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**CHAPTER 15: CARIBOU MANAGEMENT REPORT**

From: 1 July 2012

To: 30 June 2014<sup>1</sup>

**LOCATION**

**GAME MANAGEMENT UNITS:** 25A, 25B, 25D, and 26C (59,400 mi<sup>2</sup>)

**HERD:** Porcupine

**GEOGRAPHIC DESCRIPTION:** Eastern portions of the Arctic Slope, Brooks Range, and northeastern Interior Alaska

**BACKGROUND**

The Porcupine caribou herd (PCH) migrates between Alaska and the Yukon and Northwest Territories in Canada. Most of the herd's 130,000 mi<sup>2</sup> range is remote, roadless wilderness. The PCH is an important subsistence resource for Native people of Alaska and Canada. In addition, PCH provides valued hunting and wildlife viewing opportunities for nonlocal Alaska residents and nonresidents. Because the PCH often calves in promising onshore petroleum prospects in Alaska (Clough et al. 1987), various state and federal agencies and their Canadian counterparts cooperated to carry out baseline ecological studies of the PCH in the 1980s and 1990s (Fancy and Whitten 1991, Whitten and Fancy 1991, Whitten et al. 1992, Fancy et al. 1994, Griffith et al. 2002). These studies are expected to provide baseline information for development of additional studies, planning, and mitigation should petroleum development occur in the future. Since these studies, research of the PCH has been substantially reduced and efforts have been focused on monitoring population parameters to evaluate management objectives.

In 1987 the United States and Canada established the International Porcupine Caribou Board (IPCB) to coordinate management and research among government and user groups. IPCB includes a representative from the Alaska Department of Fish and Game (ADF&G), representatives of the governments of the United States, Canada, Yukon and Northwest Territories, and members of communities and Native organizations in Alaska and Canada. Additionally, ADF&G is a member of the Porcupine Caribou Technical Committee, an ad hoc committee operating under IPCB with representatives of the various management and research agencies with responsibilities for PCH. These include the U.S. Fish and Wildlife Service; Yukon Department of Environment (YDE; formerly Yukon Department of Renewable Resources); Northwest Territories Department of Environment and Natural Resources; Canadian Wildlife Service; Parks Canada; and U.S. Geological Survey, Biological Resources Division. The

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<sup>1</sup> At the discretion of the reporting biologist, this unit report may contain data collected outside the report period.

Porcupine Caribou Technical Committee meets regularly to coordinate research and management activities and sets priorities for future work.

A variety of factors affect PCH management, including IPCB and Porcupine Caribou Technical Committee recommendations, biological studies, subsistence harvest, and congressional actions regarding the potential opening of the Arctic National Wildlife Refuge (ANWR) to petroleum exploration and development.

PCH remained more stable than other Alaska herds during the 1960s and 1970s at about 100,000 caribou (Table 1). In 1979 the population began a steady increase and reached 178,000 caribou by 1989. Annual rates of growth averaged about 5% from 1979 to 1989. PCH then decreased to 160,000 caribou in 1992, probably in response to lower yearling recruitment after harsh winters (Arthur et al. 2003). The herd continued to decline to an estimated 129,000 animals in 1998 and 123,000 in 2001, probably due to increased adult mortality (Arthur et al. 2003). Estimates of population size could not be obtained during 2002–2009 due to inadequate survey conditions. In 2010 a successful photocensus survey was conducted which resulted in a population estimate of 169,000 caribou. In 2013 a photocensus survey resulted in a population estimate of 197,000 caribou representing an average annual growth rate of 5% from 2010 through 2013.

## **MANAGEMENT DIRECTION**

The following goals, proposed by IPCB in 1998 (International Porcupine Caribou Board 1998), have been used to guide management activities since the decline in research efforts of the early 1990s.

### **MANAGEMENT GOALS**

- Conserve PCH and its habitat through international cooperation and coordination so the risk of irreversible damage or long-term adverse effects as a result of the use of caribou or their habitat is minimized.
- Ensure opportunities for customary and traditional uses of PCH.
- Enable users of PCH to participate in international efforts to conserve PCH and its habitat.
- Encourage cooperation and communication among governments, users of PCH, and others to achieve these objectives.

### **MANAGEMENT OBJECTIVE AND MANAGEMENT ACTIVITIES**

- Maintain a minimum population of 135,000 caribou.
  - Conduct photocensuses every 2–3 years to estimate population size.
  - Estimate parturition rates and late June calf:cow ratios from radiocollared females.
  - Monitor herd movements by periodically locating radiocollared and GPS (satellite) collared caribou.

- Monitor the harvest through field observations, hunter reports, and contact with residents.

## METHODS

### RADIO COLLAR DEPLOYMENT AND MAINTENANCE

We annually maintained 75–90 radio collars (VHF [very high frequency] transmitters, GPS [global positioning system] transmitters, and PTT [Platform Terminal Transmitters]) on cow caribou and 10–20 VHF radio collars on bull caribou. Caribou were captured using a handheld netgun shot from an R-44 helicopter, manually restrained with hobbles and hood, and fitted with a VHF, GPS, or PTT collar. Annually in March, 10–20 10-month-old calves (short yearlings) were captured and radiocollared, and adult female caribou were recaptured and fitted with new collars approximately 4–6 years after radio collars were originally deployed. In addition, 10–15 bulls (ages unknown) were radiocollared annually. Bulls are not recaptured because they typically die prior to the life expectancy of the collar.

### POPULATION STATUS AND TREND

#### *Population Size*

ADF&G, with assistance from ANWR and YDE staff, estimated population size of the herd using the modified aerial photo-direct count extrapolation (APDCE) technique (Davis et al. 1979, Valkenburg et al. 1985) conducted at 2–4 year intervals during 1979–2001. The technique required monitoring postcalving aggregations by radiotracking radiocollared caribou from mid-June through mid-July. Aggregations of sufficient quality to conduct a photocensus typically occurred, presumably in response to insect harassment, when temperatures were  $>55^{\circ}\text{F}$ , and wind speed was  $<8$  mph (Davis et al. 1979, Valkenburg et al. 1985). Groups of caribou were then photographed with a Zeiss RMK-A aerial camera mounted in the belly of a DeHavilland DHC-2 Beaver aircraft. Small groups of caribou were often photographed with handheld cameras or visually estimated. Estimated population size in a given year was the summation of the total number of caribou enumerated from photographs, and caribou that were visually estimated.

Prior to 2010, photocensus results were considered a minimum estimate of herd size. The method lacked an estimate of variance and likely underestimated herd size because groups of caribou having no radio collars can be difficult to detect and, occasionally, groups with radio collars are not detected. Furthermore, the magnitude of the bias likely varied between years and was largely affected by how well the herd aggregated and to a lesser extent the number of radio collars deployed within the herd.

Beginning in 2010, herd size was estimated by conducting a photocensus survey as described above and applying a model developed by Rivest et al. (1998) to estimate herd size and provide a measure of uncertainty. The estimator is based on a 2-phase sampling design. Phase 1 uses the distribution of radiocollared caribou among groups of known size to estimate the number of caribou in groups without radiocollared caribou. Phase 2 uses a Horvitz–Thompson estimator and the proportion of active radio collars detected to expand the herd size from phase 1 to account for caribou represented by radio collars not located during the survey. Rivest et al. (1998) describe 3 detection models for use in phase 2. Of these models, the “homogeneity” model has been most frequently applied (Couturier et al. 1996, Patterson et al. 2004) and is best suited for our data. This model assumes that 1) all active radio collars are identified in observed

groups and 2) unobserved groups with radiocollared caribou are missed because they are outside of the surveyed area. Phase 2 calculations are not necessary if all radio collars are located and associated groups are counted. Also, the consequences of not meeting the assumptions of Phase 2, particularly by choosing an inappropriate detection function, are greatly mitigated when a high proportion of the active radio collars are detected, and associated groups are counted. Finally, this estimator assumes random distribution of radio collars among caribou in the herd, and a statistical test is provided to evaluate the appropriateness of this assumption for a given survey.

#### *Parturition, Calf: Cow Ratios, and Early Calf Survival*

Parturition rate was estimated by observing radiocollared females  $\geq 4$ -years old from a fixed-wing aircraft during the first half of June. In addition, we opportunistically observed 2- and 3-year-olds to estimate age-specific parturition rates. Caribou observed with calves, hard antlers, or distended udders were classified as parturient (Whitten 1995a). Parturient caribou may have been misclassified because the cow did not have hard antlers, the udder was not distended, calves were born early and died, or calves were born late and not observed.

The proportion of calves:100 cows was estimated by observing radiocollared females  $\geq 4$ -years old from a fixed-wing aircraft in late June after most calves were born. June calf survival was estimated with 2 methods: 1) the proportion of radiocollared cows observed with a calf in late June compared to those observed with a calf in early June (excludes most perinatal mortality), and 2) late June calf:cow ratio/parturition rate (survival from birth to late June).

#### *Population Composition*

Fall sex and age composition was estimated by classifying caribou from a helicopter near peak of rut to take advantage of presumed mixing of bulls, cows, and calf caribou. Peak rut was estimated as the date 228 days (gestation period) prior to the median calving date of the PCH estimated from parturition surveys conducted annually in early June. Caribou groups were located by radiotracking collared caribou (bulls and cows) from fixed-wing aircraft. Using a cluster sampling scheme (Cochran 1977), we classified approximately 200 caribou per radio collar per group. If  $< 200$  caribou were present in a group, all or most of the caribou in that group were classified. The presence or absence of a vulva was used to differentiate the sexes for adult caribou, and size was used to differentiate calves from adults. Bulls were further classified as small, medium, or large based on antler characteristics (Eagan 1993). Bull:cow and calf:cow ratios were generated using pooled data, and variance was estimated using variance in those ratios between independent clusters, weighted by cluster size.

Using sampling techniques recommended by Urquhart (1983), YDE funded and conducted composition counts from a helicopter during March on PCH's winter range in most years since 1991. Because group composition is unlikely to be homogeneous, Urquhart (1983) recommended a sample size of 10% of herd size composed from several well-dispersed sample areas. Caribou were classified as adult cow, calf, and immature and mature bulls.

Historical composition data for the herd can be found in Whitten (1993a) and Stephenson (2005) for the postcalving period during 1971–1992 and in Whitten (1981, 1992) for the fall period during 1972–1980.

### *Distribution and Movements*

Personnel from ADF&G, ANWR, and YDE cooperated to monitor distribution of PCH during calving, postcalving, summer, rut, and winter by relocating radiocollared caribou from fixed-wing aircraft and using location data collected remotely from GPS or PTT collars.

### **HARVEST**

Harvest and hunting pressure by Alaska residents who lived south of the Yukon River (nonlocals) and by nonresidents were monitored using harvest reports submitted by hunters. Alaska residents who lived north of the Yukon River (locals) were not required to obtain caribou harvest tickets and report cards. However, they were required to register with ADF&G or an authorized vendor. Reporting has typically been poor; therefore, harvest by local residents prior to regulatory year (RY) 2006, which begins 1 July and ends 30 June (e.g., RY06 = 1 July 2006–30 June 2007), was estimated based on knowledge of local hunting patterns and the availability of caribou near communities. Local harvest depends largely on the relative availability of caribou and can be quite variable between years.

Prior to RY06, ADF&G likely underestimated local harvest in Alaska in years when PCH wintered near Arctic Village and Kaktovik. Underestimates of harvest for those communities was due to poor harvest reporting by local residents and a lack of subsistence household surveys by ADF&G. We adjusted total annual local harvest from 200–500 during RY93–RY05 to 400–700 beginning in RY06. To arrive at this estimate, we used, in part, a model developed by Sutherland (2005) to estimate harvest of Western Arctic caribou for villages within that herd's range. The model uses household surveys, community size, proximity to the herd, and the ability of villagers to access caribou to estimate harvest for a given year. Although we did not have the data necessary to run the model for Arctic Village, Sutherland (2005) provided estimates of harvest for various villages on a per capita basis. Among similarly-sized communities, Anaktuvuk Pass consistently had the highest per capita harvest, 2 caribou/person. Because both communities show a high reliance on caribou, we used estimated per capita harvest for Anaktuvuk residents to estimate harvest of PCH caribou by Arctic Village residents (200–350 caribou/year). We estimated harvest by Kaktovik residents (200–250 caribou/year) from household surveys conducted in 1987–1988 (Pedersen 1990) and adjusted per capita harvest rates for current Kaktovik population size. In some years caribou are opportunistically-harvested by residents of Venetie, Beaver, Fort Yukon, and Chalkyitsik (0–100 caribou/year combined) which are on the periphery of the PCH's range. The total estimated annual harvest range of 400–700 caribou for the above communities, combined, represents the harvest range expected for years when caribou are relatively scarce.

Canadian harvest was obtained from YDE during 1984–1998. During 1999–2009 YDE did not collect harvest data, but Canadian managers assumed average harvest was 4,000 annually. Beginning in 2010, hunters in Canada were required to report harvest as the result of a harvest management plan implemented in that year. For years when harvest data were available (reported or estimated), data were summarized by regulatory year.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

#### *Population Size*

On 14 July 2013 we completed a photocensus of the PCH, resulting in a population estimate of 197,228 (SE = 13,772; 95% CI = 168,667–225,789) caribou (Table 1). The photocensus included 70 of the 89 active radio collars deployed on PCH caribou (bulls and cows) and 1 radiocollared Central Arctic herd cow that had been with the PCH since spring 2013. Radio collar distribution resulted in a total of 23 groups of which 14 groups were in Alaska, and 9 groups were in Canada. In addition, 13 groups that did not contain collared caribou were located and photographed, 6 in Alaska and 7 in Canada. In total, 36 groups were identified and photographed. Enumeration of all caribou on photographs resulted in 141,978 caribou (Table 2).

Using Rivest et al.'s (1998) method, including the homogeneity model in phase 2 calculations to expand the estimate for missing radio collars, the 2013 PCH photocensus data set consisted of 23 groups that totaled 133,295 caribou and accounted for 71 of 90 PCH radio collars (includes 1 caribou originally collared as Central Arctic herd; Table 2). Abundance was estimated at 197,228 (SE = 13,772; 95% CI = 168,667–225,789) caribou (Table 1). Our assumption of a random distribution of radio collars in the survey was supported ( $P = 0.865$ ; Table 1).

The 2013 photocensus resulted in the highest herd size estimate in the history of monitoring the PCH (Table 3). However, the 95% CI in 2013 overlapped with the estimate obtained in 2010 (168,948, SE = 7,384, 95% CI = 153,493–184,403) and the minimum count obtained in 1989 (178,000; Table 3).

#### *Parturition and Early Calf Survival*

Parturition rate of radiocollared females  $\geq 4$ -years old was 86% ( $n = 42$ ) in 2013 and did not differ significantly (95% binomial CI) from the long-term mean (1987–2012;  $\bar{x} = 81\%$ ; Table 4). Parturition rate was not estimated in 2014 due to poor weather that prevented adequate radiotracking flights.

Parturition rate for 3-year-olds was 67% ( $n = 3$ ) in 2013 and was unknown in 2014 due to poor weather that prevented adequate radiotracking flights. Mean parturition for all 3-year-olds during 2005–2013 was 68% ( $n = 38$ ). Parturition rates of 3-year-olds have been positively correlated with herd growth rates, and reproductive rates have been used as an index to evaluate nutritional status (Boertje et al. 2012). Herd growth rates were negative when 3-year-old parturition rates fell below 40% and were stable or positive when this parturition rate was  $\geq 60\%$  (Boertje et al. 2012).

Postcalving survival of calves estimated from cows observed with calves in early June that were subsequently observed in late June (excludes most perinatal mortality) was not estimated in 2013 because caribou were aggregated in shrubby vegetation which made identification of individual radiocollared caribou and their unmarked calves difficult or impossible. Postcalving survival of calves was not estimated in 2014 due to poor weather that prevented adequate radiotracking flights.

The late June calf:cow ratio of radiocollared females  $\geq 4$ -years old in 2013 was not estimated due to previously mentioned issues with sightability. The late June calf:cow ratio in 2014 was 49:100 ( $n = 39$ ) compared to the long-term mean (years 1987–2011) of 58 calves:100 cows (Table 4).

### *Population Composition*

In October 2012 we located 59 radiocollared caribou in Alaska and Yukon and sampled 40 caribou groups containing 1–4 radio collars per group. Most caribou groups ( $n = 28$ ) contained 1 radiocollared caribou and 12 caribou groups contained 2, 3, or 4 radio collars. Twenty-eight groups contained radiocollared cows, 9 groups contained radiocollared bulls, and 3 groups included both radiocollared bulls and cows. The number of individuals classified per group ranged from 4 to 936 caribou and varied based on the number of radiocollared caribou present per group and the total number of caribou available for classification in each group. The number of individuals classified per radio collar ranged from 4 to 296 caribou and averaged 221 caribou. Of 11,614 caribou classified, 9,518 were adults and 2,096 were calves. We estimated ratios of 47 bulls:100 cows and 32 calves:100 cows (Table 4).

Previous caribou composition surveys (PCH 2009, Central Arctic 2009, Teshekpuk 2009) identified sources of bias associated with estimating compositions of large caribou herds (Caikoski 2013). Although minimized compared to many other times of the year, sexual segregation is still apparent during rut-timed composition counts. In particular, substantial heterogeneity in calf:cow and bull:cow ratios were observed both within and between groups of caribou found by locating radiocollared bulls and those identified by locating radiocollared cows. In addition, large-scale spatial heterogeneity in composition was observed for PCH in 2009 when the herd was split between Alaska and Yukon. Although we attempted to minimize sources of bias in the 2012 composition survey by sampling across the full spatial distribution of the herd and by using cow and bull radio collars, the extent and magnitude of any bias in the 2012 survey is unknown.

March composition surveys to estimate the calf:cow ratios were not conducted in RY12 or RY13. The long-term mean calf:cow ratio in March is 34 calves:100 cows (range = 20–56 calves:100 cows; Table 4).

### *Distribution and Movements*

Calving Distribution. In early June 2013 most radiocollared cows were on the coastal plain or adjacent foothills between the Babbage and Kongakut rivers. Estimates of calving distribution and the concentrated calving area were not calculated in 2012 due to a small sample size. Only 10 of 39 radiocollared cows that were judged parturient were observed with a calf at heel during the parturition survey in 2013.

In 2014, calving distribution and the concentrated calving area could not be estimated due to adverse weather conditions. However, based on the locations of cows fitted with GPS collars, most caribou likely calved on the coastal plain between the Hulahula and Kongakut rivers in Alaska. Additional calving may have occurred on the coastal plain in Yukon between the Babbage River and the Alaska-Yukon border.

In the 1980s and 1990s most of PCH calved in ANWR, often in the 1002 area (The Alaska National Interest Lands Conservation Act of 1980 established ANWR. Section 1002 of that act identifies 1.5 million acres on the coastal plain in the western portion of ANWR in which management direction for land use[s] has been deferred due to the area's potential for oil and gas resources. This area is referred to as the "1002 area" in this report).

Since 2004, PCH has primarily calved in Ivvavik National Park, Canada. In 7 of 11 years during 2004–2014, calving occurred on the coastal plain, primarily in Yukon between the Alaska-Canada border and the Babbage River. In the other 4 years, calving occurred in both Alaska and Canada, and some calving occurred in the 1002 area during 3 of those years.

Summer Distribution. Following calving in summer 2012, caribou were dispersed north of the Continental Divide from the Babbage River to the Canning River using both the northern foothills of the Brooks Range and coastal plain. Additional caribou were present in the upper Firth, Coleen, and Sheenjek river drainages in July.

Following calving in summer 2013, PCH was segregated into 3 distinct regions. About 20% of the radio collars remained on the coastal plain and moved west to the Canning River and mixed with Central Arctic caribou. About 65% of the radio collars moved to the south side of the Brooks Range to the upper Sheenjek and Coleen river drainages. The remaining radio collars, composed entirely of bulls, were in the Richardson Mountains on the border of Yukon and Northwest Territories.

Following calving in summer 2014, most of PCH were on the coastal plain from the Alaska border to the Canning River during late June and early July. By late July and early August the herd dispersed over a large geographic area from the Hulahula River to the Yukon-Northwest Territories border north of the Continental Divide and from the East Fork Chandalar River to the Old Crow Flats south of the Continental Divide.

Fall Distribution. In August 2012 about 80% of the PCH satellite- and GPS-collared caribou were in the Richardson Mountains or Old Crow Flats in northern Yukon, and the remaining caribou were in Alaska, mostly in the Sheenjek and East Fork Chandalar river drainages. During September most of PCH that were in Yukon moved west into Alaska and, by late September, over 90% of PCH was in Alaska distributed between the East Fork Chandalar River and the Coleen River.

In August and September 2013 the PCH was distributed over a large geographic area extending from the Aichilik River to the Yukon-Northwest Territories border north of the Continental Divide and from the Coleen River to the Richardson Mountains south of the Continental Divide. In late September through early October about 75% of the herd moved west to the East Fork Chandalar river drainage in Alaska, and remaining caribou moved south to the Ogilvie Mountains in Yukon.

Winter Distribution. During 2012–2013 the PCH wintered in 3 discrete regions. Based on the locations using satellite and GPS collars ( $n = 14$ ), about 50% of PCH wintered in the Old Crow Flats in Yukon and in the upper Coleen river drainage in Alaska. About 35% of PCH wintered in the Ogilvie Mountains in Yukon, and 15% of PCH wintered in the North Fork Chandalar river



drainage in Alaska. Caribou that wintered in the North Fork Chandalar river drainage were mixed with Central Arctic herd caribou.

During 2013–2014, based on the locations of satellite and GPS collars ( $n = 20$ ), about 50% of PCH wintered in the Ogilvie Mountains in Yukon, and 50% of PCH wintered in the upper Chandalar River or Hodzana Hills in Alaska. Caribou that wintered in Yukon were mixed with the Hart River, Fortymile, and potentially Nelchina caribou. PCH that wintered in Alaska were mixed with Central Arctic, Hodzana, and Teshekpuk caribou.

Historical information on movements and distribution of PCH are summarized by Garner and Reynolds (1986), Whitten (1987, 1993b, 1995b), Whitten and Regelin (1988), Fancy et al. (1989), Golden (1989, 1990), Whitten and Fancy (1991), and Griffith et al. (2002).

## **MORTALITY**

### *Harvest*

Season and Bag Limit. The State of Alaska’s hunting season for resident hunters during RY12–RY13 was 1 July–30 April; in addition, hunters could take only bull caribou during 23–30 June in Unit 26C. The bag limit for all Alaska residents was 10 caribou. The season for nonresident hunters during RY12–RY13 was 1 August–30 September, and the bag limit was 2 bulls.

Alaska Board of Game Actions and Emergency Orders. The Alaska Board of Game made no changes to the seasons or bag limits for PCH caribou in RY12–RY13, and no emergency orders were issued.

Alaska Harvest. Nonlocal Alaska resident and nonresident hunters harvested 138 PCH caribou in Alaska during RY12 and 136 caribou in RY13 (Table 5). Most harvest by nonlocals and nonresidents occurred in Unit 25A in the Coleen, Sheenjek, and East Fork Chandalar river drainages. Overall, harvest and hunting pressure by nonlocal Alaska residents and nonresidents remained low. The combined reported harvest by nonlocal Alaska residents and nonresidents represents a small proportion (<20%) of the estimated harvest in Alaska and is less than 10% of the total combined harvest in Alaska and Canada. Due to difficult logistics, high expense, and uncertainty in herd location from year to year, PCH has never been subjected to substantial harvest by nonlocal and nonresident hunters in Alaska.

Total annual harvest of PCH in RY12 and RY13 in Alaska is unknown because reporting by local Alaska residents is low. Most local Alaska harvest is by residents of Kaktovik and Arctic Village. Harvest occurs seasonally and is affected by caribou distribution. Harvest by Kaktovik residents occurs primarily during summer, following the calving period, and likely does not exceed 200 animals. Residents of Arctic Village harvest caribou primarily during winter in years when PCH winters in or near the upper Chandalar River. This harvest likely ranges 200–350 caribou in years when caribou are accessible. In RY12 and RY13 harvest was likely near the upper range for Arctic Village because caribou were concentrated near the community for several months during winter. A small number of additional caribou were harvested by residents of Venetie in both years.

Canada Harvest. PCH harvest in Canada during RY12 was estimated at 1,283 caribou (Table 5) (Cooley and Branigan 2014). Most harvest occurred in August followed by September and July,

and 86% of the harvest consisted of bulls (Cooley and Branigan 2014). Harvest in Canada during RY13 was estimated at 2,920. Eighty-three percent of the RY13 harvest was bulls, and harvest chronology was unknown (Table 5).

Harvest Rate. In RY12 the total harvest was estimated at 1,821–2,121 caribou (Table 5), which is 1.1% of the 2013 population estimate. Total harvest in RY13 was estimated at 3,456–3,756 caribou (Table 5), which is 1.8% of the 2013 population estimate.

Hunter Success. Success rates for nonlocal Alaska residents and nonresidents combined were 57% in RY12 and RY13, similar to previous years (Table 6). Most PCH caribou harvested by nonlocal Alaska residents and nonresidents were harvested in Units 25A and 26C. Hunting pressure was low in Units 25D and 25B. This is expected as these units are on the periphery of the PCH's range.

Local hunter success depended on spatial and temporal distribution of PCH relative to village locations. Success rates by Kaktovik residents were likely low or moderate in RY12 and RY13 because PCH migrated south of the coastal plain into the Brooks Range during mid- to late June. However, success rates for residents of Arctic Village were likely high in RY12 and RY13 due to an abundance of PCH caribou that wintered in the upper Chandalar river drainage.

Harvest Chronology. Nearly all nonlocal Alaska resident and nonresident harvest of PCH in Alaska occurs during August and early September. Local harvest near Kaktovik primarily occurs in July, August, and April if traveling conditions are good and caribou are present (Pedersen 1990). Harvest by local residents south of the Brooks Range primarily occurs during winter. However, harvest chronology depends on availability of caribou near villages, and harvest occurs whenever caribou are present.

Transport Methods. Traditionally, nonlocal Alaska resident and nonresident hunters fly into the PCH's range, and a few travel by boat up the Porcupine River. Local residents in Alaska use boats or ATVs in summer and snowmachines in winter when the predominant harvest of PCH in Alaska occurs.

### *Natural Mortality*

A study on the causes of natural mortality on PCH has not been conducted since the late 1980s. However, wolves, grizzly bears, and golden eagles were determined to be the 3 most common predators, with golden eagles being a significant source of mortality on PCH calves on the calving grounds (Whitten et al. 1992).

Annual survival rates of radiocollared adult cows are not available for RY12 and RY13. Survival rates for those years are currently being analyzed by the U.S. Fish and Wildlife Service and will be available for the next report period (Eric Wald, U.S. Fish and Wildlife Service, personal communication, Fairbanks, 2015).

Wertz (2008) reported annual adult female survival rates of 75–88% ( $\bar{x}$  = 82%) during 2003–2006. This appears to be lower than during 1997–2001 when average annual survival was 90% (Arthur et al. 2003), and during 1982–1991 when average annual survival was 84% (Fancy et al. 1994). Population models (Walsh et al. 1995, Griffith et al. 2002, Arthur et al. 2003) suggest that

annual adult survival rates less than 84% would result in a population decline such as that observed in PCH during 1989–2001. During 2006–2011 estimated survival rates improved (range 83–88%;  $\bar{x}$  = 88%) and were consistent with population growth observed in PCH during that time period (Eric Wald, personal communication).

## **HABITAT**

Studies indicate that calving caribou select areas with rapid plant growth rather than specific sites or habitats (Griffith et al. 2002). Areas with the most rapid plant growth vary each year but tend to be in the region identified by Fancy and Whitten (1991) as the primary calving area of PCH. Over time the entire extent of the calving grounds may be important for caribou.

In recent years PCH has wintered partially or entirely on the south side of the Brooks Range between the North Fork Chandalar and Coleen rivers in Alaska. The herd is often partially mixed with the Central Arctic herd. It is unknown whether the shift in winter range from the Ogilvie Mountains, Old Crow Flats, and Richardson Mountains in Yukon to Alaska is habitat related.

## **CONCLUSIONS AND RECOMMENDATIONS**

Population size of PCH was the largest ever estimated in 2013 at 197,000, representing an average annual growth rate of 5% since 2010 when the herd was estimated at 169,000 caribou. During 2001–2010 the herd likely grew at an average rate of 2–3% annually since 2001, although rates may have varied substantially during that period. The current increase in population size observed in PCH is consistent with an improvement in estimated annual survival rates of radiocollared cows from 2003 to 2011.

Current and historic harvest rates of PCH in Alaska are low; thus, consumptive use in Alaska has probably played a small or insignificant role in the periods of increasing or decreasing abundance observed in PCH since the 1970s. Therefore, ADF&G and the Board of Game have maintained liberal hunting seasons and bag limits for residents and nonresidents.

For the first time since the late 1990s, an estimate of PCH harvest in Canada was obtained for the 2010–2011 and 2011–2012 hunting seasons. In those years consumptive users in Canada harvested an estimated 1,720 and 1,850 caribou, respectively, composed mostly of bulls (Cooley and Branigan 2014). In 2012–2013 and 2013–2014, Canadian harvest was estimated at 1,283 and 2,920 caribou, respectively. Prior to 2010–2011, harvest levels or composition was mostly unknown but was thought to average 4,000 caribou annually and may have been as high as 6,000 in some years (Porcupine Caribou Management Board 2010). Harvest in Canada is likely strongly influenced by spatial and temporal distribution of PCH relative to communities and more importantly, the Dempster Highway. Future harvest estimates will provide additional insight into the range of PCH harvest in Canada.

We met our goal to conserve PCH and its habitat through international cooperation and coordination with ANWR and Canadian government agencies (YDE, Northwest Territories Department of Environment and Natural Resources, Canadian Wildlife Service, and Parks Canada) to assess demographic indices (parturition rates, early calf survival, adult and yearling survival, population size, and seasonal distribution). We met regularly with these agencies as part of the Porcupine Caribou Technical Committee.

We met our goal to ensure opportunities for customary and traditional uses of PCH by providing liberal seasons and bag limits. The goals to enable users of Porcupine caribou to participate in international efforts to conserve the herd and to encourage cooperation and communication among users and governments were met because IPCB, which includes members from Alaska and Canada, met during RY12–RY13. In addition, local and nonlocal residents of Alaska participated in the State of Alaska’s regulatory process through advisory committee and Board of Game meetings, and residents of Canada participated in the development and adoption of the harvest management plan.

Based on the population estimate of 197,000 caribou obtained in July 2013, we met our management objective of 135,000 caribou during RY12–RY13. No regulatory changes are recommended at this time.

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Please cite any information taken from this section, and reference as:

Caikoski, J. R. 2015. Units 25A, 25B, 25D, and 26C caribou. Chapter 15, pages 15-1 through 15-24 [*In*] P. Harper and L. A. McCarthy, editors. Caribou management report of survey and inventory activities 1 July 2012–30 June 2014. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2015-4, Juneau.

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Table 1. Porcupine caribou herd photocensus abundance estimate statistics, 2013.

Statistic	Value
Located and photographed radio collars <sup>a</sup>	71
“Missing” radio collars <sup>b</sup>	19
Caribou enumerated from located radio collars	133,295
Abundance estimate	197,228
95% confidence interval	168,667–225,789
Standard error	13,772
<i>t</i> -value	2.07
Test of randomness ( <i>P</i> -value >0.05 fails to reject randomness)	0.865

<sup>a</sup> Includes one caribou collared as a Central Arctic herd cow.

<sup>b</sup> “Missing” radio collars refers to radio collars that were not in groups photographed. General locations of all missing radio collars were known (see text above).

Table 2. Number of caribou counted and radio collars present by group during summer 2013 Porcupine caribou herd (PCH) photocensus.

Group	No. of caribou	Total PCH radio(s)	PCH cow radio(s)	PCH bull radio(s)	CAH <sup>a</sup> radio(s)	Comments
AK 1/1	5,203	3	2	1		
AK 2	404					Excluded from model input
AK 3	253					Excluded from model input
AK 4/2	3,501	3	3			
AK 5	348					Excluded from model input
AK 6/3	7,035	4	3	1		
AK 7-12/4	31,515	16	14	1	1 <sup>b</sup>	
AK 13/5	11,220	6	6			
AK 14/6	9,017	5	5			
AK 15	677					Excluded from model input
AK 16	1830	2	2			
AK 17/8	8613	3	3			
AK 18/9	11,446	3	3			
AK 19/10	931	1	1			
AK 20/12	1,375	1	1			
AK 21	161					Excluded from model input
AK 22/13	3,305	2	2			
AK 23/14	21,297	7	7			
AK 24/15	1,930	1	1			
AK 25	2,321					Excluded from model input
CA 1	2,665	1		1		
CA 2	2,038	2		2		
CA 3	1,232					Excluded from model input
CA 4	1,946	3		3		
CA 5	384					Excluded from model input
CA 6	1,793	1		1		
CA 7	524	1		1		
CA 8	111					Excluded from model input
CA 9	65					Excluded from model input
CA 10	1,020	2		2		
CA 11	2,040					Excluded from model input
CA 12	2,349	2		2		
CA 13	598	1		1		
CA 14	2,144	1		1		
CA 15	610					Excluded from model input
CA 16	77					Excluded from model input
Total	141,978	71	53	17	1	

<sup>a</sup> CAH = Central Arctic herd.

<sup>b</sup> CAH cow.

Table 3. Porcupine caribou herd population estimates, 1961–2013.

Year	Population estimate <sup>a</sup>	Technique <sup>b</sup>
1961	110,000	Calving ground census
1972	99,959	APDCE
1977	105,000	APDCE
1979	105,683	APDCE
1982	125,174	APDCE
1983	135,284	APDCE
1987	165,000	APDCE
1989	178,000	APDCE
1992	160,000	APDCE
1994	152,000	APDCE
1998	129,000	APDCE
2001	123,000	APDCE
2002–2009 <sup>c</sup>		
2010	169,000 ± 15,500	APDCE <sup>d</sup>
2013	197,000 ± 28,500	APDCE <sup>d</sup>

<sup>a</sup> All estimates include calves except for the 1961 estimate.

<sup>b</sup> Calving ground census data presented by R. O. Skoog at the 1962 Alaska Science Conference; APDCE = aerial photo-direct count extrapolation (Davis et al. 1979, Valkenburg et al. 1985).

<sup>c</sup> No estimates due to poor aggregation or weather conditions for photography.

<sup>d</sup> Modeling developed by Rivest et al. (1998) applied to data collected from APDCE method to estimate herd size and apply 95% confidence intervals.

Table 4. Porcupine caribou demographic data, 1987–2014<sup>a</sup>.

Year	Cows observed <sup>b</sup>	Parturition rate	June calf survival <sup>c</sup>	Postcalving survival <sup>d</sup>	Late June calf:cow <sup>e</sup>	October calf:cow	October bull:cow	March calf:cow <sup>f</sup>	Population estimate
1987	51	0.78	0.71		0.55				165,000
1988	91	0.84	0.65		0.55				
1989	74	0.78	0.74		0.58			0.43	178,000
1990	74	0.82	0.90		0.74				
1991	77	0.74	0.82		0.61			0.22	
1992	78	0.86	0.57		0.49			0.30	160,000
1993	63	0.81	0.56	0.83	0.45			0.32	
1994	98	0.91	0.77	0.93	0.70			0.40	152,000
1995	95	0.69	0.85	0.92	0.59			0.46	
1996	74	0.89	0.81	0.91	0.72			0.38	
1997	48	0.75	0.77	0.90	0.58			0.39	
1998	58	0.83	0.82	0.94	0.68			0.28	129,000
1999	39	0.84	0.83	0.86	0.70			0.56	
2000	44	0.73	0.61	0.82	0.44			0.27	
2001	70	0.84	0.61	0.79	0.51			0.31	123,000
2002	68	0.87	0.65	0.85	0.56			0.38	
2003	70	0.87	0.79	0.85	0.69			0.33	
2004	74	0.82	— <sup>g</sup>	— <sup>g</sup>	— <sup>g</sup>			0.24	
2005	55	0.64	0.77	0.88	0.49			— <sup>h</sup>	
2006	66	0.79	0.73	0.86	0.58			0.39	
2007	67	0.88	0.83	0.90	0.73			— <sup>h</sup>	
2008	63	0.79	0.73	0.92	0.59			— <sup>h</sup>	
2009	65	0.77	0.57	0.75	0.44	0.23	0.44		
2010	41	0.85	0.76	0.87	0.65	0.34	0.57	0.20	169,000 <sup>i</sup>
2011	59	0.86	0.48	0.59	0.41				
2012	— <sup>g</sup>	— <sup>g</sup>	— <sup>g</sup>	— <sup>g</sup>	— <sup>g</sup>	0.32	0.47		
2013	42	0.86	— <sup>j</sup>	— <sup>j</sup>	— <sup>j</sup>				197,000 <sup>i</sup>
2014	39	— <sup>g</sup>	— <sup>g</sup>	— <sup>g</sup>	0.49				
Mean <sup>k</sup>		0.81	0.72	0.85	0.58			0.34	

<sup>a</sup> Data from Fancy et al. 1994, Alaska Department of Fish and Game, and Yukon Department of Environment.

<sup>b</sup> Number of radiocollared cows for which parturition status was determined in early June, excluding those known to be <4-years old. Includes cows of unknown age, likely ≥4-years old. Prior to 2003 all caribou were of unknown age, however most were thought to be ≥4-years old.

<sup>c</sup> Estimated as (July calf:cow ratio)/(parturition rate).

<sup>d</sup> Includes only calves observed during early June whose dams were observed in late June (i.e., does not include most perinatal mortality).

<sup>e</sup> Excludes radiocollared cows known to be <4-years old.

<sup>f</sup> As of March of the year following birth of each cohort; includes all cows >1-year old.

<sup>g</sup> No data due to adverse weather conditions.

<sup>h</sup> No data due to mixing of caribou herds on winter range.

<sup>i</sup> Modeling developed by Rivest et al. (1998) applied to data collected from APDCE method to estimate herd size and apply confidence intervals.

<sup>j</sup> No data due to dense caribou groups making identification of cow:calf pairs not possible.

<sup>k</sup> Mean is for years 1987–2011.

Table 5. Porcupine caribou herd harvest<sup>a</sup>, regulatory years<sup>b</sup> 1985–2013.

Regulatory year	Reported <sup>c</sup>				Estimated		Total <sup>d</sup>
	M	F	Unk	Total	Alaska	Canada	
1985	52	12	1	65	500–700	4,000	4,500–4,700
1986	70	14	0	84	1,000–2000	500–1,000	1,500–3,000
1987	106	22	1	129	<500	2,000–4,000	2,500–4,500
1988	82	7	0	89	<500	2,000–4,000	2,500–4,500
1989	104	8	0	112	500–700	2,000	2,500–2,700
1990	19	1	0	20	100–150	1,680	1,780–1,830
1991	101	3	0	104	100–150	2,774	2,874–2,924
1992	78	1	0	79	658	1,657	2,315
1993	77	5	0	82	250	2,934	3,184
1994	72	3	0	75	200	2,040	2,240
1995	61	7	0	68	200	2,069	2,269
1996	76	2	0	78	200	2,159	2,359
1997	58	4	1	63	300	1,308	1,608
1998	83	11	1	95	300	– <sup>e</sup>	
1999	84	4	0	88	400	– <sup>e</sup>	
2000	62	10	0	72	300	– <sup>e</sup>	
2001	105	9	0	114	400	– <sup>e</sup>	
2002	72	3	1	76	300	– <sup>e</sup>	
2003	120	8	0	128	500	– <sup>e</sup>	
2004	60	7	0	67	200	– <sup>e</sup>	
2005	32	10	0	42	500	– <sup>e</sup>	
2006	57	1	1	59	400–700	– <sup>e</sup>	
2007	113	13	0	126	400–700	– <sup>e</sup>	
2008	78	15	0	93	400–700	– <sup>e</sup>	
2009	108	18	2	128	400–700	– <sup>e</sup>	
2010	89	15	3	107	400–700	1,720	2,227–2,527
2011	127	27	1	155	400–700	1,850	2,405–2,705
2012	116	18	4	138	400–700	1,283	1,821–2,121
2013	118	15	3	136	400–700	2,920	3,456–3,756

<sup>a</sup> A small proportion (<10%) of the reported harvest may be Central Arctic herd caribou from Unit 25A.

<sup>b</sup> Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1985 = 1 July 1985–30 June 1986).

<sup>c</sup> Data from Alaska general harvest tickets.

<sup>d</sup> Includes reported and estimated harvest beginning in regulatory year 2010.

<sup>e</sup> Canadian data not collected.

Table 6. Porcupine caribou herd<sup>a</sup> nonlocal<sup>b</sup> and nonresident hunter success, regulatory years<sup>c</sup> 1995–2013.

Regulatory year/ Hunters	Unit				Total for Units 25 and 26C
	25A	25B	25D	26C	
<i>1995</i>					
Total hunters	57	9	1	21	88
Successful	32	2	0	10	44
% Successful	56	22	0	48	50
<i>1996</i>					
Total hunters	47	20	0	9	76
Successful	29	16	0	2	47
% Successful	62	80	0	22	62
<i>1997</i>					
Total hunters	56	10	3	17	86
Successful	34	5	0	6	45
% Successful	61	50	0	35	52
<i>1998</i>					
Total hunters	85	12	3	17	117
Successful	63	3	2	9	77
% Successful	74	25	67	53	66
<i>1999</i>					
Total hunters	80	23	16	6	125
Successful	55	14	5	3	77
% Successful	69	61	31	50	62
<i>2000</i>					
Total hunters	91	13	12	6	122
Successful	56	0	2	2	60
% Successful	62	0	17	33	49
<i>2001</i>					
Total hunters	121	27	14	14	176
Successful	85	5	2	9	101
% Successful	70	19	14	64	57
<i>2002</i>					
Total hunters	98	21	23	12	154
Successful	65	5	2	4	76
% Successful	66	24	9	33	49
<i>2003</i>					
Total hunters	127	29	12	13	181
Successful	95	19	0	9	123
% Successful	75	66	0	69	68
<i>2004</i>					
Total hunters	85	11	16	20	132
Successful	54	0	3	8	65
% Successful	64	0	19	40	49

Regulatory year/ Hunters	Unit				Total for Units 25 and 26C
	25A	25B	25D	26C	
<i>2005</i>					
Total hunters	80	11	12	30	133
Successful	24	0	0	18	42
% Successful	30	0	0	60	32
<i>2006</i>					
Total hunters	88	12	33	23	156
Successful	45	1	1	12	59
% Successful	51	8	3	52	38
<i>2007</i>					
Total hunters	142	10	16	55	223
Successful	82	1	3	40	126
% Successful	58	10	19	73	57
<i>2008</i>					
Total hunters	140	10	18	52	220
Successful	74	1	1	32	108
% Successful	53	10	6	62	49
<i>2009</i>					
Total hunters	195	14	16	39	264
Successful	108	2	4	18	132
% Successful	55	14	25	46	50
<i>2010</i>					
Total hunters	152	16	16	42	226
Successful	79	1	5	22	107
% Successful	52	6	31	52	47
<i>2011</i>					
Total hunters	169	10	15	56	250
Successful	116	0	9	30	155
% Successful	69	0	60	54	62
<i>2012</i>					
Total hunters	167	17	14	38	236
Successful	106	4	2	23	135
% Successful	63	24	14	61	57
<i>2013</i>					
Total hunters	136	42	3	51	232
Successful	70	30	0	33	133
% Successful	51	71	0	65	57

<sup>a</sup> A small proportion (<10%) of reported harvest in Unit 25A may be Central Arctic herd caribou.

<sup>b</sup> Nonlocal includes Alaskans residing outside Units 25, 26B, and 26C.

<sup>c</sup> Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 1995 = 1 July 1995–30 June 1996).