Caribou
Management Report
of survey-inventory activities
1 July 2000–30 June 2002

Carole Healy, Editor
Alaska Department of Fish and Game
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Ken Whitten

Note that population and harvest data in this report are estimates and may be refined at a later date.

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Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 PO BOX 25526
JUNEAU, AK 99802-5526

CARIBOU MANAGEMENT REPORT

From: 1 July 2000
To: 30 June 2002

LOCATION

GAME MANAGEMENT UNIT: 21D, 22A, 22B, 22C, 22D, 22E, 23, 24 and 26A

HERD: Western Arctic

GEOGRAPHIC DESCRIPTION: Northwest Alaska

BACKGROUND

The Western Arctic Caribou Herd (WAH) ranges over approximately 140,000 mi^2 (363,000 km^2) of northwestern Alaska (Figs 1 and 2). Summer range encompasses the calving grounds and consists of the northern foothills and mountains of the Brooks Range west of the Trans-Alaska Pipeline. In most years during the mid 1980s through 1995 most of the WAH wintered in the Nulato Hills as far south as the Unalakleet River drainage. Since 1996 the WAH has shifted the southern extremity of its winter range from the Nulato Hills to the Seward Peninsula. Additionally, since the mid 1990s this herd has generally dispersed more during winter than prior to this time.

In 1970, the WAH numbered approximately 242,000 caribou. By 1976 it had declined to an estimated 75,000 animals. From 1976 to 1990 the WAH grew about 13% annually, and from 1990–1996 it grew 1–3% annually. The herd may have peaked in 1996 at 463,000 caribou. Census results suggest the WAH declined about 2% annually between 1996 and 1999 to 430,000 caribou; however, the 1999 estimate may be conservative and the population may have remained stable during this time. Since 1990, density of the WAH over its total annual range has been 3.0-3.3 caribou/mi^2 (1.1-1.3 caribou/km^2). This figure is misleading, though, because caribou exhibit a 'clumped' distribution in both space and time. Seasonal densities provide a more useful measure for evaluating effects of density on range and on individual caribou. However, seasonal densities only reduce rather than correct for the effects of clumping behavior on density.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Protect and maintain the WAH and its habitat.

- Provide for subsistence and recreational hunting on a sustained yield basis.

- Provide for viewing and other uses of caribou.
- Perpetuate associated wildlife populations, including carnivores.

MANAGEMENT OBJECTIVES

The following management objectives comprise the 7 basic elements of the WAH Cooperative Management Plan that was finalized in March 2003:

- Encourage cooperative management of the herd and its habitats among state, federal and local entities and all users of the herd.
- Recognizing that caribou herds naturally fluctuate in numbers, manage for a healthy population using strategies adapted to population levels and trends.
- Assess and protect important habitats of the WAH.
- Promote consistent, understandable and effective state and federal regulations for the conservation of the WAH.
- Seek to minimize conflict between reindeer herders and the WAH.
- Integrate scientific information, traditional ecological knowledge of Alaska Native users, and knowledge of all users into management of the herd.
- Increase understanding and appreciation of the WAH through use of scientific information, traditional ecological knowledge of Alaska Native users, and knowledge of all other users.

METHODS

Many of the terms used in this report are defined as follows:

> 'Caribou' in the generic sense refers to the WAH. Caribou from other herds are identified in text.
>
> 'Local hunter' is anyone that resides within the range of the WAH.
>
> 'Nonlocal hunter' includes residents of Alaska that live outside the range of the WAH and includes nonresident and alien hunters.
>
> 'Winter' is 1 November–31 March.
>
> 'Adult caribou' is any caribou >12 mos old.
>
> 'Calf' is any caribou <10–11 mos old.
>
> 'Short yearling' is any caribou 10–11 mos old.

‘Maternal cow’ refers to a female caribou accompanied by a calf or having ≥1 hard antler during June.

‘Recruitment survey’ is used interchangeably with ‘short yearling survey.’ These surveys are conducted during late March through May to estimate the ratio of short yearlings:100 adult caribou.

‘Conventional telemetry’ refers to radio collars with very high frequency (VHF) transmitters located using antennas mounted on airplanes.

‘Collar year’ is the period 1 October–30 September of the subsequent year.

‘Satellite collar’ is a radio collar that contains both a VHF transmitter and a PTT (platform terminal transmitter).

‘c.i.’ is the abbreviation for ‘confidence interval.’

‘Photocensus’ is the aerial direct count photo extrapolation technique (Davis et al. 1979).

Population Status and Trend. Radio collars were first deployed in the WAH in 1979 (Davis and Valkenburg 1985). Initially, few collars were deployed and the frequency of relocation flights was low. Although we have never collared more than 0.03% of the herd, since the late 1980s we have typically conducted 15–20 relocation flights annually.

Conventional VHF and satellite radiotelemetry techniques were used to estimate population size, adult mortality, calf production and recruitment, sex and age composition, movement patterns and distribution. Telonics, Inc. (Mesa, AZ) manufactured all radio collars deployed in the WAH. Configuration of conventional and satellite collars, PTT duty cycles, VHF relocation techniques, types of data collected, allocation of collars between bulls and cows and sources of error in telemetry data have been previously described (Dau 1997, 1999).

As in the past, we attempted to complete each ‘collar year’ (1 Oct–30 Sep) with more than 100 functional transmitters on living caribou during this reporting period. To meet this goal we typically begin each collar year with 115–130 potentially active collars in the herd. We have not attempted to radiocollar a cross-section of ages and sexes in the population. For example, we attempt to maintain only 15 collared bulls in the total marked sample annually and we only deploy collars on large adult bulls. The radiocollared sample of cows, however, is probably representative of adult female cohorts because collars are randomly deployed annually among females >2 years old irrespective of maternal status. Only cows in very poor physical condition are not collared.

We began the 2000–2001 collar year with 93 potentially active conventional collars on living caribou (84 cows and 9 bulls). Of these, 22 collars on cows were also equipped with a functional PTT. Sample sizes of potentially active radio collared living caribou in 2001–2002 were 103 (93 cows and 10 bulls) of which 33 cows were equipped with a functional PTT. In 2002–2003 we began the ‘collar year’ with 113 potentially active collars on living caribou (97 cows and 16 bulls) of which 32 cows and 4 bulls had a functional PTT.

During the reporting period all radio collars were deployed during September in Unit 23 at Onion Portage on the Kobuk River. The rationale and methods for this technique have been previously described (Dau 1997). Many residents of northwest Alaska object to chemical immobilization and helicopter capture techniques. Therefore, as in the past to avoid using these techniques, we did not remove or replace radio collars on caribou during this reporting period.

Since 1999 we have used model ST-18 satellite collars with PTTs powered by 2 C-cell batteries. They were paired with model 600 VHF transmitters powered by 2 D-cell batteries. This configuration encloses both transmitters in a single canister and weighs about 3 lbs (1388 g). It is more streamlined than the 2-cannister ST-3 and ST-14 configurations that weighed almost 4 lbs (1789 g). The history and objectives of the WAH PTT program, configuration of satellite collars, PTT duty cycles, and use of data was summarized by Dau (1997). In 2000 and 2001 VHF transmitters were programmed with a 16-hr ON/8-hr OFF duty cycle to extend battery life. We did not use VHF duty cycles during 2002 following problems encountered in 2000 and 2001.

In 2000 we deployed radio collars on 20 caribou (3 bulls and 17 cows). Four of the collars deployed on cows were equipped with a PTT. Thirty six caribou (30 cows and 6 bulls) were radiocollared during 2001; of these, 15 were satellite collars that were deployed on cows. The Selawik National Wildlife Refuge (SNWR) contributed 10 of the satellite collars to the WAH collaring program in 2001. During 2002 we deployed 43 radio collars (30 conventional and 13 satellite collars) on caribou (28 cows and 15 bulls). Three of the satellite collars deployed in 2002 were provided by the SNWR: these were all deployed on cows. Four satellite collars purchased by ADF&G in 2002 were deployed on bulls. All satellite collars provided by the SNWR in 2001 and 2002 were equipped with a breakaway device (Telonics Cr-2a) programmed to release 3 years after the manufacture date.

Population Size and Composition. We determined population size using the aerial direct count photo extrapolation (photocensus) technique (Davis et al. 1979). The herd was last censused in July 1999. A photocensus was attempted, but not completed, in June/July 2002. Population composition for the WAH was estimated from calving surveys during June, composition counts during October and short yearling surveys during April–May.

In 2000 calving surveys were conducted on 7 and 12–14 June in a C-185 with 3 observers. In 2001 calving surveys were conducted in a C-185 and PA-18 on 4-6 and 16-17 June, and in 2002 they were conducted in a C-185 and PA-18 during June 1-3 and 5. We attempted to conduct calving surveys on or slightly before the date of peak calving (assumed to be roughly June 7-10); however, survey dates were ultimately dictated by weather. Calving survey techniques, criteria to determine maternal status, and geographic coverage were the same as previously described (Dau 1997).

Fall composition surveys were conducted 14 November 2001 using techniques previously described (Dau 1997). Fall composition surveys were not conducted in 2000 because of poor weather or in 2002 because of helicopter unavailability and conflicts with other work.

During 2001 spring composition (short yearling or recruitment) surveys were conducted on 13, 23, 28 and 29 May and 1 June. In 2002 these surveys were conducted on 29 March, 4 April and 15, 16 and 20 May. After the reporting period recruitment surveys were conducted in spring

2003 on 5, 6, 8 and 30 April, and on May 1 and 2. In all years we used survey techniques previously reported (Dau 1997).

Distribution and Movements. Distribution and movements of the herd were assessed using spring (Jan–May), summer (June) and fall (Aug–Dec) range-wide conventional telemetry surveys often in conjunction with composition surveys. Flights were based out of Barrow, Kotzebue, Nome and Fairbanks using survey techniques previously described (Dau 1997). Additionally, PTT data supplemented conventional telemetry locations.

I evaluated winter range use by subdividing the total WAH range (not just the winter range depicted in Figs 1 and 2) into 9 areas and counted the number of collared caribou that wintered in each area annually. The 9 subareas are:

1) the coastal plain of Unit 26A;
2) that portion of Unit 26A west of the Utukok River;
3) the northern foothills of the Brooks Range in Unit 26A east of the Utukok River;
4) the Kobuk drainage west of Selby drainage including the Squirrel drainage below the North Fork, Selawik drainage and Buckland drainage;
5) Kobuk drainage above Selby drainage, central Brooks Range north of the Koyukuk River and west of Bettles/Wiseman, and Noatak drainage above Douglas Creek;
6) a portion of the Koyukuk drainage south of the Koyukuk River;
7) most of the Seward Peninsula west of Buckland and Koyuk villages;
8) Nulato Hills; and
9) Noatak drainage below Douglas Creek, the Wulik and Kivalina drainages, and Squirrel drainage above the North Fork.

The first winter after a caribou was radiocollared was excluded from the sample because the collaring location predetermined range use the following winter. When a collared caribou used >1 area in a single winter, I assumed use of each area was equal and assigned the appropriate fraction of use to each area for that individual. I defined ‘winter’ as November–March. Caribou density on each winter range was estimated by multiplying the percentage of collared WAH animals in that area by the estimated population size. This approach did not consider reindeer or caribou from the Teshekpuk Lake Herd (TLH) and Central Arctic Herd (CAH) that were on WAH range. It also ignored collared WAH caribou not located during a winter and assumed those radiocollared caribou we did locate were randomly distributed throughout the herd. Given the small proportion of collared caribou in the WAH, this assumption was probably not always correct. I used population growth rates to estimate population size for years when we did not conduct a census.

Unlike my evaluation of winter range use where I subdivided the total WAH range, I evaluated summer range-use only for the area delineated as ‘summer range’ in Figures 1 and 2. Telemetry work conducted in conjunction with photocensuses since 1988 has indicated at least 95% of the herd has been within the area we’ve delineated as summer range by early July. Therefore, I calculated 95% of the estimated population size to estimate caribou density on summer range.

Mortality. Mortality rates for adult WAH caribou were estimated from cows with conventional radiocollars or ST-18 PTTs on a collar-year basis. Radiocollared bulls and cows collared with

ST-3 or ST-14 PTTs were not used to estimate mortality (Dau 1997). Two collar years (1999–2000 and 2001–2002) span portions of this reporting period. Radiocollared cows not located for 2 years were retroactively dropped from the sample of potentially active collars. Therefore, annual mortality estimates usually increase 1–3% for 1 or 2 years after the end of each collar year. Estimated mortality rate includes all sources of mortality.

Harvest. We monitored harvest using 3 systems: 1) registration permits for local hunters; 2) statewide harvest tickets for nonlocal hunters; and 3) community-based harvest assessments for selected communities within the range of the WAH. Beginning in the 1998–1999 regulatory year the Division of Wildlife Conservation (DWC) resumed administering the statewide caribou harvest ticket system as they do for other big game species, e.g. moose.

During this reporting period I estimated total annual harvest by local hunters using community harvest assessment data. For communities not surveyed during this period, but which have been surveyed in the past, I calculated a mean per capita harvest rate from historical data and multiplied it by the appropriate community population size. When using historical data to estimate per capita harvest rates for individual communities, I included only years when availability of caribou was roughly comparable. For communities never surveyed I calculated a mean per capita harvest for communities nearby or with similar access to caribou. When combining several communities to calculate per capita harvest for an 'unsurveyed community,' I summed human population sizes and caribou harvests over all communities (i.e., 'people' and 'caribou' were the sample units, not 'community') to avoid disproportionately weighting samples from small communities. For communities in Unit 26A near areas where the CAH, TLH and WAH mingled, I initially estimated total community caribou harvest as described above. Geoff Carroll, Unit 26A Area Biologist, then estimated the percentage of total harvest comprised of WAH caribou based on the distribution of collared caribou in each herd. Although there is uncertainty associated with assigning harvest levels to individual caribou herds where they mix (which is not incorporated into our estimated confidence intervals) we felt this approach was better than ignoring mixing of herds altogether. Confidence intervals were calculated for each community using a parametric bootstrap technique (R. Sutherland, pers. commun.). This technique employed a Poisson distribution with 'WAH total harvest' as the distribution parameter. We calculated each 95% interval by randomly selecting 1000 samples from the Poisson distribution, sorting them and dropping the lowest 2.5% (25) and the highest 2.5% (25) of the values. The smallest remaining value was the lower limit and the largest was the upper limit. Confidence limits for individual communities were summed to produce an interval around total harvest.

In addition to the 3 conventional systems for estimating harvests described above, we also developed statistical harvest models to estimate local harvests by communities in Units 22, 23 and 26A for the 1999–2000, 2000–2001 and 2001–2002 regulatory years (R. Sutherland, pers. commun.). It is much easier to estimate caribou harvests over the entire range of the WAH using statistical models than by calculating per capita harvest rates for individual communities. The models were based upon Analysis of Covariance. The dependent variable was 'community harvest' with independent variables of 'community population size' and 'caribou availability.' Herd availability was an indicator variable (far, close or average). For communities that have been surveyed in >1 yr it was evident harvest levels lacked independence through time.

Likewise, community harvest assessments for neighboring communities suggested a spatial dependence as well. Because community harvest levels were not independent through space or time, statistical harvest models were developed using a Generalized Least Squares technique. This technique accommodates dependent observations.

Disease. We collected blood samples from caribou when radiocollars were deployed at Onion Portage. Caribou were captured, restrained and released as previously reported (Dau 1997). In September 2000 we sampled 57 bulls and 59 cows; in 2001, 50 bulls and 40 cows, and in 2002 (after this reporting period) 55 bulls and 39 cows. Body condition (very skinny, skinny, average, fat, very fat) and presence/absence of a calf were recorded for caribou from which a blood sample was collected. Samples collected during 2000 were analyzed to monitor prevalence of 8 selected bacteria and viruses in the herd (Dau 1999) as well as haptoglobin levels (Dau 2001). Samples collected during 2001 and 2002 are initially being analyzed only for *Brucella* and haptoglobin levels.

On 15 April 2002 I necropsied 10 caribou collected in proximity to the Red Dog Mine and Port Site Road. Dr. Philip Meyer assisted with the necropsies. TekCominco hired 2 individuals from Noatak, Roland Ashby and Thurston Booth, to kill the caribou and paid for the heavy metals analyses. The meat from these caribou was salvaged and donated to the Kotzebue Senior Center. On 5 August, 2002 (after the reporting period) I killed and necropsied a mature bull caribou that had spent about 1 month near the Red Dog Mine tailings impoundment. Again, TekCominco paid to analyze its tissues for heavy metals. While processing the bull collected during August I trained 2 TekCominco staff in necropsy procedures.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The July 1999 photocensus produced a minimum estimate of 430,000 caribou (Table 1, Fig 3). Results of this census have been previously reported (Dau 2001). At its peak population size in 1999, the density of this herd over its total range was 3.3 caribou mi^2 (1.3 caribou/km^2). Overall density for the censuses conducted during 1990–1999 when the population was essentially stabile averaged 3.2 caribou/mi (SD=0.1, n=4). This is a slightly conservative measure of grazing pressure exerted annually on WAH range because it does not include reindeer or caribou from other herds with overlapping ranges. However, the functional density experienced by most individual caribou on seasonal ranges was undoubtedly much higher given their clumped distribution throughout the year.

At the end of the reporting period, late June 2002, we attempted to census the WAH. Avgas and all equipment for the camp were transported to Eagle Creek during the last week of June. However, high winds, snow, fog and cool temperatures prevailed during 30 June–12 July. We monitored the distribution of the herd from Kotzebue using conventional telemetry techniques as often as possible during this time. On 12 July the census was postponed until July 2003 because caribou were spread almost linearly through the De Long Mountains from Mount Kelly to Howard Pass, a straight-line distance of roughly 150 mi. All fuel and equipment were retrieved from Eagle Creek soon after the census was postponed.

During July 2003 (after the reporting period) we photographed the WAH as the 1st step in the photocensus process. Photographs were taken July 9, 11 and 12. Conditions were not ideal on any of the photography days. However, telemetry indicated >95% of the herd was aggregated in the groups we photographed. Also, continued marginal weather and movements of the herd suggested we would get no better opportunities to conduct photography during this attempt. As a result, we exposed 1157 photographs to completely photograph the herd. We intend to have the photographs counted by November, 2004. Even without a minimum count it was obvious during the photography the WAH is still very large.

Population Composition

Calving. We conduct calving surveys for several reasons: 1) to assess the distribution of WAH calving activity; 2) to monitor initial calf production; and 3) to contribute to our annual estimate of adult caribou mortality. Additionally, this parameter provides a 'backhanded' way to assess body condition of mature cows the previous fall (Cameron and Ver Hoef 1994). Calf production per se has probably had little affect on the population dynamics of this herd since at least the mid 1980s.

We observed 66 calves:100 radiocollared cows during June 2001, 78 calves:100 cows in 2002 and 68 calves:100 cows in 2003 (Table 2). The 2002 ratio is the highest observed since 1992. Calf production has generally increased since 1998 (Figure 4). We assume WAH calving peaks during the 1st week of June; however, we have no data to evaluate that assumption beyond qualitative observations of antler status and distention of cows' bellies associated with near term pregnancy. Since the mid 1990s we've attempted to conduct calving surveys during the week of peak calving. However, poor weather has often prolonged calving surveys beyond this time period. Our estimates of calf production are probably conservative because we do not record udder status for collared cows (Whitten 1995) and therefore misclassify some cows that lose their calf and antlers soon after birth as 'nonmaternal.' Even so, there has been no correlation between the median date that calving surveys were conducted and the calf:cow ratio.

The strong negative correlation between the calf:cow ratio and the proportion of cows with velvet antlers during calving previously reported (Dau 1997) continued through this reporting period (Spearman rank correlation = -0.89, n = 15 years). The median proportion of cows with velvet antlers during years when the calf:cow ratio was $\geq$70:100 (2.6%, n=7) was significantly lower (Kruskal-Wallis P=0.0003) than during years when this ratio was <70:100 (15.2%, n=8). Cows with substantial growth of velvet antlers during calving either failed to conceive the previous fall or lost their fetus during early pregnancy. This suggests low calf:cow estimates are real and not artifacts of sampling error.

Between June 1992 and May 2002 there was no correlation between June and subsequent fall calf:cow ratios (r = 0.09, n = 10). This suggests calf survival through summer has a greater effect on the fall calf:cow ratio than initial productivity.

Fall Composition. The fall calf:cow ratio was 37:100 and bull:cow ratio was 38:100 in 2001. Poor weather and aircraft mechanical problems limited coverage during 2001 to the Mulgrave Hills. Although approximately half of the WAH was in this area during the time of the surveys, large numbers of caribou were also in areas (e.g. the Seward Peninsula) we did not cover. Additionally, the November 2001 Board of Game meeting delayed fall surveys until after rut was completed and sexual segregation had begun to occur. Therefore, these results should be viewed with caution. No fall composition surveys were conducted in 2000 or 2002 because of poor weather or helicopter unavailability.

Since 1992 the fall calf:adult ratio has ranged from 24–33:100. This ratio is less vulnerable to misclassification than the calf:cow ratio because calves are easy to distinguish from adults. However, spatial or temporal segregation of bulls and cows likely confounds even calf:adult estimates because we do not sample the entire WAH and because sexual segregation varies among years. Between 1992 and 1999 there was a weak correlation (r = 0.54, n = 10) between the October calf:adult ratio and subsequent April/May calf:adult ratio.

Since 1992 the fall bull:cow ratio has ranged from 38-64:100 (Table 3). The median ratio has been 51 bulls:100 cows. Sexual segregation and our inability to sample the entire herd probably account for more annual variability in this parameter than actual changes in population composition.

<u>Spring Composition</u>. We observed 19 short yearlings:100 adults in spring 2001, 15:100 in spring 2002 and 19:100 in 2003 (Table 4, Fig. 5). There has been no trend in this parameter since 1999. Since the early 1980s, however, recruitment has generally declined.

Distribution and Movements

<u>Historical Summary</u>. Our historical understanding of the distribution of the WAH was previously reported (Dau 2001). During range-wide telemetry surveys we located: 88 of 134 potentially active collars during fall 2000 (66%); 90 of 127 (71%) during spring 2001; 84 of 125 (67%) during fall 2001; 91 of 126 (72%) during spring 2002; 110 of 135 (81%) during fall 2002; 97 of 126 (77%) in spring 2003; and 119 out of 133 (89%) in fall 2003.

Since spring 1995 when we began conducting range-wide surveys, we've located through conventional telemetry techniques an average 73% (SD = 10, n = 9) of all potentially active collars during spring and 74% during fall (SD=10, n = 9) surveys. Often, collars missed during a range-wide survey are located during the previous or subsequent survey period mixed with caribou that are found. This suggests long frequency scan times, steep topography, movements of caribou, errors made when programming receivers and infrequent relocation flights are responsible for 'missed' collars rather than incomplete coverage of the herds' range or unusual movements of caribou. The distribution of collars located during range wide surveys is probably a reasonably accurate though rough approximation of the distribution of the entire WAH (i.e., there have been no 'pockets' of caribou in areas we did not search).

<u>General Movement Pattern</u>: Pregnant cows and some nonmaternal caribou begin migrating from winter range toward the calving grounds in April. In typical years most pregnant cows have reached the calving grounds in the Utukok uplands by late May. Bulls, nonmaternal cows and immature caribou lag behind pregnant cows during the spring migration perhaps in part to exploit the northward progression of snow melt and green up. Most cows give birth in the Utukok uplands during late May through early June (Fig. 1; see section below). By mid June large post-calving aggregations begin forming as cows with neonates move west toward the Lisburne Hills. As mosquitoes begin to emerge in late June, bulls and nonmaternal caribou move into the western North Slope and De Long Mountains. Mosquito harassment intensifies and

oestrid flies emerge in early July. During the first half of July insect harassment causes WAH caribou to form aggregations sometimes numbering >100,000 individuals in this area. Even during the period of maximum insect harassment WAH caribou begin moving east-northeast through the Brooks Range and its northern foothills toward Howard and Anaktuvuk Passes. By early-to-mid August insect harassment begins to diminish and some caribou disperse north and west onto the North Slope, some going as far as Cape Lisburne and Barrow, while other caribou remain in the mountains between the Howard Pass and Anaktuvuk Pass. The fall migration begins in mid August as caribou in the vanguard move southwest toward Kotzebue and Norton Sounds. By late September, before some WAH caribou have even begun to migrate, caribou near the front of the migration have reached the southernmost portions of winter range. The fall migration extends through mid-to-late November. No matter where WAH caribou are, directed and lengthy migratory movements generally cease by this time and they become relatively sedentary until April when the spring migration begins.

Winter Range. Winter range is the most difficult of all WAH seasonal ranges to delineate. The area identified as ‘winter range’ in Figures 1 and 2 represents where most of the herd has wintered in most years since the mid 1980s. In reality, of course, caribou seasonal ranges are not mutually exclusive and, during winter, WAH caribou occur throughout most of their annual range albeit at very low densities in some areas (Table 5). Inupiaq of northwest Alaska have long understood that caribou winter range in this region has substantially shifted since the late 1800s (K. Mills, W. Woods, N. Sheldon, pers. commun.; see also Skoog 1968). Biologists that worked with this herd during the 1960s and 1970s recognized similar events (J. Hemming and J. Davis, pers. commun.).

Although radio collars have been deployed in the WAH only since 1979 and sample sizes of collared caribou have always been small in relation to the size of the herd, telemetry data provide rough estimates of winter range distribution through time (too few locations of caribou were recorded to evaluate winter range use before 1983-1984). The highest density observed in an area during any single winter was 26.4 caribou/mi^2 (10.2 caribou/km^2) in the Nulato Hills during 1990-1991 (Table 6). As shown in Figures 1 and 2, between 1983–1984 and 1996–1997 most WAH caribou wintered in the lower Kobuk-Selawik-Buckland area and in the Nulato Hills. Beginning in 1996–1997 caribou began to shift northwest from the Nulato Hills onto the Seward Peninsula (Tables 5 and 6).

The intensity and consistency of winter use of the Nulato Hills by WAH caribou between 1985–1986 and 1994–1995 is striking (Tables 5 and 6). In 7 of 10 years during this time >50% of the herd wintered in this area. In 2 winters (1990–1991 and 1993–1994) density in this area was >20 caribou/mi^2 (8 caribou/km^2) and in 4 other winters (1988–1989, 1989–1990, 1992–1993 and 1994–1995) density was 15-20 caribou/mi^2 (6-8 caribou/km^2). In only 1 other year since 1983–1984 did winter density in any other subarea (Seward Peninsula during 1996–1997) exceed 15 caribou/mi^2 (6 caribou/km^2).

In 1996–1997 the WAH began shifting its winter range northwest from the Nulato Hills to the Seward Peninsula. In no year prior to 1996–1997 did >9% of the herd winter on the Seward Peninsula. In only 1 year since that time (1999–2000) did <20% of the herd winter in this area and in 1996–1997 59% of the herd wintered there. For several years after this shift began 20-30% of the WAH still wintered in the Nulato Hills. Caribou have continued to abandon the

Nulato Hills since 1996 though. Only 5% of collared WAH caribou wintered in the Nulato Hills during 2001–2002 and none wintered there during 2002–2003. Telemetry information is consistent with reports from residents of Koyuk, Shaktoolik and Unalakleet, and with opportunistic observations by ADF&G staff, of very few widely scattered caribou in the Nulato Hills during this reporting period.

In addition to shifting its winter range during the mid to late 1990s, the WAH also became more dispersed during winter than in previous years. For example, in 10 of 13 years between 1983–1984 and 1996–1997 >50% of the herd wintered in a single geographic area (usually, the Nulato Hills). In each year since 1997–1998 the herd has been distributed in 3–4 geographic areas during winter and no area has contained >50% of the herd.

The estimates of winter range density reported here do not include caribou from the TLH, CAH or reindeer; therefore, the figures reported here represent minimum densities. This would primarily affect densities reported for the central Brooks Range, the foothills of the Brooks Range east of the Utukok River and the Seward Peninsula.

Calving Grounds. Two approaches have been used to delineate the WAH calving grounds, one qualitative and the other quantitative. In 1994, ADF&G qualitatively delineated seasonal ranges of the WAH, including the calving grounds, based on satellite and conventional telemetry data, opportunistic observations of caribou by ADF&G staff during wildlife surveys and many reports from the public. We attempted to show areas used seasonally by most of the herd in most years. Strengths of this approach are that it is informed by observations of literally tens of thousands of unmarked caribou (i.e., caribou not radiocollared) and considers contextual information that isn't always measured (e.g., snow characteristics, behavior, density of groups, general direction of travel, etc.) or measurable (e.g., traditional knowledge of Native residents). Weaknesses of this approach are that it is not quantifiable or repeatable. This approach emphasizes general patterns of 'typical' distribution.

In contrast, Kelleyhouse (2001) calculated concentrated calving and extent of calving for the WAH using kernel analyses and ADF&G data from 1987–2000. Quantifiable and repeatable, this approach is based on small sample sizes and considers only location information. In addition to showing patterns of distribution, this approach is well suited to showing variability in distribution among years.

Kellyhouse's depiction of concentrated calving generally agrees with ADF&G's qualitative delineation of the calving area except at their western extents. Kernel analyses extend concentrated calving farther west than ADF&G's delineation of calving. This difference is largely because ADF&G excluded calving data collected in 1990 while Kelleyhouse included it in her analyses. In 1990, in addition to the western distribution of 'calving,' the density of collared cows, westerly movement pattern and paucity of cows with hard antlers suggest we probably conducted calving surveys after the period of peak calving. Calendar dates of the 1990 surveys were within the range of dates for other years which suggests calving probably occurred early that year. In 1990 the westward post-calving movement was likely well underway when we conducted calving surveys. Kellyhouse's area of concentrated calving is smaller and more discontinuous than ADF&G's qualitative depiction of calving probably because sample sizes used in the kernel analyses were small in relation to the number of caribou observed during ADF&G's qualitative delineation.

Kelleyhouse (2001) defined 'maternal' cows as those observed with a neonate at heel. In contrast, ADF&G has defined 'maternal' cows as those with a neonate at heel or having $\geq$1 hard antler. For determining parturition rate, ADF&G's definition is preferable (Whitten 1995). However, for delineating calving areas Kelleyhouse's definition is the more conservative approach because some pregnant cows may move 10–20 km/day up to the time of parturition (B. Griffith, pers. commun.). Caribou from this herd typically move almost due north onto the calving area. In all years when we classified at least some collared cows as 'maternal' based on antler status (n=11), median latitude was greater for cows with a neonate than for those without a neonate but $\geq$1 hard antler. In 7 of these years (1988, 1989, 1993, 1998, 2000, 2001 and 2002) this difference was statistically significant (Kruskal-Wallis tests, all $P<0.05$).

As previously reported (Dau 2001), the distribution of cows was unusually far south during the 2000 calving season. Breakup was exceptionally late during 2000 and it appeared many cows (up to 25%) calved en route to the calving grounds. For example, we observed 4 collared cows with neonates (of 39 collared cow/calf pairs) on the south side of the Brooks Range and 6 additional collared cow/calf pairs just northwest of Howard Pass. During the 2001 calving period the distribution of collared cows was even more dispersed and extended farther south than in 2000. As in 2000, breakup was exceptionally late during 2001. Unlike in 2000 we observed no collared cows with neonates off the traditional calving area in 2001; however, we did see 31 cows with hard antlers (i.e., maternal cows) as far south as Granite Mountain during calving surveys. If these hard-antlered cows managed to calve on the traditional calving area, they must have exhibited exceptionally high rates of travel just prior to parturition. The period of parturition may have extended later into June than in most years; if so, this would have given some cows more time to reach the traditional calving ground. Alternatively, some cows may have calved en route to the calving area after we conducted calving surveys.

To put the unusual distribution of calving during 2000 and 2001 in perspective, between 1987 and 1999 only 6 of 528 (1%) maternal cows (cows with either a neonate or $\geq$1 hard antler) and 16 of 279 (6%) nonmaternal cows were observed south of the Brooks Range crest. In 2000 we observed 11 maternal cows (28%) and 8 nonmaternal cows (36%) south of the crest. In 2001 we observed 31 maternal cows (91%, though none had a neonate) and 16 nonmaternal cows (73%) south of the Brooks Range crest. The distribution of cows was more typical in 2002 than in the previous 2 years. Although we observed no maternal cows south of the Brooks Range crest, 8 of 14 nonmaternal cows (57%) were south of the crest.

To summarize, data from 1990, 2000 and 2001 should probably not be used to delineate the typical or traditional WAH calving grounds because surveys were conducted late in relation to date of peak calving (1990) or the distribution of caribou was atypical (2000 and 2001). The anomalous years 2000 and 2001 illustrate the importance of maintaining free access onto the traditional calving grounds and an adequate buffer zone around the traditional calving area where calving may occasionally occur in years of unusual environmental conditions.

<u>Summer Range</u>. Conventional telemetry relocation flights associated with calving surveys and photocensuses as well as PTT data all indicate the vast majority of the WAH uses the western

North Slope and Brooks Range during summer. The size of the area shown as summer range in Figures 1 and 2 is about 43,000 mi^2 (111,400 km^2). In recent years up to several thousand WAH caribou, primarily bulls and immature cows, have reportedly summered on the Seward Peninsula as well (K. Persons, pers. commun.).

Although summer range is rarely, if ever, identified as critical for caribou, that portion of the De Long Mountains and its northern foothills west of and including the upper Utukok and Kugururuk drainages is probably critical for the WAH. Immediately following calving, maternal cows and calves begin moving into this area as they form large post-calving aggregations before the onset of insect harassment. Mosquitoes begin to emerge by mid-to-late June and oestrid flies (warbles, *Oedemagena tarandi*, and nose bots, *Cephenemyia trompe*) emerge by early July. Insect harassment causes bulls and nonmaternal cows to join post-calving aggregations (Dau 1986). During the first 2 weeks of July the WAH forms huge insect-induced aggregations near the Chukchi Sea coast and on barren ridge tops in the westernmost portion of its summer range. During this time virtually the entire herd rapidly moves from the Lisburne Hills/Cape Thompson area eastward toward Howard Pass and Chandler Lake (Fig 6). At no other time of year is the WAH more concentrated that during the first half of July. Any development that would affect WAH movements at this time would essentially impact the entire herd. For that reason this portion of summer range should probably be considered as critical to the WAH as calving grounds or important movement areas, e.g. Howard Pass and Onion Portage.

Telemetry data collected during the 1988–1999 photocensuses (n=5) suggest at least 95% of the WAH is consistently on its summer range by early July. Using this approach, caribou density on summer range has varied only in relation to population size and reached 10.1 caribou mi^2 (3.9 caribou/km^2) in 1999. Of course, density is much higher than this during early July when the herd is highly aggregated in the western portion of its summer range and lower when it is dispersed in August. Unlike for winter range, reindeer and caribou from the CAH and TLH have little effect on summer range densities because there is little mixing of animals during summer.

<u>Satellite Collars</u>. The annual distributions of satellite-collared WAH caribou were similar in 2001 and 2002 (Figs 1 and 2). Even so, this data reflects some of the annual variability in distribution that typically occurs.

Satellite collars enabled us to effectively search for conventional radiocollared caribou. They also allowed us to monitor the distribution and movements of the WAH during periods of inclement weather and short day length. The PTTs were especially useful for notifying reindeer herders of potential conflicts with caribou. During calendar year 2000 we had up to 25 satellite collars deployed in the WAH and collected 1564 locations. During 2001 up to 37 satellite collars provided 1622 locations and in 2002, 28 satellite collars provided 1391 locations. The number of locations reported here excludes locations collected during September-December in the first year of deployment. Because all collars are deployed at Onion Portage, including this data would erroneously suggest very high use of this and the nearby area. I also standardized all PTTs to a 1-day-on/5-days-off duty cycle for the entire year to avoid differences in duty cycles among seasons and individual PTTs.

Despite never having >10 functional PTTs on living WAH caribou at any time before 1998, satellite collars indicated the overall distribution of the WAH amazingly well. A scatter plot of all WAH PTT locations collected since 1987 agrees with our representation of overall range (Fig 1) determined from thousands of conventional collar locations as well as countless opportunistic observations of caribou and public reports. Even so, the primary limitation of this data is the small number of PTT-collared caribou in relation to herd size (Dau 1999, 2001): during 1987–2002 we deployed a total of only 67 satellite collars on WAH caribou. Additionally, we have deployed very few PTTs on bull caribou. Despite this limitation, the aggregate of PTT data collected since 1987 provides an excellent depiction of general movements and seasonal distributions of the WAH. Until a much higher proportion of this herd is collared with PTTs, their use for time- and area-specific purposes should be approached with caution.

MORTALITY

Our estimates of adult mortality are conservative because they exclude bulls that tend to experience higher mortality rates than cows. Also, we do not collar emaciated, injured, or clinically diseased cows even though they comprise part of the population. Although these factors would shift the WAH mortality curve up, they should not affect its temporal trend (Dau 1997). We believe our estimates provide a reasonably accurate index of adult caribou mortality for the entire herd.

Since 1985 annual mortality has ranged from 7 (1997–1998) to 23 (1992–1993) deaths:100 collared adult cows (Table 7, Fig 7). Annual estimates of adult mortality have shown no statistically significant trend through time ($R^2 = 0.10$) and have exhibited more variability among years since 1992–1993 than prior to that time. Three-year moving averages reduce the effects of annual variability and suggest mortality has generally increased very slowly since the mid 1980s (Fig 8).

Adult caribou mortality is most meaningful in relation to recruitment. The significance of Fig. 8 is that these parameters have slowly converged since at least the mid 1980s. The census that will be attempted in July 2003 may allow us to evaluate the accuracy of the 1999 census as well as recent annual estimates of recruitment and adult mortality.

Harvest

<u>Season and Bag Limit</u>. On state-managed lands the following seasons and bag limits were in effect throughout the reporting period:

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Units 21D, 22A, 22B, 23, 24, and 26A		
Resident Hunters: 5 caribou per day. Nonresident Hunters: 5 caribou total per year.		
Bulls	No closed season	No closed season

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Cows	1 July–15 May	1 July–15 May

Federal hunting seasons during this reporting period were identical to state regulations during this reporting period. However, the bag limit was 15 caribou per day for federally qualified subsistence users in Unit 23. The federal bag limit in other units used by the WAH was 5 caribou per day.

Board of Game Actions and Emergency Orders. Many emergency orders (EOs) were issued for caribou hunting in portions of Game Management Unit 22 during this reporting period. These were in response to recent influxes of caribou into areas where 1) they had not appeared for many years, 2) where reindeer husbandry occurred and 3) where no permanent caribou hunting regulations existed. When EOs opened hunting, bag limits were 5 caribou per day for resident hunters and 5 caribou per year for nonresident hunters. The following emergency orders, in chronological order, were issued to regulate harvest of WAH caribou:

1. EO 05-01-00 opened caribou hunting in the eastern portion of Unit 22E from July 22, 2000 to August 31, 2000. The area opened was that portion of Unit 22E northeast of Shishmaref, Cape Lowenstern, the northeast bank of Serpentine River and the northeast bank of Hot Springs Creek. The purpose of this action was to provide opportunity to harvest bull caribou that had moved into this area.

2. EO 05–04–00 opened caribou hunting in the southeastern portion of Unit 22E during 1 September 2000–30 June 2001 (see EO for description of area). This area was opened to caribou hunting after discussion with hunters and reindeer herders from Shishmaref. The area was identified to maximize hunting opportunity for caribou while minimizing the likelihood of inadvertent and illegal harvest of reindeer.

3. EO 05–06–00 opened caribou hunting 12 October 2000–30 June 2001 in that portion of Unit 22D east of the Taylor Highway (Nome-Kougarok Road) and south of the Kuzitrin Bridge. The purpose of this order was to provide opportunity to hunt approximately 2000 caribou that had moved into the Pilgrim drainage in early October.

4. EO 05–04–01 opened caribou hunting in the northeast portion of Unit 22E during 4 July 2001–30 June 2002. The purpose of this action was to provide opportunity to hunt caribou that had been observed in this area during mid June 2001.

5. EO 05–08–01 opened caribou hunting in that portion of Unit 22D east of the Taylor Highway (Nome-Kougarok Road) and south of the Kuzitrin Bridge, the Kougarok River drainage, and a 1-mile-wide corridor along the west side of the Taylor Highway during 31 October 2001–30 June 2002. This order was issued to provide opportunity to hunt caribou that were migrating into the area.

6. EO 05–09–01 opened caribou hunting in that portion of Unit 22C east of the east bank of the Solomon River during 21 November 2001–30 June 2002. This order was issued to allow hunting of caribou that had moved into the eastern portion of Unit 22C.

Human-Induced Harvest. Hunters (recreational and subsistence hunters combined) reported harvesting roughly 15,700 WAH caribou during the 2000–2001 regulatory year, and 15,200 during 2001–2002. Assuming hunters took 15,000-17,000 caribou annually since 1999, this constituted roughly 3.5–4.0% of the 1999 population of 430,000 caribou.

These harvest estimates do not include caribou killed but not retrieved. Each year some harvested caribou are left in the field when discovered to be diseased or infested by parasites. Although often justifiable, carcasses are occasionally abandoned unnecessarily when common, harmless parasites are discovered in the meat or internal organs. ADF&G produced and distributed a field booklet of common wildlife diseases to try to reduce this source of caribou mortality through education (Elkin and Zarnke 2001). Additionally, some ADF&G staff prepared public service announcements and provided radio interviews regarding wildlife disease. More seriously, public reports and opportunistic observations of caribou carcasses suggest many WAH caribou are killed each winter and spring and abandoned merely because they are skinny. Additionally, wounding losses from inappropriate hunting techniques also result in caribou killed but not retrieved. The magnitude of these losses is unknown and virtually impossible to quantify.

Permit Hunts. All caribou hunting by residents that live north of the Yukon River and within the range of the WAH is by registration permit. Registration permits are available at license vendors and ADF&G offices in northwestern, western, and Interior Alaska. The permits are free and there is no limit to the number of permits issued each year. ADF&G sends a letter to each person that registered to hunt and asks how many caribou they shot the preceding year. Comparisons of registration permit harvest data and community harvest assessments indicate only about 10% of the actual harvest is reported through the registration permit system (Georgette 1994). The exception to this is the community of Nome where compliance with reporting requirements is believed to be much better (K. Persons, pers. commun.).

Nonresidents and residents that live outside the range of the WAH must carry a statewide caribou harvest ticket when hunting. Fish and Wildlife Protection officers indicate most nonlocal hunters possess a statewide caribou harvest ticket when hunting caribou (C. Bedingfield, J. Rodgers and D. Hildebrand, pers. commun.). We think this system is reasonably accurate for monitoring caribou harvested by nonlocal hunters.

Hunter Residency and Success. Beginning in the 1998–1999 regulatory year the statewide caribou harvest report system was resumed as for other big game, e.g. moose. During the 2000–2001 regulatory year, nonlocal hunters reported harvesting 523 caribou and in 2001–2002 they took 785 caribou (Table 8).

Statewide harvest ticket data confirm what we have suspected for many years: despite very long seasons in 5 game management units, nonlocal hunting of WAH caribou is concentrated in Unit 23 during late August through September. Since the 1998–1999 regulatory year an average 73% (n=4; SD=2) of all nonlocal WAH hunters pursued caribou in Unit 23. Similarly, an average 91% of nonlocal hunting effort occurred during late August-September (n=4; SD=2). This space/time concentration of nonlocal caribou hunting has contributed to widespread and occasionally intense conflicts between local and nonlocal hunters throughout Unit 23. Similar conflicts have been reported in the vicinity of Anaktuvuk Pass.

Community-based harvest assessments have been conducted in selected villages within the range of the WAH since 1985 (Table 9). Generally, hunters residing within the range of the WAH harvested roughly 15,000 caribou annually since at least the mid 1990s. Annual estimates of local harvest (Tables 10 and 11; see also Dau 2001 for the 1999–2000 estimate of local harvest) probably underestimate annual variability in harvest levels. The artificial consistency of these annual harvest estimates occurs because few new community assessments are conducted each year. Therefore, per capita community harvest estimates based on historical data change little over short time spans (or not at all for communities with no new data). Until community harvest assessments are conducted more frequently and in a higher proportion of communities within the range of the WAH, or drastic changes occur in human population size or availability of this caribou herd, there is little benefit in using this approach to estimate local harvest levels more frequently than every 5-6 years. Factors that may make community based estimates of local caribou harvest conservative have been previously reported (Dau 2001).

The statistical model estimates of harvest for communities within Units 22, 23 and 26A were 14,468 (95% confidence interval 12,210-16,833) in 2000–2001, and 14,325 (95% c.i. 12,039-16,737) in 2001–2002. These estimates agree closely with per capita estimates (Tables 10 and 11). This modeling exercise suggested harvests were similar among communities within a GMU but differed among GMUs.

<u>Harvest Chronology</u>. Subsistence harvest patterns are tied to seasonal movements of caribou and ease of travel in the country. For example, Point Hope and North Slope villages harvest western Arctic caribou mainly during July and August while Shaktoolik and Unalakleet hunters primarily take them during September through March. In Unit 23, harvests are typically high during fall and spring migration periods, and also when caribou winter near communities. Unlike many subsistence activities that are seasonally specific, subsistence hunting of caribou occurs whenever they are available and accessible.

During early fall, subsistence hunters select large bulls because they provide the best meat. Once bulls enter rut and become unpalatable, typically after 7–10 October, most subsistence hunters take cows until approximately March or April. In decades past, subsistence hunters resumed harvesting bulls in roughly mid-to-late December (W. Uhl, personal communication). During the rest of the year subsistence hunters take caribou of both sexes based on availability and the body condition of individual animals.

Virtually all harvest by nonlocal hunters occurs between late August and late October and harvest peaks during mid September. Nonlocal hunters harvest large bulls almost exclusively even after the onset of rut.

<u>Transport Methods</u>. Most subsistence hunters harvest WAH caribou using snow machines during late October–early May and boats or 4-wheelers during the rest of the year. Few local hunters use aircraft to hunt caribou. In contrast, nonlocal hunters depend almost entirely on aircraft to initially access caribou hunting areas. Once in a hunting area many nonlocal hunters use boats to

float rivers. Guides now rely heavily on 4-wheelers for hunting. This practice dramatically increased during the mid 1990s in Unit 23 and most guides now cache 4-wheelers at remote camps.

In Unit 23 some village residents transport nonlocal moose and caribou hunters via boats. This has proven divisive in some villages where transporters have exceeded numbers of clients acceptable to their community, where nonlocal clients have competed for choice hunting areas or inadvertently trespassed on private land (e.g. Native allotments or corporation lands) and when loud jet boats have been used for transport.

Other Mortality

Disease. Serology results show no temporal trends in exposure to 8 selected bacteria and viruses in the WAH for samples collected during 1992–2000 (Table 12). This may be at least partly because serologic surveys are inherently poor for monitoring the prevalence of disease in wildlife populations (J. Blake and T. O'Hara, pers commun). Beginning with samples collected during 2001 WAH serum samples will initially be analyzed only for brucellosis and haptoglobin levels. Follow-up diagnostic serological tests may be conducted for individual caribou that exhibited an elevated haptoglobin level. Our primary objective for collecting caribou sera is to provide a 'red flag' indicator of disease in this herd annually. During this reporting period we analyzed our backlog of WAH caribou sera collected in 1992–1997 for haptoglobin levels. Haptoglobin results for samples collected during September 2001 and 2002 were not available when this report was prepared.

During 1992–2000, for caribou that had both a body condition score and a haptoglobin level, few individuals were scored 'very skinny' (6 cows and 2 bulls) or 'very fat' (16 cows and 15 bulls). No caribou scored 'very fat' has ever had an elevated haptoglobin level. In contrast, 83% of all cows and 100% of all bulls scored 'very skinny' had an elevated haptoglobin level. There were little differences in the percentages of bulls or cows among the condition categories 'skinny,' 'average' or 'fat.' This may be partly because our subjective assessment of body condition is insensitive for caribou that are only slightly above or below 'average.' Alternatively, there may be little actual difference in haptoglobin levels for caribou ranging from 'skinny' to 'fat.' Overall, about 10–11% of all caribou tested during 1992–2000 have had an elevated haptoglobin level (21 of 201 bulls and 28 of 263 cows). This does not indicate that 10–11% of the WAH is diseased. It indicates 10–11% of the herd has had some type of inflammation stemming from bacteria, viruses, parasites or physical trauma. During 1992–2000, 49% of all cows with a normal haptoglobin level were accompanied by a calf during September (n=270) while 45% of 31 cows with an elevated level had a calf. This difference is not biologically significant especially given the small number of cows observed with an elevated haptoglobin level. There has been no temporal trend in the percentage of caribou with an elevated haptoglobin level during this time (Table 12).

Levels of exposure to brucellosis have been low since 1996 (Table 12). The primary impact of this disease on caribou populations is reduced reproductive success (Dieterich 1981). During September 1992–2002 a higher percentage of cows with no evidence of exposure to brucellosis (49%, n=411 cows) were accompanied by a calf than those with antibodies against this disease (31%, n=26 cows). Although these percentages differ substantially, the low number of cows exposed to this disease in recent years renders this difference biologically insignificant. Brucellosis is probably not affecting the population dynamics of the WAH at this time.

Environmental contaminants. Residents of Unit 23 have been concerned about contamination of subsistence foods since the Atomic Energy Commission conducted the Project Chariot/Plowshare Program in the 1950s and 1960s. Production of heavy metals at the Red Dog Mine beginning in the late 1980s renewed these concerns.

No WAH caribou collected since 1994 have revealed patterns or levels of heavy metals or radionuclides considered harmful to caribou or to people who eat them (Alaska Department of Public Health, unpub. rep.; O'Hara et al. 1999; O'Hara et al. unpub. ms.; Exponent, unpub. rep.; Woshner et al., unpub. ms.). Unfortunately, results of metal analyses for the bull collected near the tailings impoundment on 5 August 2002 are reported in terms of dry weight and are not comparable to results of all other collections reported in terms of wet weight.

Although metals levels in mosses and soil were clearly elevated along the Red Dog Road during summer 2000 (see 'Habitat' section below), caribou apparently did not assimilate adequate amounts of these elements to increase their tissue levels above those found in other Alaskan (O'Hara et al. unpub. ms.) and Canadian (Larter and Nagy 1999) caribou herds. This is probably because individual WAH caribou spend relatively little time near the Red Dog development complex. Any attempt to isolate the effects of the Mine on metals levels in caribou tissues would likely be confounded by naturally-occurring mineralization of the western De Long Mountains.

HABITAT

Assessment

ADF&G did not monitor range condition for the WAH during this reporting period.

During the summer of 2000 the National Park Service evaluated heavy metal levels in mosses and soils along the Red Dog Road (Ford and Hasselbach 2001). Although their results showed high concentrations of lead (Pb), zinc (Zn) and cadmium (Cd) near the road and indicated ore concentrate from the Mine was the source of these metals, subsequent discussions revealed the methods used near Red Dog were not comparable to other studies (L. Hartig, pers. commun.). Even so, Tek Cominco has since taken steps, e.g. complete coverage of transport truck payloads, to reduce or eliminate escapement of ore dust from transport vehicles.

Enhancement

There were no WAH habitat enhancement activities during the reporting period.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

WAH Cooperative Management

The Western Arctic Caribou Herd Working Group (Working Group) was organized in 1997. The purpose of the Working Group is to ensure the conservation of the Western Arctic Caribou herd, safeguard the interests of all users of the herd, and integrate indigenous knowledge with Western science. The Working Group consists of 20 voting chairs representing multiple stakeholders. It is a non-regulatory body, emphasizes shared decision-making and is supported by four resource management agencies including the Alaska Department of Fish and Game.

During this reporting period the Working Group held 2 meetings a year and produced a newsletter, *Western Arctic Caribou Trails*, which was mailed biannually to almost 9,000 box holders within the range of the WAH.

In March 2003, the Working Group approved the *Western Arctic Caribou Herd Cooperative Management Plan,* a collaborative effort that supercedes the 1984 *Western Arctic Caribou Herd strategic management plan*. The new plan consists of seven plan elements: Cooperation; Population Management; Habitat; Regulations; Reindeer; Knowledge; and Education. Each of these plan elements consists of a goal, strategies and identified management actions. The Population Management element employs a population tracking strategy that intensifies biological surveillance and reduces allowable harvest as the herd declines. Implementation of the plan is facilitated through the four cooperating management agencies that meet annually and make subsequent recommendations to the Working Group.

A distinguishing characteristic of this new management plan is that it was written collaboratively by the Working Group. The plan thus represents agreement among those who use, manage and value the herd on how the herd should be managed. The approved plan also provides general guidelines for how the Western Arctic Herd should be managed in the future.

School programs

As in the past, ADF&G staff made presentations on WAH caribou in schools throughout the range of this herd. In 2000, 7^{th} and 8^{th} grade students from Anaktuvuk Pass participated in the Onion Portage (Kobuk River) collaring project. In 2001, high school students from Point Hope and Ambler participated in this project, and in 2002 high school students from Noorvik assisted. Students participating in the collaring project typically learn about the natural history of this herd, practical aspects of managing caribou, wildlife telemetry techniques and careers in natural resource management. Additionally, they learn camping skills from their teachers and chaperones and, when we necropsy a caribou, students are exposed to elementary anatomy, physiology and parasitology. Student involvement in the caribou collaring project has been a positive experience for the students, school district staff and agency staff since its inception in 1991.

Conflicts between the WAH and reindeer industry

Recent losses of reindeer to the WAH have been previously reported (Dau 2001). During this reporting period the Seward Peninsula reindeer industry continued to lose deer as they joined the WAH. During the winters of 2001–2002 and 2002–2003 substantial numbers of reindeer were lost from the Davis herd (Nome) when they joined the WAH. Only the Davis, Kakaruk (Teller) and Ongtowasruk (Wales) herds are still commercially viable as of spring 2003. ADF&G posted a web page showing real-time locations of satellite-collared WAH caribou on the Seward Peninsula in response to requests from reindeer herders for this information.

Satellite collar locations on the internet

ADF&G staff and the WAH Working Group discussed putting satellite collar locations for the entire WAH range on a web page. Residents of Units 23 and 26A fear this will concentrate highly mobile nonlocal hunters who access hunting areas using airplanes in areas where collars are located, and that such a web site will ultimately attract more nonlocal hunters into areas where conflicts and crowding already occur. Although the educational benefits of posting WAH satellite collar locations on the internet are appreciated by everyone involved in this discussion, the consensus is that we will only publish caribou location information for the Seward Peninsula to minimize the impact of caribou on the reindeer industry.

User issues

Conflicts between nonlocal hunters, commercial operators (guides and transporters) and local hunters continued in portions of WAH range during this reporting period. These conflicts were most pronounced in Unit 23 but also occurred near Anaktuvuk Pass. This complex issue involves all hunters, not just caribou hunters, and is affected by: 1) use on aircraft by nonlocal hunters and commercial operators in contrast to local hunters' use of boats and snow machines; 2) other portions of Alaska experiencing shortened seasons, reduced bag limits, crowding, and few trophy animals; and 3) fewer places to hunt multiple big game species, especially for nonresidents. The limiting factor driving this conflict in Unit 23 is not inadequate numbers of wildlife, certainly not with regard to WAH caribou. Rather, the limiting factor is inadequate space to accommodate all users. The Unit 23 Users Issues process initiated by ADF&G during 1999 was discontinued in 2001 because of inadequate staffing. In 2003 the Kotzebue office of the NPS began their own process to regulate commercial activities in National Parks, Preserves and Monuments to address user issues.

CONCLUSIONS AND RECOMMENDATIONS

The WAH is still very large. However, converging trends in adult cow mortality and recruitment, a stable or possibly declining population, isolated starvation events and occasional years of generally poor pre-rut (September) body condition suggest this herd will probably decline in the foreseeable future. There is no evidence that any single factor, e.g. human harvests, predation, environmental contaminants or disease is currently limiting the size of this herd.

Our current level of investment in harvest assessment is probably adequate as long as the WAH is large and relatively stable. Once the herd begins to substantially decline, however, ADF&G, nonprofit Native organizations, boroughs and federal agencies should conduct community harvest assessments in a greater proportion of communities within the range of this herd each year, and repeat assessments in individual communities more frequently than current levels. ADF&G should continue to monitor harvest of WAH caribou by nonlocal hunters through the statewide caribou harvest ticket system. In contrast, ADF&G should consider eliminating the registration permit system except in areas where it appears to provide useful information, e.g. Nome. Until communities are assessed more frequently than current levels or caribou availability substantially changes through population size or distribution, range-wide estimates of local harvests need only be conducted once every 4–5 years. Modeling local caribou harvests appears comparable with the more laborious per capita estimation approach. In the future, it is probably unnecessary to estimate this component of harvest through the per capita technique.

Seward Peninsula reindeer continued to be lost to the WAH during this reporting period. ADF&G should continue to provide information regarding caribou movements and distribution to herders within the constraints of staff, weather, aircraft and budgets. In response to requests from reindeer herders, ADF&G will attempt to deploy 3 conventional collars and 2 satellite collars on WAH caribou on the Seward Peninsula during August 2003 to determine whether a stable subpopulation of caribou has become established in this area.

Conflicts between local subsistence hunters, nonlocal sport hunters, and commercial operators have intensified in portions of WAH range since 1992. The primary limiting factor driving these conflicts is inadequate space to accommodate all users. ADF&G should hire a planner position for Region V in part to address these issues.

ADF&G should also continue to support the WAH Working Group and help identify management issues to focus on now that the Cooperative Management Plan has been finalized.

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PREPARED BY:
Jim Dau
Wildlife Biologist III

SUBMITTED BY:
Peter Bente
Survey-Inventory Coordinator

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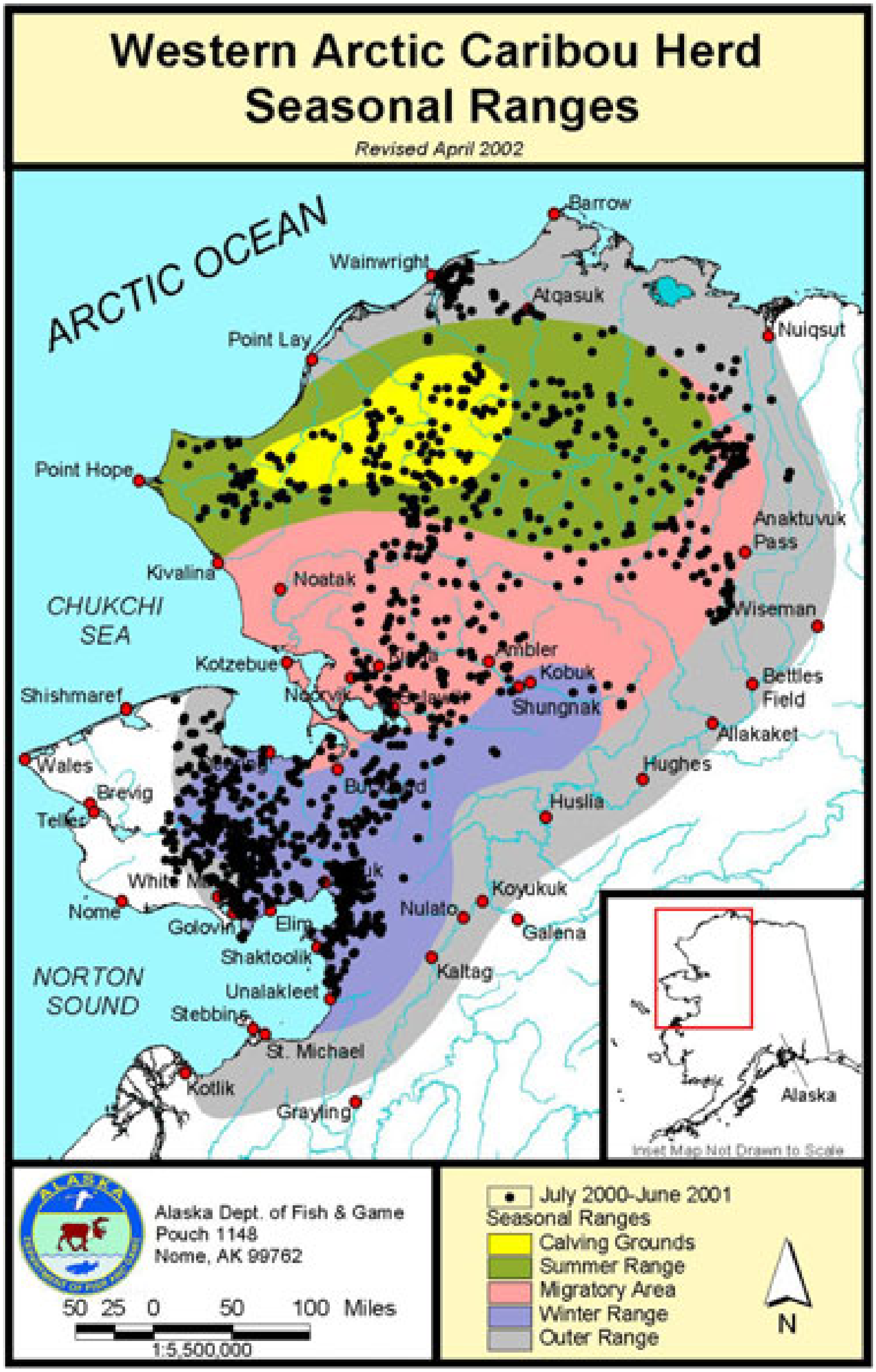

Figure 1 Seasonal ranges of the Western Arctic Caribou Herd with locations of satellite-collared caribou collected during regulatory year 2000–2001

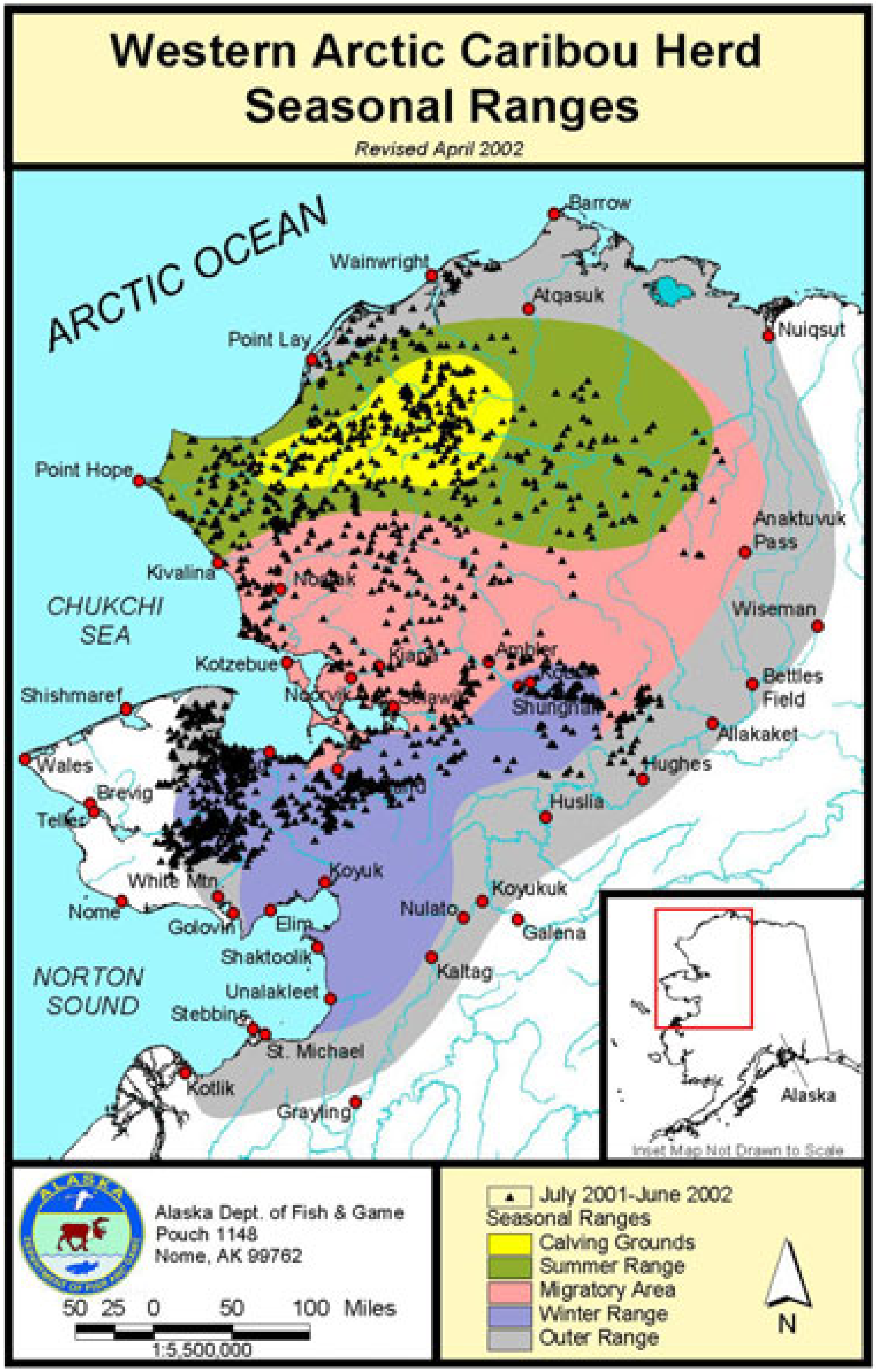

Figure 2 Seasonal ranges of the Western Arctic Caribou Herd with locations of satellite-collared caribou collected during regulatory year 2001–2002

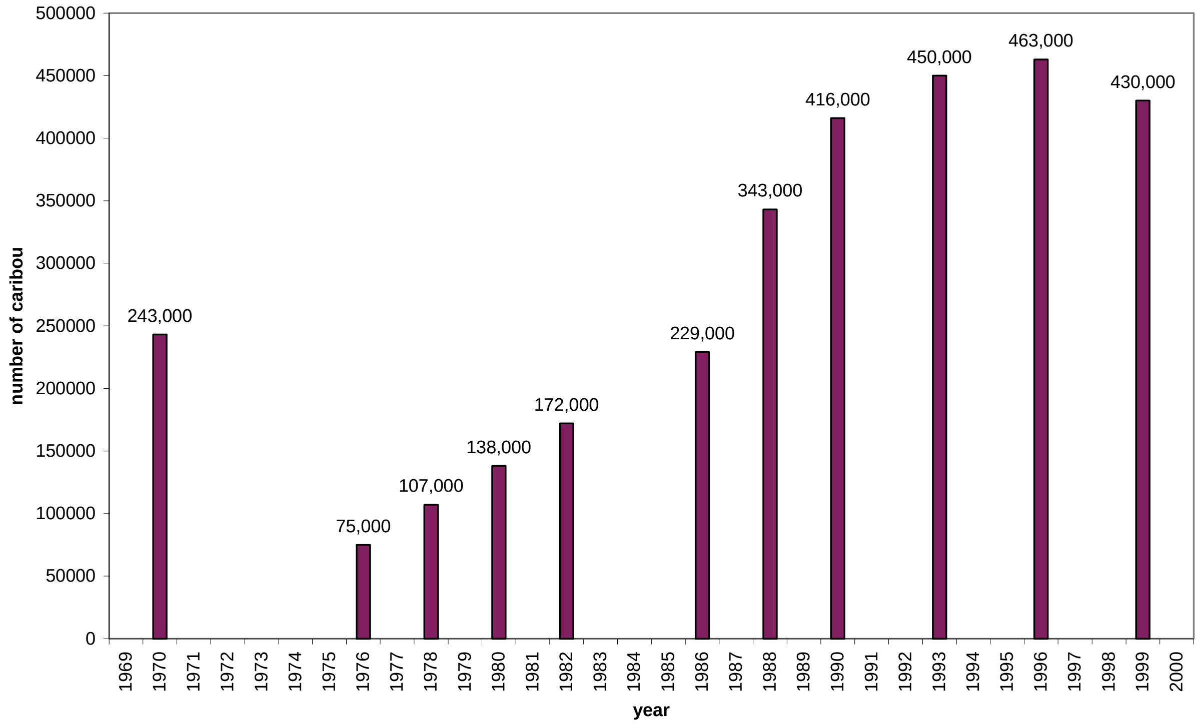

Figure 3 Photocensus estimates of the Western Arctic Caribou Herd, 1970-1999

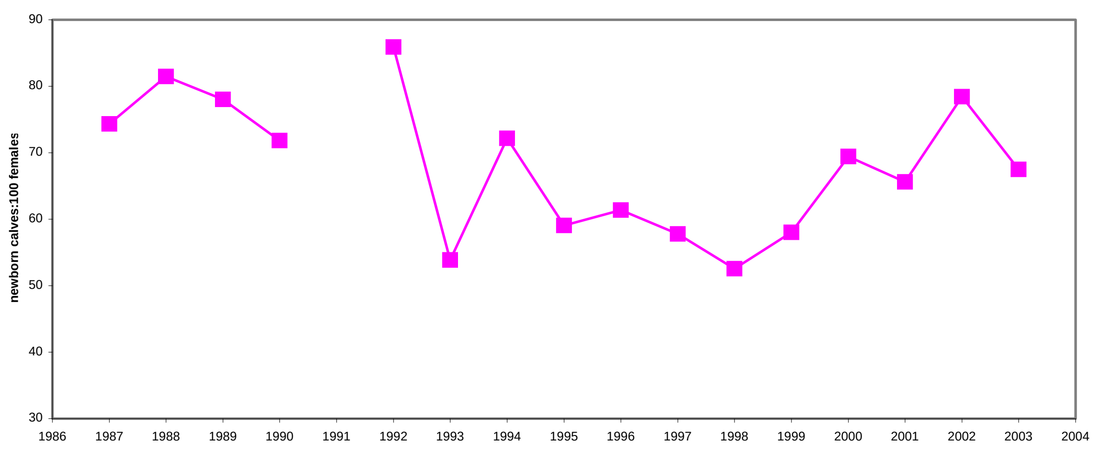

Figure 4 Western Arctic Caribou Herd calving survey results, 1987-2003

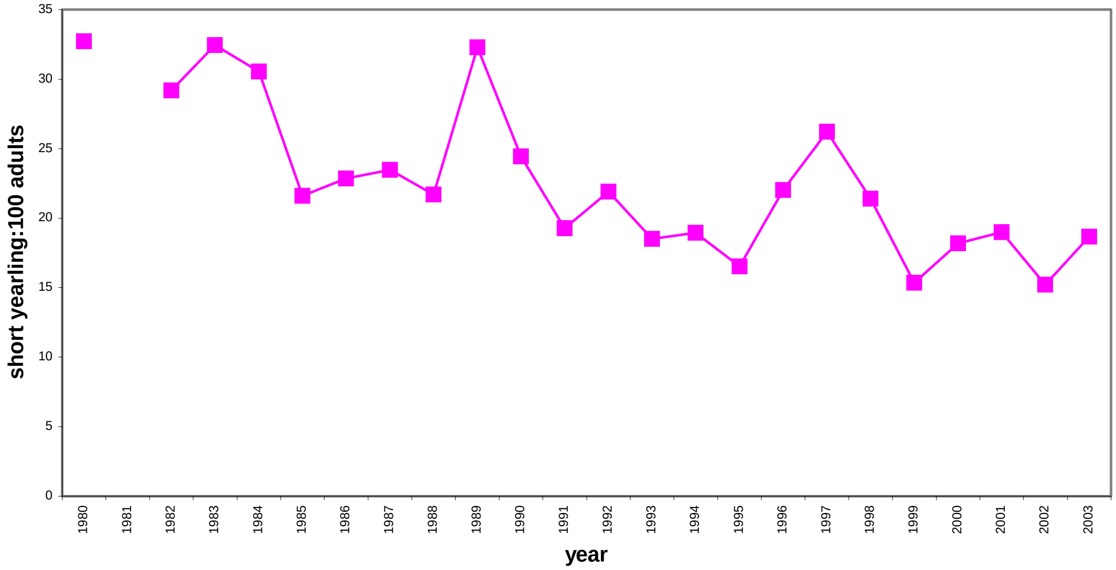

Figure 5 Annual estimates of calf recruitment for the Western Arctic Caribou Herd, 1980-2003

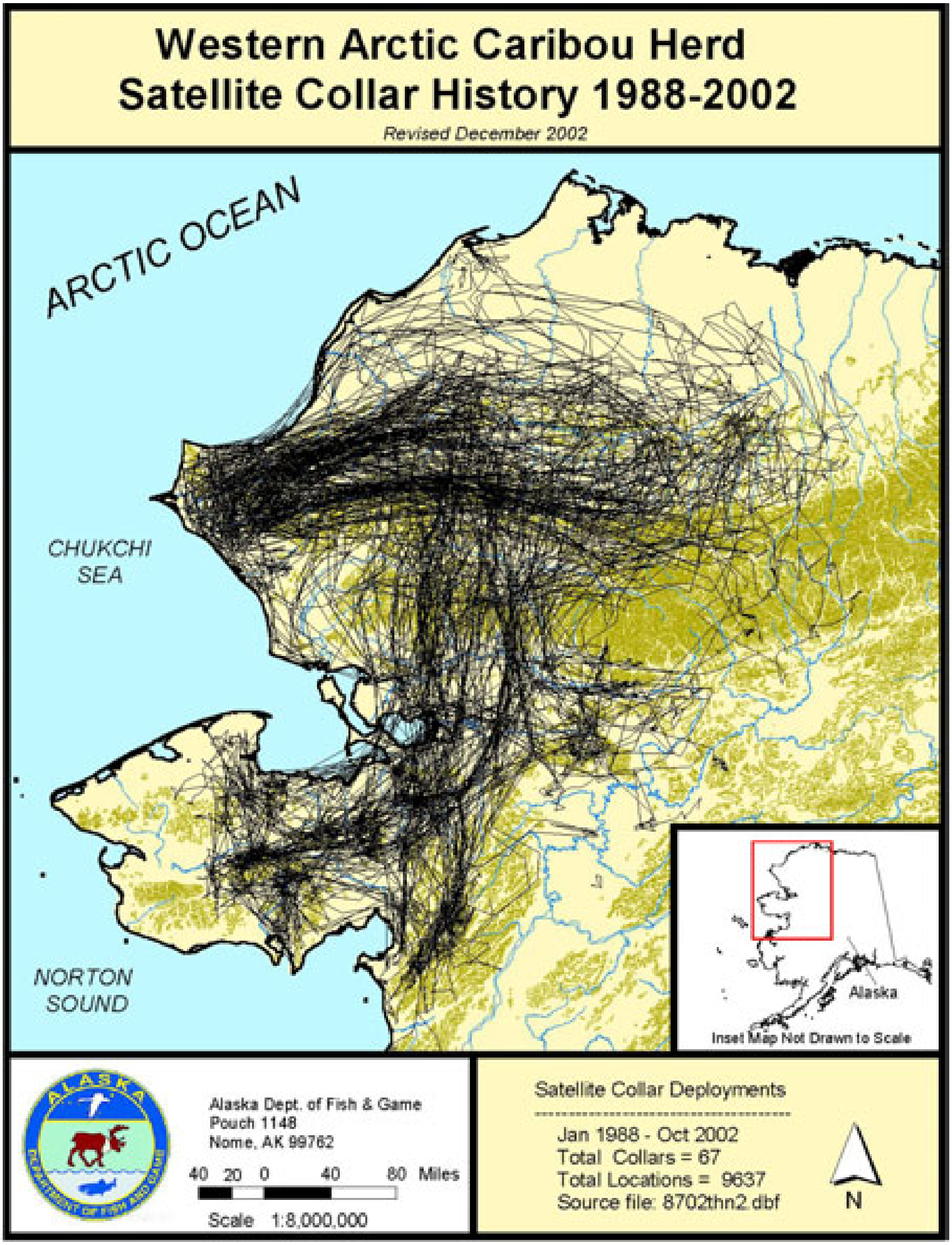

Figure 6 Track history of satellite collared caribou in the Western Arctic Herd, 1988-2002

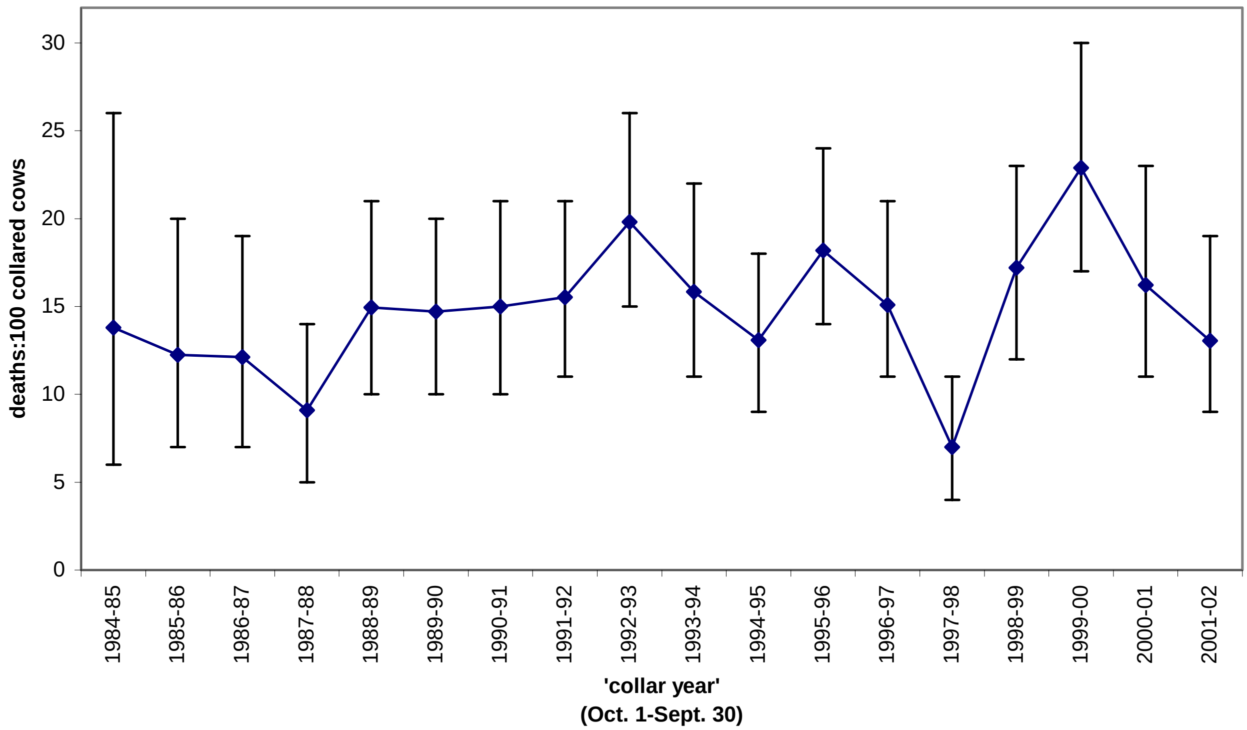

Figure 7 Annual estimates of adult cow mortality for the Western Arctic Caribou Herd, 1984-85 through 2001-2002 (brackets represent 80% binomial confidence intervals)

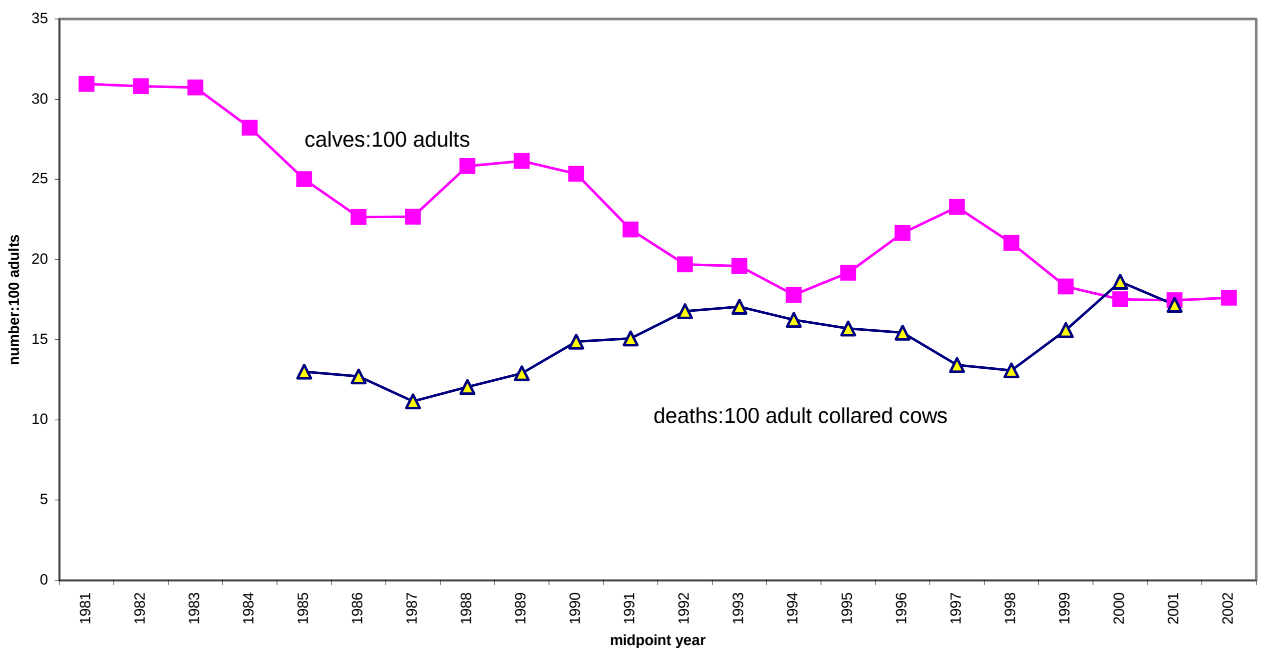

Figure 8 Three-year moving averages of Western Arctic Caribou Herd calf recruitment and adult cow mortality (Note: these indices of recruitment and adult mortality show trends but are not directly comparable)

Table 1 Photocensus population estimates of the Western Arctic Caribou Herd, 1970–1999

Census year	Minimum population size	Mean annual rate of change[a]	Estimated population size
1970	242,000		
1971		-18	200,000
1972		-18	164,000
1973		-18	135,000
1974		-18	111,000
1975		-18	91,000
1976	75,000		
1977		19	89,000
1978	107,000		
1979		14	121,000
1980	138,000		
1981		12	154,000
1982	172,000		
1983		7	185,000
1984		7	198,000
1985		7	213,000
1986	229,000		
1987		22	280,000
1988	343,000		
1989		10	378,000
1990	416,000		
1991		3	427,000
1992		3	438,000
1993	450,000		
1994		1	454,000
1995		1	459,000
1996	463,000		
1997		-2	452,000
1998		-2	441,000
1999	430,000		

[a] Mean annual rate of change = e^r

$e = 2.7183$; $r = [\ln(N_{t2}) - \ln(N_{t1})]/t$ where: t = number of years between censuses; N_{t1} = pop. estimate at $time_1$; and N_{t2} = pop. estimate at $time_2$

Table 2 Aerial calving surveys from observations of radiocollared cows in the Western Arctic Caribou Herd, 1987–2003

Year	median June survey date	With calf	No calf ≥1 hard antler	No calf soft antler	No calf no antler	Total	Maternal	Non-maternal	Calves: 100 cows
1987	16	29	0	1	9	39	29	10	74
1988	5	27	17	1	9	54	44	10	81
1989	12	34	5	2	9	50	39	11	78
1990	11	51	0	5	15	71	51	20	72
1991									
1992	12	55	6	0	10	71	61	10	86
1993	14	39	3	17	21	80	42	39	52
1994	11	42	15	2	21	80	57	23	71
1995	11	47	2	13	21	83	49	34	59
1996	6	38	16	13	21	88	54	34	61
1997	5	39	13	16	22	90	52	38	58
1998	13	36	5	16	21	78	41	37	53
1999	12	47	0	11	23	81	47	34	58
2000	13	39	11	5	17	72	50	22	69
2001	16	8	34	9	13	64	42	22	66
2002	2	13	38	8	6	65	51	14	78
2003	6	16	38	7	19	80	54	26	68

Table 3 Fall population composition of the Western Arctic Caribou Herd, 1961–2001

Year	Bulls	Cows	Calves	Total	Calves: 100 cows	Calves: 100 adults	Bulls: 100 cows
1961	276	501	187	964	37	24	55
1970	1748	2732	1198	5678	44	27	64
1975	720	2330	1116	4166	48	37	31
1976	273	431	222	926	52	32	63
1980	715	1354	711	2780	53	34	53
1982	1896	3285	1923	7104	59	37	58
1992	1600	2498	1299	5397	52	32	64
1993	859	2321	859	4039	37	25	37
1994	1354	3284	1118	5756	34	24	41
1995	1176	2029	1057	4262	52	33	58
1996	2621	5119	2525	10265	49	33	51
1997	2588	5229	2255	10072	43	29	49
1998	2298	4231	1909	8438	45	29	54
1999	2059	4191	1960	8210	47	31	49
2001	1117	2943	1095	5355	37	27	38

Table 4 Short yearling[a] survey results of the Western Arctic Caribou Herd, 1980–2003

Year	Number of caribou			Number			
	Adults	SY[a]	Total	Groups	Radio-collared cows	SY[a]:100 adults	3-yr running average
1980	7823	2559	10382			33	
1981							31[b]
1982	3988	1164	5152			29	31
1983	5079	1648	6727			32	31
1984	1646	503	2149			31	28
1985	2776	600	3376			22	25
1986	5372	1227	6599			23	23
1987	4272	1003	5275			23	23
1988	6047	1312	7359	31	45	22	26
1989	5321	1718	7039	29	37	32	26
1990	5231	1278	6509	25	36	24	25
1991	7111	1371	8482	47	48	19	22
1992	7660	1678	9338	49	52	22	20
1993	4396	814	5210	19	33	19	20
1994	8369	1587	9956	44	53	19	18
1995	13283	2196	15479	53	86	17	19
1996	5044	1111	6155	32	36	22	22
1997	9298	2438	11736	40	56	26	23
1998	7409	1585	8994	34	46	21	21
1999	6354	975	7329	34	36	15	18
2000	8568	1559	10127	42	48	18	18
2001	6814	1294	8108	32	33	19	17
2002	8268	1258	9526	38	42	15	18
2003	8748	1633	10381	43	50	19	

[a] Short yearlings are 10–11-month-old caribou.
[b] Calculates average using values from 1980-1982.

Table 5 Geographic distribution of radio collared Western Arctic Herd caribou during winter (November-March); numbers represent percentage of radio collared caribou located in each area (Note: 9 areas[a] comprise the total range of WAH, not just winter range shown in Figures 1 and 2)

Area[a]	1983 - 1984	1984 - 1985	1985 - 1986	1986 - 1987	1987 - 1988	1988 - 1989	1989 - 1990	1990 - 1991	1991 - 1992	1992 - 1993	1993 - 1994	1994 - 1995	1995 - 1996	1996 - 1997	1997 - 1998	1998 - 1999	1999 - 2000	2000 - 2001	2001 - 2002	2002 - 2003
1	14	13	6	12	0	0	0	5	5	9	0	1	10	4	6	9	0	5	0	5
2	0	16	6	0	0	0	0	0	0	0	0	1	0	0	0	0	9	0	0	0
3	7	13	0	0	0	0	11	0	0	2	4	0	5	0	5	1	1	4	0	4
4	24	32	12	38	49	28	20	2	53	6	1	26	33	12	6	11	42	12	22	21
5	14	11	18	0	8	1	9	0	9	6	8	3	26	4	25	31	5	5	9	13
6	0	0	0	0	0	1	1	0	6	19	4	1	2	1	0	2	12	0	2	8
7	2	0	0	0	1	5	2	3	4	4	7	6	9	59	29	24	17	43	30	42
8	17	5	53	38	39	64	56	89	21	54	75	55	16	20	30	20	5	29	5	0
9	21	11	6	12	3	1	2	0	2	0	0	8	1	0	0	1	9	2	26	7
n_i[b]	14	19	17	34	38	76	57	75	60	70	90	77	63	79	87	67	72	62	56	67

[a] Areas: 1 North Slope coastal plain west of Colville drainage; 16, 378 mi^2

2 Foothills of Brooks Range west of Utukok River; 8,817 mi^2

3 Foothills of Brooks Range east of Utukok River and west of Dalton Highway; 24,082 mi^2

4 Kobuk drainage below Selby River; Squirrel drainage below North Fork; Selawik drainage; Buckland drainage; 18,928 mi^2

5 Kobuk drainage above Selby R; central Brooks Range north of Koyukuk R & west of Dalton Hwy; Noatak drainage above Douglas Crk; 12,436 mi^2

6 Koyukuk drainage south of Brook Range mountains including Kanuti Flats, Galena Flats; 13,089 mi^2

7 Seward Peninsula west of Buckland and Koyukuk villages; 15,436 mi^2

8 Nulato Hills; 14,418 mi^2

9 Noatak drainage below Douglas Creek; Squirrel drainage above North Fork; Wulik and Kivalina drainages; Lisburne Hills; 16,541 mi^2

[b] Number of radio collared caribou; excludes the year in which a caribou was initially collared; when a collared caribou wintered in >1 winter range we assumed time was spent equally among ranges and included appropriate fractions of use

Table 6 Caribou density (number/mi^2) in 9 geographic areas of Western Arctic Caribou Range during winter (1 Nov.-31 March)

Area[a]	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999
1	1.73	1.71	0.82	2.01	0.00	0.00	0.00	1.39	1.34	2.55	0.00	0.18	2.69	1.05	1.55	2.35
2	0.00	3.81	1.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00
3	0.59	1.16	0.00	0.00	0.00	0.00	1.82	0.00	0.00	0.40	0.73	0.00	0.92	0.00	0.84	0.27
4	2.49	3.55	1.42	5.66	8.82	5.65	4.43	0.55	12.34	1.53	0.27	6.30	7.96	2.87	1.29	2.54
5	2.27	1.80	3.25	0.00	2.18	0.40	2.93	0.00	3.23	2.07	3.04	0.96	9.75	1.38	8.97	10.58
6	0.00	0.00	0.00	0.00	0.00	0.19	0.28	0.00	1.95	6.38	1.54	0.46	0.56	0.44	0.00	0.74
7	0.30	0.00	0.00	0.00	0.29	1.13	0.47	0.86	1.18	1.25	2.12	1.93	2.62	17.24	8.32	6.65
8	2.30	0.78	8.41	7.43	9.39	16.90	16.20	26.39	6.33	16.72	23.62	17.36	5.10	6.35	9.08	6.01
9	2.57	1.36	0.81	1.99	0.55	0.15	0.44	0.00	0.44	0.00	0.00	2.16	0.22	0.00	0.00	0.39
N[b]	*198*	*213*	229	*280*	343	*378*	416	*426*	*438*	450	*454*	*459*	463	*452*	*441*	430

[a] Areas: 1 North Slope coastal plain west of Colville drainage; 16, 378 mi^2

2 Foothills of Brooks Range west of Utukok River; 8,817 m

3 Foothills of Brooks Range east of Utukok River and west of Dalton Highway; 24,082 mi^2

4 Kobuk drainage below Selby River; Squirrel drainage below North Fork; Selawik drainage; Buckland drainage; 18,928 mi^2

5 Kobuk drainage above Selby R; central Brooks Range north of Koyukuk R & west of Dalton Hwy; Noatak drainage above Douglas Crk; 12,436 mi^2

6 Koyukuk drainage south of Brook Range mountains including Kanuti Flats, Galena Flats; 13,089 mi^2

7 Seward Peninsula west of Buckland and Koyukuk villages; 15,436 mi^2

8 Nulato Hills; 14,418 mi^2

9 Noatak drainage below Douglas Creek; Squirrel drainage above North Fork; Wulik and Kivalina drainages; Lisburne Hills; 16,541 mi^2

[b] Western Arctic Herd population size in thousands; numbers in italics represent estimates based on population growth rates, other numbers are census estimates

Table 7 Annual mortality rate and binomial confidence intervals for Western Arctic Caribou Herd cows collared with conventional or lightweight satellite radio collars[a], 1984–1985 through 2001-2002 'collar years' (1 Oct–30 Sep)

				Binomial confidence level		
Collar year	Sample size	No. died	Mortality rate[b] (%)	80%	90%	95%
1984–1985	29	4	14	6–26	5–29	4–32
1985–1986	49	6	12	7-20	5-23	5-25
1986–1987	66	8	12	7–19	6–21	5–22
1987–1988	88	8	9	5–14	5–16	4–17
1988–1989	87	13	15	10–21	9–23	8–24
1989–1990	102	15	15	10–20	9–22	8–23
1990–1991	100	15	15	10–21	9–22	9–24
1991–1992	103	16	16	11–21	10–23	9–24
1992–1993	106	21	20	15–26	14–27	13–29
1993–1994	101	16	16	11–22	10–23	9–24
1994–1995	107	14	13	9–18	8–20	7–21
1995–1996	110	20	18	13–24	12-25	11–27
1996–1997	106	16	15	11–21	10–22	9–23
1997–1998	100	7	7	4–11	3–13	3–14
1998–1999	93	16	17	12-23	11-25	10-26
1999–2000	84	19	23	17-30	15-31	14-33
2000-2001	75	12	16	11-23	10-25	9-26
2001-2002	87	13	15	10-21	9-23	8-24

[a] Sample size = total number of potentially active conventional or ST-10 satellite radiocollars active on adult cows at the beginning of the collar year
[b] Mortality rate = Number caribou died/Sample size

Table 8 Number of hunters residing outside the range of the Western Arctic Caribou herd and number of caribou they harvested by year and Game Management Unit

	1998-1999		1999-2000		2000-2001		2001-2002	
	Hunters	Caribou taken	Hunters	Caribou taken	Hunters	Caribou taken	Hunters	Caribou taken
Unit 21	8	2	3	2	5	0	2	0
Unit 22	28	23	36	32	43	51	82	70
Unit 23	446	565	440	415	445	406	431	630
Unit 24	70	25	59	12	59	11	44	17
Unit 26A	53	56	54	53	63	55	56	68
Total	605	665	592	514	615	523	615	785

Table 9 Summary of community-based harvest assessments (conducted by ADF&G unless otherwise noted) for communities within the range of the Western Arctic Caribou Herd, 1985–2002; human population numbers in parentheses estimated during household interviews rather than by Department of Commerce and Economic Development

Unit	Community	Survey year	Human population[a]	Number of caribou harvested	Reference
21					
	Galena	1996	548	40	ADF&G[b]
	Galena	1997	536	39	ADF&G[b]
	Galena	1998	481	7	ADF&G[b]
	Galena	1999	592	8	ADF&G[b]
	Galena	2001	675	0	ADF&G[b]
	Kaltag	1996	227	16	ADF&G[b]
	Kaltag	1997	247	8	ADF&G[b]
	Kaltag	1998	227	6	ADF&G[b]
	Kaltag	1999	251	0	ADF&G[b]
	Kaltag	2001	227	0	ADF&G[b]
	Nulato	1996	328	13	ADF&G[b]
	Nulato	1997	311	3	ADF&G[b]
	Nulato	1998	282	5	ADF&G[b]
	Nulato	1999	347	0	ADF&G[b]
	Nulato	2001	341	0	ADF&G[b]
	Ruby	1999	179	1	ADF&G[b]
	Ruby	2001	192	0	ADF&G[b]
22					
	Brevig Mission	2000	276	74	ADF&G[b]
	Golovin	1989	169	40	ADF&G[b]
	Golovin	2001	146	94	ADF&G[b]
	Koyuk	1998	277	263	ADF&G[b]
	Shaktoolik	1998	235	167	ADF&G[b]
	Shaktoolik	1999	216	125	ADF&G[b]
	Shismaref	1989	472	197	ADF&G[b]
	Shishmaref	1995	560	342	ADF&G[b]
	Shishmaref	2000	562	286	ADF&G[b]
	Wales	1993	152	4	ADF&G[b]
	Wales	2000	152	0	ADF&G[b]
	Elim	1999	306	227	ADF&G[b]

Unit	Community	Survey year	Human population[a]	Number of caribou harvested	Reference
	White Mountain	1999	197	93	ADF&G[b]
23					
	Deering	1994	147	142	ADF&G[b]
	Kivalina	1992	344	351	ADF&G[b]
	Kotzebue	1986	(2681)	1917	ADF&G[b]
	Kotzebue	1991	2751	3782	ADF&G[b]
	Noatak	1994	379	615	ADF&G[b]
	Noatak	1999	423	683	ADF&G[b]
	Shungnak	1998	245	561	ADF&G[b]
	Shungnak	2002	249		ADF&G[b]
	Kiana	1999	398	488	ADF&G[b]
	Point Hope	1992	699	225	Fuller and George 1997
	Selawik	1999	767	1289	ADF&G[b]
	Noorvik	2002	677		ADF&G[b]
24					
	Alatna	1997	25	21	ADF&G[b]
	Alatna	1998	25	11	ADF&G[b]
	Alatna	1999	34	0	ADF&G[b]
	Alatna	2001	33	0	ADF&G[b]
	Allakaket	1997	176	11	ADF&G[b]
	Allakaket	1998	191	43	ADF&G[b]
	Allakaket	1999	197	13	ADF&G[b]
	Allakaket	2001	97	9	ADF&G[b]
	Anaktuvuk Pass	1990	314	592	Pedersen and Opie 1990
	Anaktuvuk Pass	1991	272	545	Pedersen and Opie 1991
	Anaktuvuk Pass	1992	270	566	Fuller and George 1997
	Anaktuvuk Pass	1993	318	574	Pedersen and Opie 1993
	Anaktuvuk Pass	1994–95	318	322	Brower and Opie 1996
	Bettles	1997	23	0	ADF&G[b]
	Bettles	1998	31	25	ADF&G[b]
	Bettles	1999	36	21	ADF&G[b]
	Evansville	1997	44	3	ADF&G[b]
	Evansville	1998	28	4	ADF&G[b]
	Evansville	1999	24	2	ADF&G[b]
	Huslia	1997	218	56	ADF&G[b]
	Huslia	1998	245	264	ADF&G[b]

Unit	Community	Survey year	Human population[a]	Number of caribou harvested	Reference
	Huslia	1999	283	78	ADF&G[b]
	Huslia	2001	285	0	ADF&G[b]
26					
	Barrow	1987	3016	1595	Braund et al. 1991
	Barrow	1988	3379	1533	Braund et al. 1991
	Barrow	1989	3379	1656	Braund et al. 1991
	Barrow	1992	3908	1993	Fuller and George 1997
	Atqasuk	1994–95	237	262	Hepa et al. 1997
	Nuiqsut	1985	337	513	Pedersen 1995
	Nuiqsut	1992	418	278	Fuller and George 1997
	Nuiqsut	1993	361	672	Pedersen 1995
	Nuiqsut	1994–95	418	258	Brower and Opie 1997
	Nuiqsut	1999	468	413	Pedersen 2001
	Nuiqsut	2000-01	468	600	Pedersen 2001
	Point Lay	1987	(121)	157	Pedersen 1989
	Wainwright	1988	506	505	Braund et al 1993
	Wainwright	1989	468	711	Braund et al 1993
	Wainwright	1992	584	748	Fuller and George 1997

[a] Human population figures from Alaska Department of Commerce and Economic Development, Alaska Community Database (www.dced.state.ak.us/mra/CF_CUSTM.htm)
[b] Alaska Department of Fish and Game Community Profile Database

Table 10 Estimated harvest of Western Arctic Herd Caribou during the 2000-2001 regulatory year by residents living within the range of this herd

Unit	Community	Human population	Per capita caribou harvest	Total community harvest	% WAH in harvest	Estimated Nr. of WAH caribou harvested	Assessments used to estimate per capita harvest[a]
21	Galena	675	0.01	6	100	6	Galena 98, 99, 01
	Kaltag	230	0.00	0		0	Kaltag 99,01
	Koyukuk	101	0.01	1	100	1	Gal. 98, 99, 01; Kal. 01; Nulato 99, 01
	Ruby	188	0.00	0	100	0	Ruby 99, 01
	Grayling	194	0.00	0	100	0	Kaltag 99, 01
	Nulato	336	0.00	0		0	Nulato 99, 01
	Total Unit 21					7	
22	Brevig Mission	276	0.27	74	100	74	Brevig 00
	Elim	313	0.74	232	100	232	Elim 99
	Golovin	144	0.74	107	100	107	Elim 99
	Koyuk	297	0.95	282	100	282	Koyuk 98
	Nome	3,505	0.16	574	100	574	Registration Permit System
	Saint Michael	368	0.27	99	100	99	Brevig 00
	Shaktoolik	230	0.71	163	100	163	Shaktoolik 98
	Shishmaref	562	0.51	286	100	286	Shishmaref 00
	Stebbins	547	0.27	147	100	147	Brevig 00
	Teller	268	0.08	21	100	21	Teller 00
	Unalakleet	747	0.71	531	100	531	Shaktoolik 98
	Wales	152	0.00	0	100	0	Wales 00

Unit	Community	Human population	Per capita caribou harvest	Total community harvest	% WAH in harvest	Estimated Nr. of WAH caribou harvested	Assessments used to estimate per capita harvest[a]
	White Mountain	203	0.47	96	100	96	White Mt. 99
	Total Unit 22					2,612	
23	Ambler	309	1.94	601	100	601	Shungnak 98, 02
	Buckland	406	1.67	679	100	679	Noa. 94, 99; Shg. 98; Kia. 99; Sel. 99
	Deering	136	1.67	227	100	227	Noa. 94, 99; Shg. 98; Kia. 99; Sel. 99
	Kiana	388	1.23	476	100	476	Kiana 99
	Kivalina	377	1.02	385	100	385	Kivalina 92
	Kobuk	109	1.94	212	100	212	Shungnak 98, 02
	Kotzebue	3,082	1.37	4237	100	4237	Kotzebue 91
	Noatak	428	1.62	693	100	693	Noatak 94, 99
	Noorvik	634	1.38	875	100	875	Noorvik 02
	Point Hope	757	0.32	244	100	244	Pt. Hope 92
	Selawik	772	1.68	1297	100	1297	Selawik 99
	Shungnak	256	1.94	498	100	498	Shungnak 98
	Total Unit 23					10,424	
24	Alatna	35	0.00	0	100	0	Alatna 99, 01
	Allakaket	97	0.08	8	100	8	Allakaket 99, 01
	Anaktuvuk Pass	282	1.76	496	80	348	Anaktuvuk Pass 90–95
	Bettles	43	0.46	20	100	20	Bettles 99

Unit	Community	Human population	Per capita caribou harvest	Total community harvest	% WAH in harvest	Estimated Nr. of WAH caribou harvested	Assessments used to estimate per capita harvest[a]
	Evansville	28	0.10	3	100	3	Evansville 97-99
	Hughes	78	0.28	22	100	22	Husl. 97–01; Alat. 97–01; Allak. 97–01
	Wiseman	21	0.28	6	100	6	Bettles 97-99; Evans. 97-99
	Huslia	293	0.14	40	100	40	Huslia 99, 01
	Total Unit 24					447	
26A	Atqasuk	228	1.11	252	40	101	Atqasuk 94–95
	Barrow	4,581	0.51	2338	30	701	Barrow 88, 89, 92
	Nuiqsut	433	1.28	555	10	56	Nuiqsuit 00
	Point Lay	247	1.27	315	80	252	Pt. Lay 87; Ww 88–89, 92
	Wainwright	546	1.27	691	40	276	Wainwright 88–89, 92
	Total Unit 26A					1,386	
Total: All Units						14,876[b]	

[a] Abbreviations: Alatna (Alat.); Allakaket (Allak.); Barrow (Brw.); Galena (Gal.); Kaltag (Kal.); Kiana (Kia.); Noatak (Noa.); Selawik (Sel.); Shaktoolik (Shkt.); Shungnak (Shg.); Wainwright (Ww); White Mountain (Wh. Mt.)
[b] 13,700–16,000 caribou (95% bootstrap confidence interval)

Table 11 Estimated harvest of Western Arctic Herd Caribou during the 2001-2002 regulatory year by residents living within the range of this herd

Unit	Community	Human population	Per capita caribou harvest	Total community harvest	% WAH in harvest	Estimated Nr. of WAH caribou harvested	Assessments used to estimate per capita harvest[a]
21	Galena	694	0.00	0	100	0	Galena 01
	Kaltag	227	0.00	0	100	0	Kaltag 01
	Koyukuk	101	0.00	0	100	0	Gal. 01; Kal. 01; Nul. 01
	Ruby	188	0.00	0	100	0	Ruby 99, 01
	Grayling	194	0.00	0	100	0	Kaltag 00, 01
	Nulato	347	0.00	0	100	0	Nulato 99
	Total Unit 21					0	
22	Brevig Mission	292	0.27	78	100	78	Brevig 00
	Elim	326	0.74	242	100	242	Elim 99
	Golovin	146	0.64	94	100	94	Golovin 01
	Koyuk	313	0.95	297	100	297	Koyuk 98
	Nome	3,499	0.16	574	100	574	Registration Permit System
	Saint Michael	379	0.08	30	100	30	Teller 00
	Shaktoolik	224	0.58	130	100	130	Shaktoolik. 99
	Shishmaref	576	0.51	293	100	293	Shishmaref 00
	Stebbins	567	0.08	44	100	44	Teller 00
	Teller	258	0.08	20	100	20	Teller 00
	Unalakleet	736	0.58	426	100	426	Shaktoolik 98
	Wales	152	0.00	0	100	0	Wales 00

Unit	Community	Human population	Per capita caribou harvest	Total community harvest	% WAH in harvest	Estimated Nr. of WAH caribou harvested	Assessments used to estimate per capita harvest[a]
	White Mountain	203	0.47	96	100	98	White Mt. 99
	Total Unit 22					2,326	
23	Ambler	302	1.60	483	100	483	Shungnak 02
	Buckland	426	1.67	712	100	712	Noa. 94, 99; Shg. 98; Kia. 99; Sel. 99
	Deering	133	1.67	222	100	222	Noa. 94, 99; Shg. 98; Kia. 99; Sel. 99
	Kiana	394	1.23	483	100	483	Kiana 99
	Kivalina	380	1.02	388	100	388	Kivalina 92
	Kobuk	108	1.60	173	100	173	Shungnak 02
	Kotzebue	3,095	1.37	4255	100	4,255	Kotzebue 91
	Noatak	442	1.62	715	100	715	Noatak 94, 99
	Noorvik	656	1.38	905	100	905	Noorvik 02
	Point Hope	733	0.32	236	100	236	Pt. Hope 92
	Selawik	754	1.68	1302	100	1,302	Selawik 99
	Shungnak	253	1.60	405	100	405	Shungnak 02
	Total Unit 23					10,279	
24	Alatna	33	0.00	0	100	0	Alatna 01
	Allakaket	197	0.09	9	100	9	Allakaket 99, 01
	Anaktuvuk Pass	292	1.76	514	70	360	Anaktuvuk Pass 90–95
	Bettles	40	0.46	19	100	19	Bettles 97-99

Unit	Community	Human population	Per capita caribou harvest	Total community harvest	% WAH in harvest	Estimated Nr. of WAH caribou harvested	Assessments used to estimate per capita harvest[a]
	Evansville	25	0.10	2	100	2	Evansville 97-99
	Hughes	74	0.28	21	100	21	Husl. 97–01; Alat. 97–01; Allak. 97–01
	Wiseman	24	0.28	7	100	7	Bettles 97-99; Evans. 97-99
	Huslia	289	0.00	0	100	0	Huslia 01
	Total Unit 24					418	
26A	Atqasuk	230	1.11	254	40	102	Atqasuk 94–95
	Barrow	4,508	0.51	2301	30	690	Barrow 88–89, 92
	Nuiqsut	438	1.28	562	10	56	Nuiqsuit 00
	Point Lay	252	1.27	321	80	257	Pt. Lay 87; Ww 88–89, 92
	Wainwright	545	1.27	690	40	276	Wainwright 88–89, 92
	Total Unit 26A					1,381	
Total: All Units						14,404[b]	

[a] Abbreviations: Alatna (Alat.); Allakaket (Allak.); Barrow (Brw.); Galena (Gal.); Kaltag (Kal.); Kiana (Kia.); Noatak (Noa.); Selawik (Sel.); Shaktoolik (Shkt.); Shungnak (Shg.); Wainwright (Ww); White Mountain (Wh. Mt.)
[b] 13,300–15,500 caribou (95% bootstrap confidence interval)

Table 12 Percent positive results and sample sizes (in parentheses) for 8 selected pathogens and haptoglobin levels from serology analyses of the Western Arctic Caribou Herd, 1962–2002 (Note: these percentages reflect gross levels of exposure to pathogens rather than levels of actual infection)

	IBR[a]		BVD[b]		PI3[c]		RSV[d]		EHD[e]		BT[f]		Lepto.[g]		Bruc.[h]		Hapto.[i]	
Year	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)
1962															30	(56)		
1963															19	(74)		
1964															14	(37)		
1965															12	(149)		
1975	18	(11)	18	(11)	0	(12)		(40)					0	(9)	14	(14)		
1981	0	(20)	0	(19)	0	(20)		(55)	0	(20)	0	(20)	0	(19)	39	(23)		
1986	5	(40)	3	(40)	24	(41)	0	(63)	2	(41)	0	(41)	0	(41)	19	(37)		
1992	5	(59)	3	(59)	22	(58)	0	(60)	0	(59)	0	(59)	3	(59)	4	(52)	0	(14)
1993	2	(63)	8		8	(63)	0	(44)	5	(63)	0	(63)	5	(63)	12	(51)	4	(25)
1994	0	(61)	5	(61)	8	(61)	0	(71)	11	(61)	0	(61)	2	(61)	11	(47)	19	(27)
1995	2	(44)	18	(44)	2	(44)	0	(75)	0	(44)	0	(44)	0	(44)	12	(34)	5	(19)
1996	6	(71)	18	(71)	11	(66)	7	(112)	0	(71)			1	(70)	3	(76)	1	(73)
1997	0	(75)	15	(75)	16	(73)	1	(52)	0	(71)			0	(75)	0	(76)	11	(62)
1998	4	(112)	21	(11)	7	(111)	8	(72)	0	(104)			15	(112)	7	(113)	16	(112)
1999	6	(70)	14	(64)	4	(52)	0	(72)	0	(74)	6	(72)	12	(77)	5	(77)	10	(77)
2000	0	(116)	10	(11)	4	(70)	0				0	(116)			6	(115)	10	(116)
2001															2	(50)		
2002															1	(92)		

[a]IBR = Infectious Bovine Rhinotracheitis
[b]BVD = Bovine Viral Diarrhea
[c]PI3 = Parainfluenza type 3
[d]RSV = Respiratory Synctial Virus
[e]EHD = Epizootic Hemorrhagic Disease
[h]Brucellosis = *Brucella suis* type 4
[i]Haptoglobin level
[f]BT = Bluetongue
[g]Leptospirosis = *Leptospira* spp.