2019, 18 cows were with a calf and 9 were parturient; and on 6 June 2019, all 10 radiocollared cows had a calf.

Table 7. Estimated peak of calving dates for the Central Arctic caribou herd, 1997–2017, Alaska.

Year	Survey dates	No. of radiocollared parturient ≥3-year-old cows	Est. dates for the peak of calving[a]
1997	6 Jun	16	4–5 Jun
1998	3–4 Jun	25	1–3 Jun
1999	5 & 9 Jun	33	8 Jun
2000	6–7 Jun	32	8–10 Jun
2001	3–8 Jun	43	9–10 Jun
2002	4–7 Jun	55	4–6 Jun
2003	30 May–8 Jun	52	4–6 Jun
2004	31 May–11 Jun	69	4–6 Jun
2005	31 May–9 Jun	56	4–6 Jun
2006	29 May–8 Jun	57	4–6 Jun
2007	2–6 Jun	56	7–8 Jun
2008	2–4 Jun	32	1–2 Jun
2009	1–3 Jun	36	4 Jun
2010	2–5 Jun	39	2–5 Jun
2011	2–3 Jun	34	4–5 Jun
2012	3, 7 Jun	27	6–7 Jun
2013	3–6 Jun	22	7–8 Jun
2014	2–3 Jun	26	4–6 Jun
2015	1–8 Jun	46	3 Jun
2016	2–4 Jun	38	2 Jun
2017	31 May–7 Jun	52	7 Jun
2018	31 May–4 Jun	–[b]	4 Jun
2019	4–6 Jun	50	2 Jun
2020	1–3 Jun	63	3–4 Jun
2021	4–5 Jun	48	4 Jun
2022	1–3 Jun	35	5 Jun

Note: In years 2002–2006 and 2017, radiocollared cows were relocated daily or every 2–3 days until a calf was present (Arthur and Del Vecchio 2009). If observations of cows identified as parturient with no calf were followed by observations with a calf present, then the range of days between observations was determined as the estimated date that the cows had calved. In years 1997–2000 and 2007–2016, the estimated date of peak of calving was determined using criteria based on the percentage calculated using the proportion of ≥3-year-old cows with calves to parturient cows ≥3 years old at the last date of radiotracking. If the results were: 1) ≤25%, a span of 3 days was added following the last radiotracking date; 2) 26–39%, 2 days were added; 3) 40–49%, 1 day was added; 4) 51–59%, 1 day was subtracted, and included the last radiotracking date; 5) 60–74%, 2 days were subtracted; and 6) ≥75%, a span of 3 days was subtracted (Lenart 2013).

[a] Peak of calving was defined as the date when 50% or more of the radiocollared parturient cows ≥ 3 years old gave birth. Est. stands for estimated.

[b] Peak of calving estimated in 2018 was difficult to ascertain because the exact dates caribou were observed were not recorded; therefore, no data are available.

Regulatory Year 2019

By 2 June 2020, 29–33% of cows ≥3 years old considered parturient (n = 63) had a calf; therefore, the peak of calving was estimated to be 3 or 4 June (Table 7). On 1 June 2020, 15 cows were with a calf and 36 were parturient; on 2 June 2020, 4 cows were with a calf and 8 were parturient; and on 3 June 2020, all 2 radiocollared cows (3 years old) were parturient. Data from radiotracking activities on 3 June 2020 were not included in determining the median calving date because only 2 caribou were located.

Regulatory Year 2020

By 4 June 2021, 54% of cows ≥3 years old considered parturient (n = 48) had a calf; therefore, the peak of calving was estimated to be 4 June 2021 (Table 7). On 3 June 2021, 9 cows were with a calf and 11 were parturient; on 4 June 2021, 15 cows were with a calf and 13 were parturient; and on 5 June 2021, 8 cows were with a calf and 3 were parturient.

Regulatory Year 2021

By 3 June 2022, 31% (11) of cows ≥4 years old considered parturient (n = 35) had a calf; therefore, the peak of calving was estimated to be 5 June 2022 (Table 7).

Overall, during RY17–RY21, the estimated peak of calving date ranged from 2 to 5 June. This range of dates was similar to those estimated in the last reporting period (RY12–RY16), and the range between estimates was slightly more consistent than the interannual variation in the last reporting period (Table 7).

Recommendations for Activity 1.7

Continue. If time permits, ADF&G area management staff should consider analyzing weather data and snowmelt during calving to determine if they are related to the peak of calving.

ACTIVITY 1.8. Estimate 50% and 95% isopleths for radiocollared parturient cows during calving (M1 and M2).

Data Needs

Estimating annual core calving ranges is important for identifying calving grounds and providing a foundation for collaboration with the oil industry to minimize disturbance to caribou movement during calving. This allows ADF&G management staff to monitor accessibility of historic seasonal ranges and minimize the adverse effects of development on the CAH.

Methods

To display calving areas, 95% (extended calving area) and 50% (core) isopleth polygons were calculated annually from RY17 to RY21 using GPS locations of collared cows during the peak parturition period of each year (Table 7). Only cows that were determined to be with a calf or were considered parturient (based on antler and udder distension) during the calving surveys were included in the sample (see Activity 1.5 for adult sample size). Kernel density estimates were created using the "hr_kde" function in the amt (Animal Movement Tools) package in R software (Signer et al. 2019, R Core Team 2026). Individual utilization distribution rasters were generated using the reference bandwidth estimator. Individual year raster output was normalized using the following calculation: ("raster" − "raster".minimum) / ("raster".maximum − "raster".minimum). Each normalized raster was summed for the RY17–RY21 combined results (M. Spathelf, GIS Analyst, ADF&G, personal communication).

Results and Discussion

Throughout RY17–RY21, the CAH calved in Unit 26B, just south of the coast, south of Prudhoe Bay, and east of Nuiqsut. Calving cows used areas east and west of the Dalton Highway, with a higher concentration on the west side (Fig. 4).

Recommendations for Activity 1.8

Continue.

ACTIVITY 1.9. Estimate late June calf-to-cow ratios of radiocollared cows and early calf survival (M1 and C2).

Data Needs

Estimates of late June calf-to-cow ratios and early summer calf survival provide an index of recruitment potential for that year. Estimates of early calf survival are among the demographic data used to help determine a trend in the population size when a photocensus is not completed.

Methods

The proportion of calves to 100 cows was estimated by observing radiocollared cows ≥3 years old from a fixed-wing aircraft during the third or fourth week of June, after calving was most likely to have occurred. During RY17−RY21, surveys were conducted from 18 to 22 June.

The ratio of calves to 100 cows was calculated as the number of adult cows observed with a calf at heel divided by the total number of adult cows observed. This metric is referred to as the "late June calf-to-100-cow ratio." These ratios were calculated for cows ≥4 years old, 3 years old, and ≥3 years old. Because not all caribou observed were of known age, unknown-age cows were included in the ≥4-year-old and ≥3-year-old categories. In 2022, calf-to-cow ratios for 3-year-old cows and >3-year-old cows were not estimated because there were no 3-year-old caribou collared due to the COVID-19 pandemic in 2020.

Results and Discussion

The annual average late June calf-to-100-cow ratios from RY17 to RY21 were higher than those seen in 2012–2014 during the population decline. In 2018–2021, the average ratio of calves to collared 3-year-old cows was 53:100; in 2012–2014 and 2017, it was 48:100. The average ≥3-year-old late June calf-to-100-cow ratio was 73:100 in 2018–2021 and 60:100 in 2012–2017. The average ≥4-year-old late June calf-to-100-cow ratio was 72:100 in 2018–2022 and 62:100 in 2012–2017 (Table 8).

Recommendations for Activity 1.9

Continue. Investigate whether there is a large enough sample size to conduct a formal 3-week survival analysis.

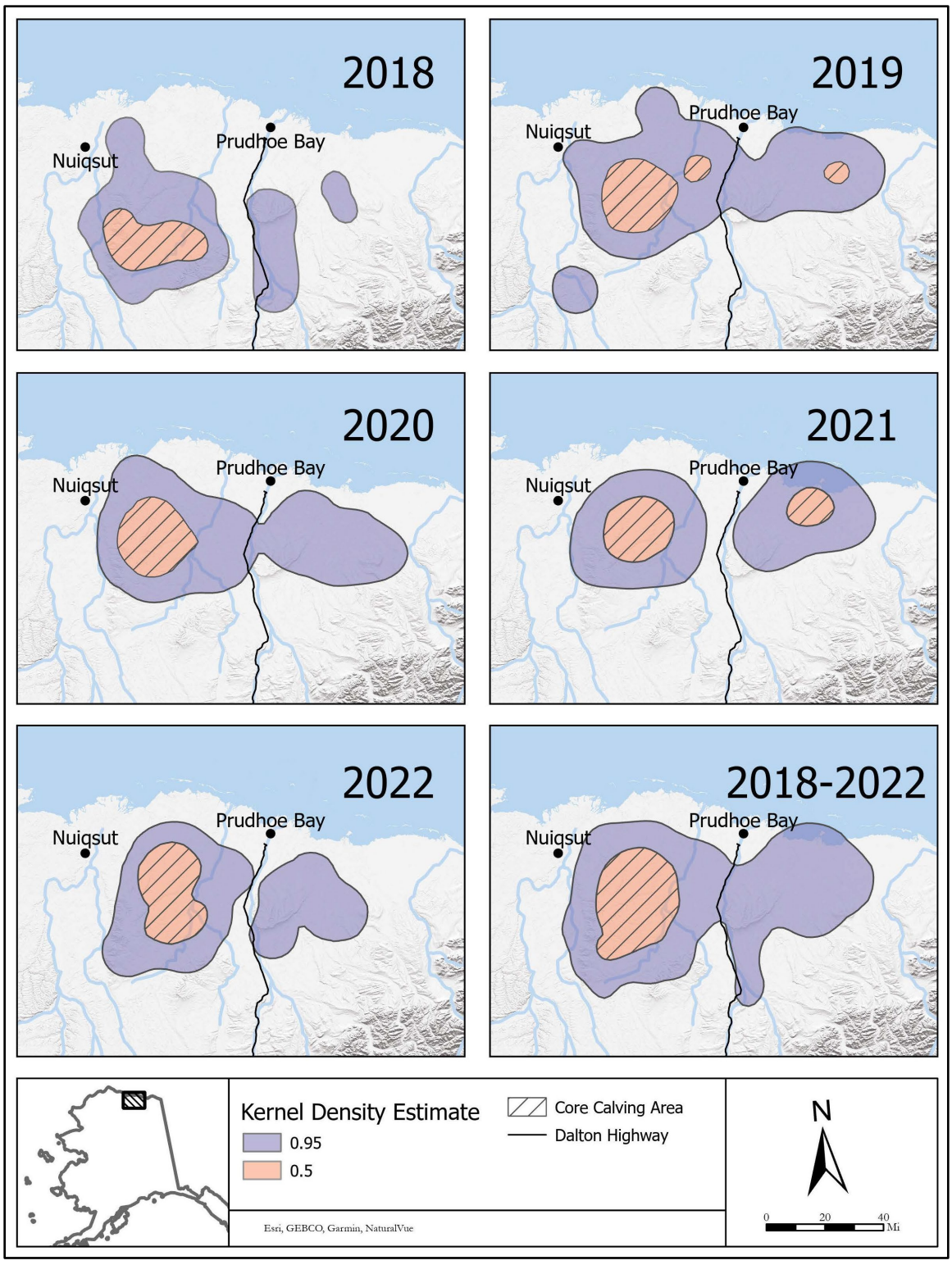


Figure 4. Maps of Central Arctic caribou herd calving areas during 1–15 June 2018–2022, Alaska. The maps display 50% (orange, hatched polygon) and 95% (purple polygon) isopleths for radiocollared Central Arctic cows considered parturient during calving in individual years and combined. Parturient cows include pregnant cows and cows observed with a calf.

Table 8. Late June calf-to-cow ratios (calves:100 cows) for ≥4-year-old, 3-year-old, and ≥3-year-old collared cows, Central Arctic caribou herd, 2000–2022, Alaska.

Year	Date	3 years[a]	(*n*)[b]	≥3 years[a]	(*n*)[b]	≥4 years[a]	(*n*)[b]
2000	17–19 Jun	85	(7)	77	(39)	75	(32)
2001	23–25 Jun	33	(12)	67	(46)	79	(34)
2002	23–25 Jun	64	(14)	76	(66)	79	(52)
2003	24–26 Jun	–	–	–	–	77	(53)
2004	24 Jun	–	–	–	–	82	(44)
2005	24 Jun	60	(5)	68	(63)	71	(58)
2006	23–24 Jun	71	(7)	77	(62)	89	(55)
2007	22–23 Jun	75	(4)	81	(57)	81	(53)
2008	23–24 Jun	–	–	–	–	91	(45)
2009	23–24 Jun	60	(5)	53	(47)	52	(42)
2010	22–23 Jun	40	(5)	80	(44)	85	(39)
2011	20–21 Jun	50	(4)	74	(34)	77	(30)
2012	26–27 Jun	42	(7)	64	(33)	69	(26)
2013	26–27 Jun	50	(4)	55	(29)	56	(25)
2014	24–25 Jun	0	(1)	60	(35)	65	(34)
2015	–	–	–	–	–	–	–
2016	–	–	–	–	–	–	–
2017	21–22 Jun	100	(5)	60	(73)	57	(60)
2018	18–20 Jun	42	(12)	66	(73)	70	(61)
2019	18–19 Jun	44	(9)	73	(62)	77	(53)
2020	20–21 Jun	64	(14)	78	(69)	82	(55)
2021	20–21 Jun	63	(19)	73	(60)	78	(41)
2022	22 Jun	–	–	–	–	52	(52)

Note: En dashes indicate no data available.
[a] Percentages.
[b] *n* refers to the sample size of radiocollared cows.

ACTIVITY 1.10. Conduct annual fall composition surveys to estimate bull-to-cow and calf-to-cow ratios (M1, M2, M3, M4, C1, C2, and C3).

Data Needs

Annual fall composition surveys can provide demographic data used to determine population trends, assess whether an adequate number of bulls is available for breeding, and indicate bull survival and calf survival to fall. This data may also inform appropriate harvest rates when abundance is low and the harvestable surplus is near management objectives.

Methods

Fall sex and age compositions were estimated by classifying caribou from an R-44 helicopter near the peak of rut, when mixing of bulls, cows, and calves is presumed to be optimal. The date of peak rut was estimated to be 228 days (gestation period) before the median calving date, which is around 19 October for the CAH. Caribou groups were located by radiotracking collared caribou from a fixed-wing aircraft. Individual caribou were classified as cows, calves, and small,

medium, or large bulls. Summary data were reported as ratios of bulls per 100 cows and calves per 100 cows.

We determined that a minimum sample size of 10% of the herd would be adequate to estimate the bull-to-cow and calf-to-cow ratios. Based on the 2019 CAH population estimate of 30,096 caribou, our objective was to classify at least 3,000 caribou. Considering the number of potentially active radio collars (n = 91), we determined that approximately 30 caribou per radio collar should be classified to spatially distribute sampling effort for 30,000 caribou. However, we recognized that some groups might be small, some radio collars might not be found, some radio collars might be too far away from the main groups, and weather conditions might prevent us from reaching targeted radio collars. Therefore, we attempted to classify 50–75 caribou per radio collar to ensure we met the objective of classifying at least 10% of the herd and distributing sampling effort across the landscape.

Caribou were classified as cows, calves, and bulls (small, medium, or large). Summary data are reported as the ratio of bulls per 100 cows and the ratio of calves per 100 cows.

Results and Discussion

Regulatory Year 2017

On 16 and 20 October 2017, we classified 2,962 caribou. The bull-to-cow ratio was 39:100, and the calf-to-cow ratio was 51:100. A total of 16 groups were classified: 12 with 1–16 radio collars per group and 4 with 0 radio collars per group. The number of caribou classified in a group ranged from 10 to 947 caribou. Groups ranged from Toolik Lake to Deadhorse in Unit 26B.

In early-to-mid October, caribou were in large groups of 700–2,000 caribou, characteristic of traditional rutting groups. Rutting activity appeared to have taken place, and caribou were moving southward. We classified 4 groups on 16 October. Weather prevented us from returning for a few days in mid-October. On 20 October, the caribou that we classified were more scattered and in smaller groups of 25–200 caribou.

We located 51 radio collars in 12 groups out of a total of 110 active radio collars. On 16 October, we located 40 radio collars and classified 2,224 caribou from 4 groups. On 20 October, we located 11 radio collars in 8 groups and classified 585 caribou. We also classified 153 caribou from 4 groups with no radio collars present, resulting in a total of 738 caribou classified from 12 groups in mid-to-late October. Radio collars located and sampled represented approximately 46% of the active CAH radio collars (n = 110).

Regulatory Year 2018

No survey was conducted in RY18 due to weather.

Regulatory Year 2019

The survey was conducted on 14–15 October 2019. Of the 126 active radio collars, we heard signals from 83 and located 75 (49 adult cows, 14 long-yearling cows, and 12 bulls) across 72 groups used to classify caribou. Radio collars that were located and sampled represented approximately 60% of the active CAH radio collars (n = 126; 85 adult cows, 20 long-yearling cows, and 21 bulls).

On 14 October, we located 37 radio collars (25 adult cows, 7 long-yearling cows, and 5 bulls) and classified 1,461 caribou across 60 groups, including 25 groups without a radio collar (Table 9). Group sizes were small, ranging from 1 to 77 caribou, with a median of 19 and an average of 24. Of the 60 radio collars located, only 2 groups had 2 radio collars each, while all other groups had only 1 radio collar. These groups were located on the coastal plain in Unit 26B, between the lower Itkillik River and the Dalton Highway.

On 15 October, we located 38 radio collars (24 adult cows, 7 long-yearling cows, and 7 bulls) in 12 groups and classified 2,394 caribou. Group sizes ranged from 3 to 1,040 caribou. When excluding a group of 3 caribou and a group of 1,040 caribou, group sizes ranged from 10 to 290 caribou, with a median of 80 and an average of 135. The large group of 1,040 caribou had 22 collars and was distributed across approximately 5 miles. The remaining groups had 1–3 radio collars, with 73% of the groups having only 1 radio collar. These groups were located near the foothills of the Brooks Range, between the mid-upper Itkillik River and just east of the Dalton Highway.

For the survey, a total of 72 groups were classified: 47 groups had radio collars, with a range of 1 to 22 radio collars per group, and 25 groups did not have radio collars. The number of caribou classified in a group ranged from 1 to 1,040. We classified 3,855 caribou and observed a bull-to-cow ratio of 50:100 and a calf-to-cow ratio of 61:100 (Table 9).

Regulatory Year 2020

The survey was conducted on 15–16 October 2020. On 15 October, we located 34 radio collars (30 adult cows ≥2 years old and 4 bulls) and classified 3,318 caribou from 24 groups, including 7 groups without radio collars (Table 9). The number of caribou classified in these groups ranged from 4 to 613, with a median of 90 and an average of 138. Most of these groups were located along the Chandalar Shelf.

On 16 October, we located 21 radio collars (20 adult cows ≥2 years old and 1 bull) and classified 1,724 caribou from 13 groups, including 6 groups without radio collars. The number of caribou classified in these groups ranged from 13 to 374, with a median of 105 and an average of 133. These groups were located just north of the Brooks Range and west of the Dalton Highway and Itkillik River drainage.

We classified a total of 5,042 caribou and observed a bull-to-cow ratio of 50:100 and a calf-to-cow ratio of 47:100 (Table 9). Among the bulls per 100 cows, there were 22 small, 11 medium, and 15 large bulls.

Regulatory Year 2021

No survey was conducted in RY21 due to limited funding.

Recommendations for Activity 1.10

Continue this activity and find ways to minimize bias in sampling distribution, classification, and segregation of sexes. This survey should be attempted every year when a photocensus is completed (every 2–3 years). However, if a photocensus has not been completed on schedule, a composition survey should still be attempted on a 2- to 3-year basis.

Table 9. Central Arctic caribou herd fall composition surveys, 2009–2020, Unit 26B, Alaska.

Date	Bulls:100 cows	Calves:100 cows	Percent calves	(No. calves)	Percent cows	(No. cows)	Percent bulls	(No. bulls)	Sample size	No. groups	No. collars	(No. bull collars)
13–14 Oct 2009	50	33	18	(1,193)	55	(3,641)	27	(1,814)	6,648	19	37	(0)
23 Oct 2010	50	46	23	(889)	51	(1,930)	26	(968)	3,787	12	21	(0)
13 Oct 2011	69	56	25	(1,303)	44	(2,306)	31	(1,590)	5,199	22	33	(0)
14 Oct 2012	56	61	28	(1,132)	46	(1,845)	26	(1,039)	4,016	11	31	(5)
13–14 Oct 2014[a]	41	42	23	(462)	55	(1,097)	22	(445)	2,004	15	18	(0)
13–14 Oct 2016	39	47	25	(742)	54	(1,579)	21	(623)	2,944	12	28	(2)
16 & 20 Oct 2017	39	51	27	(802)	53	(1,559)	20	(601)	2,962	16	51	(10)
14–15 Oct 2019	50	61	29	(1,118)	47	(1,830)	24	(907)	3,855	72	49	(12)
15–16 Oct 2020	50	47	24	(1,213)	51	(2,554)	25	(1,275)	5,042	37	55	(5)

[a] Originally, 3,903 caribou were classified in this survey, but the department determined that caribou may have been mixed with caribou from the Porcupine caribou herd (PCH) based on PCH satellite radio collar locations. Therefore, only groups sampled west of the Middle Fork Chandalar River were included, which reduced the overall sample size.

ACTIVITY 1.11. Estimate seasonal distribution of the Central Arctic caribou herd (M3).

Data Needs

Understanding the seasonal distribution of the CAH is necessary for monitoring its accessibility to seasonal ranges and minimizing the adverse effects of development on this herd.

Methods

Satellite Radiocollar Data

Telemetry data from PTT (platform transmitter terminal) and GPS collars were compiled for CAH cows and bulls during RY17–RY21. Data were screened to remove the following: locations within the first 14 days after initial collaring; locations after collar removal; locations after mortality; locations with poor quality (indicated by a PTT quality score of A or 0); locations far offshore; and duplicates. Data were also removed based on a distance-rate-angle score that considered the angle and speed of 3 successive locations. Locations were also removed when caribou were with other herds.

Kernel Densities

For winter (1 December–15 April), calving (1–15 June), postcalving (16–30 June), mosquito season (1–15 July), oestrid fly season (16 July–7 August), late summer seasons (8 August–15 September), and annual range, we estimated kernel densities by calculating the mean location of each caribou for every 2-day period during the year using the ks package in R software (Duong et al. 2026). Fixed-kernel density estimation was employed to create the utilization distribution contours of caribou distribution for every 2-day period throughout the year, for all years of the reporting period combined (RY17–RY21). An average utilization distribution was then calculated for each season. By calculating the average of the utilization distribution based on the mean location for each animal, we could account for movements within a season while avoiding bias in the calculation caused by autocorrelation among locations for a single caribou or unequal sample sizes among caribou. The plug-in method was used to calculate the bandwidth of the smoothing parameter. The 50%, 75%, and 95% isopleths from each seasonal utilization distribution were calculated to display the high-, medium-, and low-density contours, respectively.

Dynamic Brownian Bridge Movement Models

To visualize caribou movements during spring and fall migration periods, dynamic Brownian bridge movement models (dBBMMs) were employed to create utilization distribution maps of movements based on the locations of collared individuals (Kranstauber et al. 2014). These dBBMMs, a modification of earlier Brownian bridge models (Horne et al. 2007), use an animal's speed and trajectory, calculated from intermittent GPS locations, to create a probability map describing relative use of the area traversed. A 95% isopleth of movements for each individual caribou outfitted with a collar in the area was computed. Then, the isopleth layers for each season were overlaid to calculate the proportion of collared caribou using each 100-meter pixel. This visualization displays the seasonal use of the area by the CAH as a function of both caribou

distribution and movements. The dBBMM models were computed using the move package in R software (Kranstauber et al. 2017).

Results and Discussion

Winter (1 December–15 April)

Distribution during RY17–RY21 indicated that the highest density of caribou wintered in the Brooks Range between Arctic Village and Anaktuvuk Pass, centered on the Dalton Highway (Fig. 5). One group remained in the northern Brooks Range, while another extended to the southern Brooks Range into the Hodzana Hills. In years when the herd wintered south of the Brooks Range, substantial mixing with the PCH could occur.

Spring Migration (16 April–31 May)

During RY17–RY21, this season was characterized by the CAH leaving its wintering grounds in the Brooks Range and returning to the coastal plain, north of the mountains (Fig. 5).

Calving (1–15 June)

Similar to other reporting periods, there were 2 distinct calving concentrations: the first being west of the Dalton Highway and south of the oilfields, and the second being east of the Dalton Highway to the Shaviovik River (Fig. 5). See the Activity 1.7 section of this report for more detailed information on the calving distribution of parturient CAH cows during RY17–RY21.

Postcalving (15–30 June)

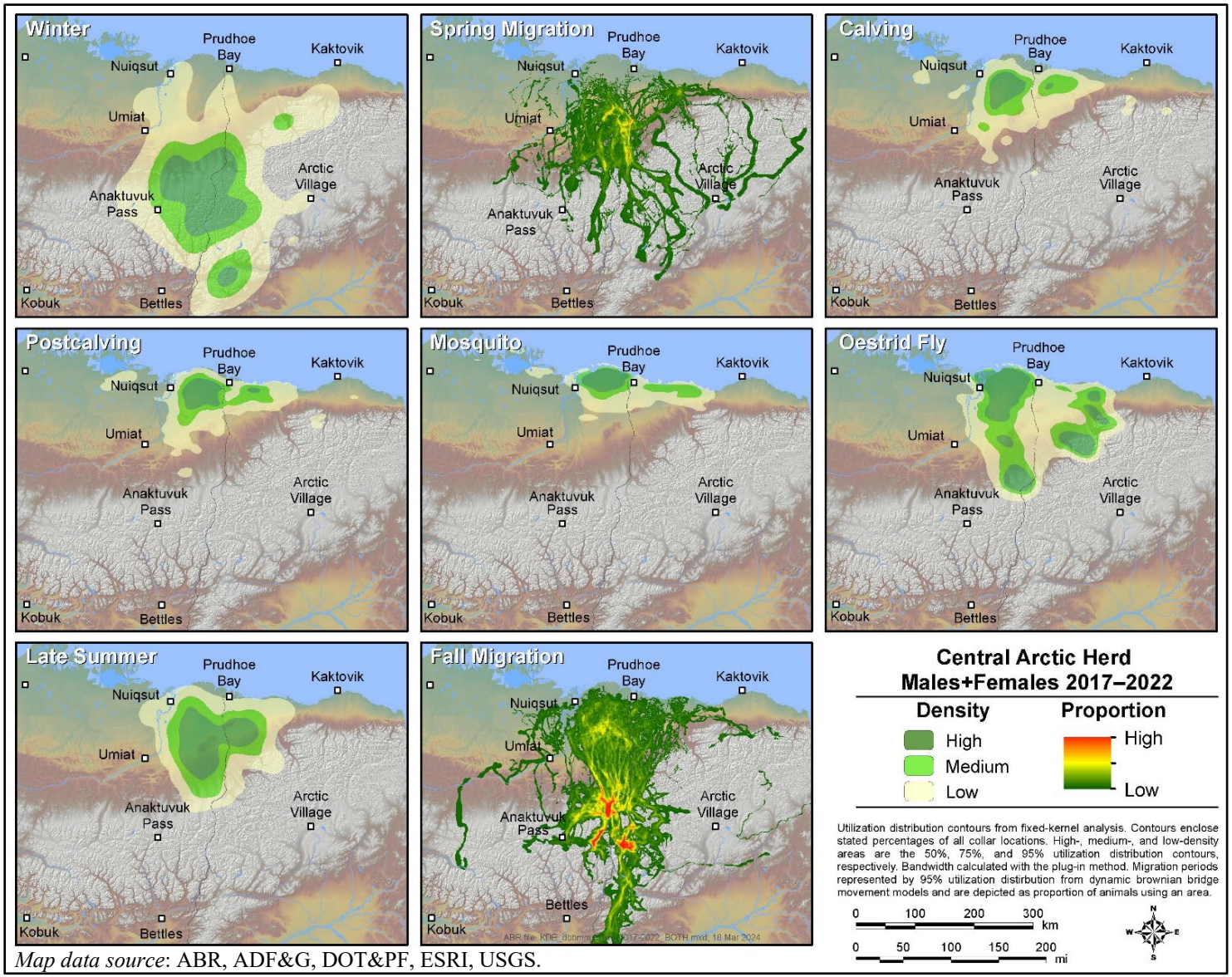
During postcalving in RY17–RY21, the CAH moved north of the calving grounds toward the coastal plain and formed groups to prepare for when mosquitoes hatched. In some years, warm temperatures contributed to mosquitoes hatching in late June, when caribou were distributed along the coast (Fig. 5). Postcalving and mosquito season frequently overlap.

Mosquito Season (1–15 July)

During the mosquito seasons in RY17–RY21, the CAH sought insect relief habitat along the coast on large gravel bars and deltas with more wind and open areas (Fig. 5). Caribou aggregated in large, tight groups when temperatures were warm (≥58 °F), wind was low (<10 mph), and mosquitoes had hatched. Caribou moved into the wind to avoid insects, and frequently the wind came from the northeast (National Oceanic and Atmospheric Administration n.d.).

Oestrid Fly Season (16 July–7 August)

Oestrid fly season directly follows mosquito season. During oestrid fly season, the CAH moved off the coastal plain (Fig. 5), sought different habitats (e.g., gravel bars further south and bands of willows), and were much more loosely aggregated.



Map data source: ABR, ADF&G, DOT&PF, ESRI, USGS.

Figure 5. Central Arctic caribou herd seasonal utilization distribution contours, regulatory years 2017–2021, Alaska. High, medium, and low density represent the 50%, 75%, and 95% utilization distribution contours, respectively.

Late Summer (8 August–15 September)

The CAH mostly remained off the coast and were loosely distributed across the coastal plain, with more caribou distributed west of the Dalton Highway (Fig. 5).

Recommendations for Activity 1.11

Continue.

2. Mortality-Harvest Monitoring and Regulations

ACTIVITY 2.1. Monitor harvest using harvest ticket reports and ADF&G Division of Subsistence household surveys (C1, C2, C3, M1, M3, and M4).

Data Needs

Estimates of annual harvest are important to ensure that harvest is within sustainable limits and to evaluate IM objectives.

Methods

Reported harvest was obtained from general harvest reports mailed to the department or reported online. Data collected from both types of reporting were stored in the department's Wildlife Information Network (WinfoNet) database.

Season and Bag Limit

Seasons and bag limits for caribou in Units 24A, 24B, 25A, 26A, 26B, and 26C were established in the 2017–2018 through 2021–2022 editions of the Alaska Administrative Code (5 AAC 85.025) and are available in the 2017–2018 through 2021–2022 Alaska Hunting Regulations. Additional state regulations affecting caribou hunting include special restrictions along the Dalton Highway, which are outlined in 5 AAC 92.530(7).

Results and Discussion

Harvest by Hunters

UNIT 26B HARVEST

Most of the CAH harvest, primarily by nonlocal residents and nonresidents, occurs in Unit 26B. All summaries related to harvest hereafter, unless stated otherwise, refer to reported harvest in Unit 26B.

Regulatory Year 2017

Out of 619 hunters (Alaska residents and nonresidents combined), 219 reported harvesting 230 caribou (35% success rate; Tables 10 and 11). A total of 348 residents hunted, and 28% successfully harvested (Table 10). A total of 268 nonresidents hunted, and 44% successfully harvested.

Regulatory Year 2018

Out of 510 hunters (Alaska residents and nonresidents combined), 209 reported harvesting 225 caribou (41% success rate; Tables 10 and 11). A total of 305 residents hunted, and 34% successfully harvested (Table 10). A total of 205 nonresidents hunted, and 51% successfully harvested.

Table 10. Reported Central Arctic caribou herd hunter residency and success, regulatory years 2000–2022, Unit 26B, Alaska.

Regulatory year	Successful hunters					Unsuccessful hunters					
	Resident[a]	Nonresident	Unknown	Total	(%)	Resident[a]	Nonresident	Unknown	Total	(%)	Total hunters[b]
2000	339	74	3	416	(52)	354	32	2	388	(48)	804
2001	331	101	4	436	(47)	403	76	3	482	(53)	918
2002	247	103	2	352	(41)	428	70	1	499	(59)	851
2003	249	90	5	344	(48)	313	58	2	373	(52)	717
2004	381	127	9	517	(52)	385	78	9	472	(48)	989
2005	421	154	1	576	(52)	425	100	3	528	(48)	1,104
2006	476	213	20	709	(53)	498	98	26	622	(47)	1,331
2007	383	189	8	580	(42)	649	141	10	800	(58)	1,380
2008	411	157	12	580	(43)	603	163	16	782	(57)	1,362
2009	461	175	6	642	(49)	574	87	8	669	(51)	1,311
2010	633	234	4	871	(54)	600	142	4	746	(46)	1,622
2011	594	194	6	794	(57)	511	81	9	601	(43)	1,401
2012	533	188	1	722	(51)	593	107	5	705	(49)	1,427
2013	359	265	5	629	(43)	655	176	3	834	(57)	1,463
2014	384	279	3	666	(46)	603	163	1	767	(53)	1,433
2015	302	283	0	585	(47)	505	166	0	671	(53)	1,256
2016	286	163	0	449	(42)	419	195	1	615	(58)	1,064
2017	98	118	3	219	(35)	250	150	0	400	(65)	619
2018	104	105	0	209	(41)	201	100	0	301	(59)	510
2019	117	161	0	278	(47)	203	107	0	310	(53)	588
2020	210	154	0	364	(57)	225	53	0	278	(43)	642
2021	189	289	0	478	(52)	258	175	0	433	(48)	911

Note: Most harvest of CAH caribou (primarily nonlocal residents and nonresidents) occurs in Unit 26B.

[a] Alaska residents.

[b] Includes both successful and unsuccessful permit holders who went hunting.

Table 11. Reported Central Arctic caribou herd harvest by sex and method of take, regulatory years 2000–2021, Unit 26B, Alaska.

Regulatory year	Bull	Cow	Unknown	Total	(By bow)[a]	Total hunters	Percent successful hunters[b]
2000	465	28	1	494	(214)	804	52
2001	496	16	4	516	(192)	918	47
2002	389	23	3	415	(96)	851	41
2003	389	11	4	404	(136)	717	48
2004	588	42	4	634	(228)	989	52
2005	635	45	7	687	(239)	1,104	52
2006	798	37	6	841	(301)	1,331	53
2007	620	68	2	690	(183)	1,380	42
2008	669	47	1	717	(180)	1,362	43
2009	757	45	13	815	(224)	1,317	49
2010	978	234	26	1,238	(296)	1,622	54
2011	814	346	12	1,172	(330)	1,401	57
2012	726	275	6	1,007	(285)	1,430	50
2013	730	135	3	869	(191)	1,463	43
2014	720	196	0	916	(200)	1,433	46
2015	530	225	1	756	(94)	1,256	47
2016	317	268	1	586	(145)	1,064	42
2017	223	7	0	230	(64)	619	35
2018	219	6	0	225	(73)	510	41
2019	297	3	0	300	(70)	588	47
2020	421	9	2	432	(135)	642	57
2021	527	7	1	535	(188)	911	52
Average	559	94	4	658	(185)	1,078	48

Note: Most harvest of Central Arctic herd caribou occurs in Unit 26B (primarily by nonlocal residents and nonresidents).

[a] Harvest by bow is also included in total harvest.

[b] Percent successful hunters is calculated by dividing the number of successful hunters by the number of total hunters and represents the percentage of hunters who hunted and harvested a caribou.

Regulatory Year 2019

Out of 588 hunters (Alaska residents and nonresidents combined), 278 reported harvesting 300 caribou (47% success rate; Tables 10 and 11). A total of 320 residents hunted, and 37% successfully harvested (Table 10). A total of 268 nonresidents hunted, and 60% successfully harvested.

Regulatory Year 2020

Out of 642 hunters (Alaska residents and nonresidents combined), 364 reported harvesting 432 caribou (57% success rate; Tables 10 and 11). A total of 435 residents hunted, and 48% successfully harvested (Table 10). A total of 207 nonresidents hunted, and 74% successfully harvested.

Regulatory Year 2021

Out of 911 hunters (Alaska residents and nonresidents combined), 478 reported harvesting 535 caribou (52% success rate; Tables 10 and 11). A total of 447 residents hunted, and 42%

successfully harvested (Table 10). A total of 464 nonresidents hunted, and 62% successfully harvested.

HARVEST BY LOCAL RESIDENTS

Unreported local resident harvest was estimated at approximately 100 caribou annually as described in Braem et al. 2011. The bulk of this harvest was attributed to Nuiqsut resident hunters, likely because of the herd's accessibility near Nuiqsut. Unreported harvest of the CAH by Kaktovik residents likely occurs in most years, particularly during summer months. However, due to the mixing of caribou from the CAH and PCH, we cannot approximate what proportion of the harvest from Kaktovik residents came from each herd.

BOWHUNTING

During RY17–RY21, bowhunter harvest accounted for 23% to 35% of the total harvest, which was higher than the previous reporting period (RY12–RY16), when it ranged from 12% to 28% (Table 11). Bowhunter success within the Dalton Highway Corridor Management Area is related to caribou distribution in August and September.

Sex of Harvest

In RY17, most of Unit 26B was closed to cow harvest and remained closed during the rest of the reporting period. During RY17–RY21, an average of 6 cows were killed each year. Most of these cows were harvested illegally.

Harvest Chronology

During RY17–RY21, 48–57% of the harvest occurred in August, 32–40% occurred in September, and less than 10% occurred in spring (March, April, May, and July).

Transport Methods

During RY17–RY21, 39–56% of the harvest was by hunters using highway vehicles, 23–36% by airplane, and 17%–29% by airboats and boats combined (Table 12).

Alaska Board of Game Actions and Emergency Orders

The 2019 photocensus found the CAH had rebounded and was within its IM objectives. Subsequently, during the March 2020 Board of Game meeting, the resident bag limit for caribou in the Unit 26B remainder was increased from 2 bulls to 4 bulls. No changes were made to the nonresident bag limit.

Recommendations for Activity 2.1

Continue.

3. Habitat Assessment-Enhancement

No habitat assessment or enhancement activities occurred for the CAH during RY17–RY21.

Table 12. Reported Central Arctic caribou herd harvest by transport methods, regulatory years 2000–2021, Unit 26B, Alaska.

Regulatory year	Airplane	(%)	Horse/dog	(%)	Boat	(%)	Airboat	(%)	Snowmachine	(%)	ORV[a]	(%)	Highway vehicle	(%)	Unk	(%)	Total[b]
2000	91	(18)	17	(3)	57	(11)	17	(3)	4	(<1)	1	(<1)	302	(61)	5	(1)	494
2001	108	(21)	7	(1)	50	(10)	18	(4)	0	(0)	5	(1)	324	(63)	4	(<1)	516
2002	112	(27)	10	(2)	54	(13)	11	(3)	1	(<1)	14	(3)	206	(50)	7	(2)	415
2003	78	(19)	2	(<1)	61	(15)	36	(9)	0	(0)	3	(<1)	219	(54)	5	(1)	404
2004	97	(15)	10	(2)	101	(16)	82	(13)	1	(<1)	3	(<1)	335	(53)	5	(<1)	634
2005	120	(17)	7	(1)	119	(17)	60	(9)	0	(0)	2	(<1)	362	(53)	17	(2)	687
2006	191	(23)	10	(1)	133	(16)	56	(7)	0	(0)	1	(<1)	433	(51)	17	(2)	841
2007	205	(30)	22	(3)	72	(10)	40	(6)	3	(<1)	1	(<1)	333	(48)	14	(2)	690
2008	259	(36)	20	(3)	93	(13)	46	(6)	0	(0)	1	(<1)	287	(40)	11	(2)	717
2009	216	(26)	33	(4)	144	(18)	45	(5)	0	(0)	1	(<1)	364	(45)	12	(1)	815
2010	356	(29)	27	(2)	194	(16)	111	(9)	0	(0)	3	(<1)	517	(42)	30	(2)	1,238
2011	330	(28)	73	(6)	178	(15)	61	(5)	0	(0)	3	(<1)	505	(43)	22	(2)	1,172
2012	324	(32)	26	(3)	136	(14)	56	(6)	0	(0)	6	(<1)	436	(43)	23	(2)	1,007
2013	343	(40)	36	(4)	122	(14)	73	(9)	0	(0)	5	(<1)	279	(33)	11	(1)	869
2014	455	(50)	38	(4)	84	(9)	73	(8)	0	(0)	1	(<1)	261	(28)	4	(<1)	916
2015	315	(42)	24	(3)	110	(15)	65	(9)	0	(0)	7	(<1)	234	(31)	1	(<1)	756
2016	166	(28)	16	(3)	107	(18)	53	(9)	0	(0)	7	(1)	234	(40)	2	(<1)	585
2017	82	(36)	0	(0)	36	(16)	20	(9)	0	(0)	0	(0)	90	(39)	1	(<1)	229
2018	60	(27)	5	(2)	35	(16)	18	(8)	0	(0)	0	(0)	105	(47)	3	(1)	226
2019	93	(31)	3	(1)	30	(10)	45	(15)	0	(0)	4	(1)	121	(40)	1	(<1)	297
2020	98	(23)	5	(1)	69	(16)	55	(13)	0	(0)	2	(<1)	191	(44)	0	(0)	420
2021	132	(25)	4	(1)	41	(8)	47	(9)	0	(0)	1	(<1)	297	(56)	0	(0)	522

[a] ORV includes 4-wheelers and other off-road vehicles.

[b] Percentages were calculated using the total, which includes unknown transport methods (Unk).

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

Data Recording and Archiving

Original raw data forms are in a file cabinet at the Fairbanks office. Electronic copies of scanned raw telemetry and capture data, Excel files, reports, and memoranda were stored on an internal database housed on the Fairbanks network drive. Harvest data was stored on an internal database (WinfoNet).

Agreements

Data sharing agreements for the use of satellite collar data were developed with ConocoPhillips, ExxonMobil, the U.S. Geological Survey, and the Porcupine Caribou Technical Committee.

Permitting

Capture operations led by ADF&G occurred under Institutional Animal Care and Use Committee (IACUC) protocol numbers 0019-2020-41, 0019-2021-38, 0019-2022-10, 0019-2023-010, and 0138-2024-020.

Conclusions and Management Recommendations

The ANS objective of 250–450 caribou (C1) was met; opportunity was available for this level of harvest, with 250–450 caribou representing less than 2% of the 2019 and 2022 abundance estimates. The IM population objective of 28,000–32,000 caribou (C2) was met in 2019, when the population was estimated at 30,096 caribou, and exceeded in 2022, when the population was estimated at 34,388 caribou. The harvest objective of 1,400–1,600 caribou (C3) was not met because fewer than 1,400 caribou were harvested in all years during RY17–RY21, mostly due to hunter access and distribution of caribou.

The objective of maintaining a population of at least 28,000–32,000 caribou (M1) was met in all years during RY17–RY21. The objective of maintaining a harvest of at least 1,400 caribou when the population is ≥28,000 caribou (M2) was not met, mostly due to hunter access. The objective of maintaining a bull-to-cow ratio of at least 40:100 was met (M3), as demonstrated by the bull-to-cow ratio of 48:100 in 2020. The objective of maintaining the accessibility of the CAH to their seasonal ranges (M4) was met based on observations and analysis of satellite radio collar movements.

II. Project Review and RY22–RY26 Plan

Review of Management Direction

MANAGEMENT DIRECTION

No change in management direction for RY22–RY26.

GOALS

No change in goals from the RY17–RY21 reporting period.

CODIFIED OBJECTIVES

Amounts Reasonably Necessary for Subsistence Uses

No change is expected from the RY17–RY21 reporting period.

Intensive Management

No change is expected from the RY17–RY21 reporting period.

MANAGEMENT OBJECTIVES

The management objectives have slightly changed from those in RY17–RY21.

M1. Maintain a population of at least 28,000–32,000 caribou (G1, G2, and G3).

M2. Maintain a harvest opportunity of at least 1,400 caribou if the population is ≥28,000 caribou (G1).

M3. Maintain a bull-to-cow ratio of at least 40:100 (G1 and G3).

M4. Maintain accessibility of historic seasonal ranges for the CAH in areas of industrial development (G2).

REVIEW OF MANAGEMENT ACTIVITIES

1. Population Status and Trend

ACTIVITY 1.1. Capture and deploy 10–20 radio collars on yearling cows and 10–20 on both adult cows and bulls combined annually. Maintain at least 30 radio collars on adult cows and 10 radio collars on adult bulls. Conduct disease assessment (M1, M2, M3, M4, C1, C2, and C3).

Data Needs

No change from the RY17–RY21 reporting period.

Methods

Captures

No change from the RY17–RY21 reporting period.

Thirteen-Month-Old Calf and Yearling Weights

No change from the RY17–RY21 reporting period.

Pathogen Exposure and Mineral Analyses

Continue working with the DWC Wildlife Health and Disease Veterinarians to determine appropriate disease and health monitoring for the CAH. Balance capture times and logistics with field sample collection and processing. If recommended and feasible, continue collecting whole blood and serum samples to test for *Brucella suis* biovar 4, *Chlamydophila* spp., contagious ecthyma virus, Q fever, and vitamin B12 (cobalamin). Analyze serum (in serum separator tubes) for serology of bovine respiratory disease complex viruses and leptospirosis antibodies, as well as to test for trace elements and adenovirus. Additionally, analyze serum haptoglobin to test for nonspecific inflammation. Collect nasal swabs for testing respiratory disease. Collect hair and feces to test for parasites.

ACTIVITY 1.2. Conduct a photocensus every 2–3 years (M1, M2, C1, C2, and C3).

Data Needs

No change from the RY17–RY21 reporting period.

Methods

Survey and enumeration methods, as well as population estimate methods, will remain unchanged from the RY17–RY21 reporting period.

ACTIVITY 1.3. Estimate growth rate (lambda [λ]; M1, M2, C1, C2, and C3).

Data Needs

No change from the RY17–RY21 reporting period.

Methods

No change from the RY17–RY21 reporting period.

ACTIVITY 1.4. Estimate annual survival rates from radiocollared cows (M1, M2, C1, C2, and C3).

Data Needs

No change from the RY17–RY21 reporting period.

Methods

Use a known-fate survival model, such as Kaplan-Meier, for survival analysis to obtain robust monthly and annual survival rates. Explore if sexes and age classes can be estimated separately with adequate sample sizes.

ACTIVITY 1.5. Estimate allowable harvest (M1, M2, M3, M4, C2, and C3).

Data Needs

No change from the RY17–RY21 reporting period.

Methods

No change from the RY17–RY21 reporting period.

ACTIVITY 1.6. Estimate annual parturition rate from radiocollared cows (M1 and C2).

Data Needs

No change from the RY17–RY21 reporting period.

Methods

Conduct a herd-level calving estimate only, rather than conducting separate eastern and western estimates. Additionally, explore whether a movement model can accurately estimate annual parturition rates for each age class.

ACTIVITY 1.7. Estimate peak of calving from radiocollared cows (M1).

Data Needs

No change from the RY17–RY21 reporting period.

Methods

No change from the RY17–RY21 reporting period.

ACTIVITY 1.8. Estimate 50% and 95% isopleths for radiocollared parturient cows during calving (M1 and M2).

Data Needs

No change from the RY17–RY21 reporting period.

Methods

No change from the RY17–RY21 reporting period.

ACTIVITY 1.9. Estimate late June calf-to-cow ratios of radiocollared cows and early calf survival (M1 and C2).

Data Needs

No change from the RY17–RY21 reporting period.

Methods

No change from the RY17–RY21 reporting period.

ACTIVITY 1.10. Conduct annual fall composition surveys to estimate bull-to-cow and calf-to-cow ratios (M1, M2, M3, M4, C1, C2, and C3).

Data Needs

No change from the RY17–RY21 reporting period.

Methods

No change from the RY17–RY21 reporting period.

ACTIVITY 1.11. Estimate seasonal distribution of the Central Arctic caribou herd (M4 and C1).

Data Needs

No change from the RY17–RY21 reporting period.

Methods

Methods will not change from the RY17–RY21 reporting period, including those for collecting satellite radio collar data, calculating kernel densities, and using dBBMM to visualize caribou movements.

2. Mortality-Harvest Monitoring

ACTIVITY 2.1. Monitor harvest using harvest ticket reports and ADG&G Division of Subsistence household surveys (C1, C2, C3, M1, M3, and M4).

Data Needs

No change from the RY17–RY21 reporting period.

Methods

No change from the RY17–RY21 reporting period.

3. Habitat Assessment-Enhancement

No habitat assessment or enhancement activities are expected for the CAH during RY22–RY26.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

Data Recording and Archiving

No change from the RY17–RY21 reporting period.

Agreements

No change from the RY17–RY21 reporting period.

Permitting

No change from the RY17–RY21 reporting period.

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