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Investigation of Regulating and Limiting Factors in the Delta Caribou Herd

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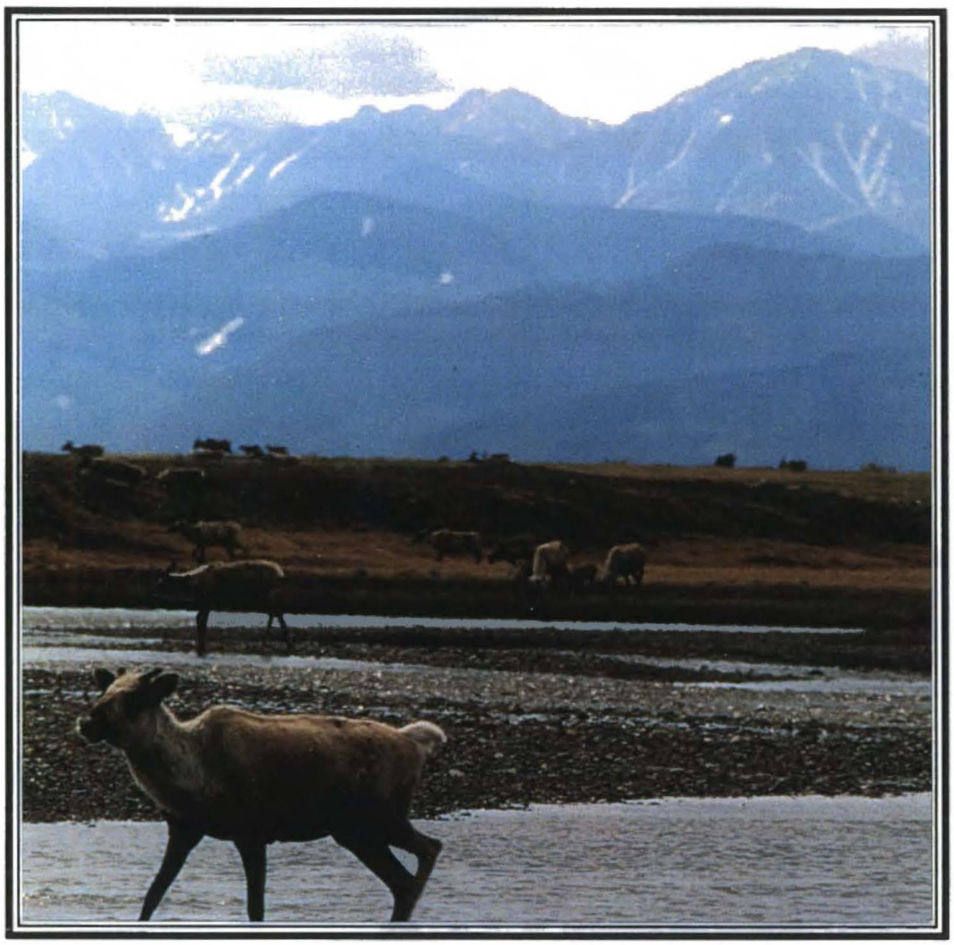

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RESEARCH PERFORMANCE REPORT

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TITLE: Investigation of Regulating and Limiting Factors in the Delta Caribou Herd

AUTHORS: Patrick Valkenburg, Bruce W Dale, Robert W Tobey, and Richard A Sellers

PERIOD: 1 July 1998–30 June 1999

SUMMARY

Since 1992 the study of limiting and regulating factors in Alaskan caribou (*Rangifer tarandus*) has been extended to herds other than the Delta caribou herd (DCH) because of pressing research and management questions. Area management biologists in Regions II and III are actively involved in the study, and the scope of work is now statewide. Besides the Delta Herd, the Nelchina, Northern Peninsula, Southern Peninsula, Kenai Mountains, Killey River, White Mountains, Ray Mountains, and Nushagak herds have yielded particularly valuable information in the study of limiting and regulating factors and in the determination of optimum herd sizes. In addition, parallel studies conducted by other researchers in the Denali and Mentasta herds have become invaluable.

From July 1998 through June 1999, in addition to routine collection of population data (i.e., fall composition counts and annual census), we weighed and measured samples of 4-month-old and 10-month-old female caribou calves in the Delta and Nelchina herds, and 4-month old calves in the Northern and Southern Alaska Peninsula herds. We also weighed newborn calves in the Delta, Nelchina, Southern Alaska Peninsula (SAP) and Northern Alaska Peninsula (NAP) caribou herds. Similar data were also collected in the Denali, Mentasta, and Fortymile herds in related studies by other biologists. We also report final results of the 1998 calf mortality study in the Northern Alaska Peninsula Herd and preliminary results of a similar study in the Southern Alaska Peninsula Herd in 1999. This year (1999) was the second year in which diversionary feeding was suspended in the Delta Herd and fall calf:cow ratios were compared for the years before, during, and after diversionary feeding.

The Delta Herd remained stable at just over 3500 from 1997–1999. In 1998, 3829 caribou were found during the census, and 3625 were counted in 1999. From 1996–1998 fall calf:cow ratios declined a few points, and though it may not be statistically significant, if real, biologically it may mean the difference between a stable herd with a sustainable harvest and a slightly declining herd in which harvest may eventually have to be reduced.

Condition (i.e., weight) of 4-month-old female caribou calves in the Delta Herd was similar to 1997 ($P>0.1$, $t<1.0$) and, as expected, natality rates of all age classes of females in 1999 were similar to those in 1998. In the Nelchina Herd, however, 4-month-old calves were significantly lighter in 1998 than in 1997 ($P = 0.01$, $t = 2.71$, $v = 32$), and subsequent natality rate of 3-year-old females was low (25%). In the Mentasta Herd, 4-month-old calves were unexpectedly light given the density of caribou on the Mentasta summer range. These data are indicative of relatively poor summer nutrition for caribou south of the Alaska Range in 1998.

In contrast, during winter 1998–1999 Nelchina caribou fared relatively well. Female calves apparently gained weight over winter ($P = 0.08$, $t = 1.8$, $v = 38$). In addition, newborn calves were relatively heavy in May 1999, further confirming that winter nutrition for Nelchina caribou was good. The herd continued to use winter range adjacent to and continuous with the winter range of the Fortymile Herd, primarily in the Ladue River drainage of Unit 20E and northern Unit 12.

In contrast to calf mortality studies conducted previously in Interior caribou herds, wolves (*Canis lupus*) and golden eagles (*Aquila chrysaetos*) were not important predators of caribou calves on the calving area of the NAP. Grizzly bears (*Ursus arctos*) were the primary predators, but given the relatively high density of grizzlies on the peninsula, it is apparent that many or most bears do not prey heavily on caribou calves. Many calves died in late June, probably from pneumonia associated with lungworm infestation. Golden eagles were rarely seen on the calving area, and though bald eagles (*Haliaeetus leucocephalus*) were abundant and occasionally killed calves, most were apparently scavenging along the beach or to a lesser extent on the calving area. The NAP has been declining since 1992 with chronically poor calf survival over summer and winter, high adult mortality, reduced natality among 3-year-old cows, and a high prevalence of lungworm in calves since at least 1994.

In the SAP, wolves and grizzly bears were the most important predators of newborn caribou calves in 1999. We found a wolf den with at least 3 adults and 2 pups along the Caribou River on the northern portion of the calving area. Golden eagles were even rarer on the SAP calving area than on the NAP calving area (only 1 golden eagle was seen in 3 weeks).

In 1999, Bruce Dale was hired to lead a detailed study of food resources and population regulation in the Nelchina Herd. Progress on and results of cooperative work on the Nelchina Herd will mostly be reported under this new project.

Key words: body condition, calf mortality, caribou, Delta Herd, diversionary feeding, natality, Nelchina Herd, Northern Alaska Peninsula Herd.

CONTENTS

BACKGROUND

A continuing long-term population dynamics study of the Delta caribou herd (DCH) began in 1979. Results of the first 17 years of research were presented in 8 progress reports, 3 final reports (each covering 5 years) (Davis and Valkenburg 1985; Davis et al. 1991; Valkenburg 1997), and numerous scientific papers (Davis et al. 1991; Boertje et al. 1996; Valkenburg et al. 1996). Predator/prey relationships and human harvest of moose (*Alces alces*), caribou, sheep (*Ovis dalli*), grizzly bears, and wolves within the range of the DCH were reviewed by Gasaway et al. (1983) and Boertje et al. (1996).

Since 1979 the DCH has gone through 4 growth phases. Herd size rapidly grew from 1979–1982 ($r = 0.18$), with high recruitment and low mortality from hunting and natural causes. The herd grew slowly ($r = 0.05$) from 1982–1985, with moderate to high recruitment, low to moderate natural mortality, and high hunting mortality. The herd also grew slowly ($r = 0.07$) from 1986–1988, with moderate recruitment, moderate to high natural mortality, and low hunting mortality. Then the herd rapidly declined (r = -0.20) from 1989–1992, with low recruitment, high natural mortality, and low hunting mortality.

In June 1993 the Board of Game approved a 3-year ground-based wolf predation control program for a portion of Unit 20A. One of the objectives of the program, which began in October 1993, was "to reverse the decline of the DCH and increase the midsummer population to 6000–8000 caribou, with a sustainable annual harvest of 300–500 caribou." To better evaluate the effectiveness of intensive management (i.e., control of wolf numbers) of the DCH, we extended the project with state funds to include annual calf mortality studies. Results of these studies will be reported in this and future Pittman-Robertson documents.

Population decline in the DCH was reversed in 1994, coincident with the wolf control program, and the herd increased to over 4000. However, after 1995 the herd once again stabilized and the research project in the DCH focused on monitoring population parameters in the caribou herd as moose and wolf numbers approach very high levels. In recent years, the study of limiting and regulating factors in caribou has been extended to other herds for which biologists have pressing research and management questions, and the scope of the study has become statewide. This new approach has only been possible because of the active interest taken by cooperating area biologists in establishing a coordinated research and management program. Besides the DCH, the Nelchina, Northern Peninsula, Southern Peninsula, Mulchatna, Kenai Mountains, Killey River, White Mountains, Ray Mountains, and Nushagak herds have yielded valuable information in the study of limiting and regulating factors and determination of optimum herd sizes.

STUDY OBJECTIVES

- Evaluate the influence of weather, density, food limitation, hunting, and predation on the population dynamics of the DCH and other caribou herds.

JOB OBJECTIVES

- Census the DCH annually.
- Determine annual natality rate and timing of calving in the DCH.
- Determine recruitment from annual fall and spring composition counts.
- Monitor harvest annually.
- Determine weight and size of calves in April to determine influence of summer versus winter weather on body condition, and test a model that predicts recruitment (i.e., fall calf:cow ratio) from April calf weights in the Delta and Nelchina herds.
- Radiocollar female calves in fall to maintain known-aged cohorts in the DCH.
- Determine if weather is a factor that limits growth of the DCH.

- Assess and analyze food habits of the DCH and other caribou herds.
- Monitor movements, dispersal, and mortality in the DCH.
- Recollar adult females to maintain cohorts of collared, known-age females.
- Monitor density, natality, mortality, body weight, and condition in Alaska caribou herds, and weather in herd ranges, opportunistically as time and funding allow.
- Improve and develop techniques for monitoring body condition in caribou.

METHODS

DELTA HERD

We conducted a fall composition count on the DCH on 1 October 1998, using an R-22 helicopter for caribou classification and a Bellanca Scout for radiotracking. The sample was distributed in proportion to the distribution of radiocollared caribou. On 3, 16, and 21 October, we used 2 R-22s to capture, weigh, measure, and radiocollar a sample of 16 female caribou calves. After rutting activities were over, on 21 October we changed collars on 8 adults whose collars were 5 years old or older. During winter, 1998–1999, we monitored distribution and mortality of radiocollared caribou by tracking them on 5 November, 1 and 2 December, 18 February, 2 March, 29–30 March, and 18–19 April. The 4 snow stations were read on 16 December, 18 February, 2 March, and 31 March. On 18–19 April 1999 we immobilized, weighed, and measured 13 female calves to evaluate their size and condition at the end of winter. From 17–25 May, we observed all collared caribou in the DCH 1–3 times to determine if they were pregnant, and on 18–22 May we captured and weighed 26 male and 35 female newborn caribou calves. Using a DeHavilland Beaver and 3 Bellanca Scouts, on 2 June we conducted the DCH census. We photographed all groups of caribou larger than 100 from the Beaver at 800–1000 ft above ground, and from the Scouts the crew visually searched the summer range and radiotracked collared caribou.

NELCHINA HERD

In addition to the standard fall composition survey and annual census that will be reported in the biennial management report, we weighed samples of calves as newborns, at 4 months of age, and again at 10 months to determine trends in body condition in relation to weather and changing herd size. On 27–28 September 1998 we collected 10 female calves and radiocollared 14 on the Little Nelchina River. We evaluated condition, weight, and fat indices and donated the carcasses to people in Glennallen. On 26–28 April 1999, we collared, weighed, and measured 15 10-month-old female calves, 1 yearling female, and 4 adult females along the migratory distribution of the Nelchina Herd from Lake Louise to Northway. In late May, we located radiocollared cows to determine if they were pregnant, and we weighed 53 newborn calves (26 males and 27 females) on 25 May. We did not conduct a photocensus of the Nelchina Herd as planned because caribou did not aggregate suitably while the Beaver was available. The 1999 census was a visual count.

NAP, SAP, MULCHATNA, AND NUSHAGAK HERDS

Due to the availability of outside funding (primarily from US Fish and Wildlife Service), we were able to continue to extend work on caribou herds in southwestern Alaska. For the first time, we conducted a coordinated round of fall composition counts with a helicopter (R-44) in Southwest Alaska. We also took advantage of the helicopter to place more radio collars on NAP and SAP caribou and to collect caribou calves to evaluate herd condition and the prevalence of lungworm in the NAP, SAP, Mulchatna, and Nushagak herds. During 1–11 October 1998, we conducted composition counts and collected 10 female calves about 5 miles south of King Salmon where about one-third of the NAP was located. We also deployed conventional collars on 4-month-old calves, and satellite collars on adult cows, in the range of the NAP and SAP herds. We deployed the satellite collars on large adult females only near Port Moller and Herendeen Bay, but conventional collars were distributed across the north-south distribution of both herds. We also collected 10 female calves and conducted composition counts about 15 km west of the village of Kollignek in the range of the Mulchatna Herd on 2 October. On 12 October, we flew to Dillingham and then to the range of the Nushagak Herd where we collected 5 female calves to assess condition and the prevalence of lungworm in that herd.

In June 1999, in cooperation with the US Fish and Wildlife Service (FWS, Alaska Peninsula and Izembek National Wildlife Refuges), we conducted a calf mortality study in the SAP Herd to determine the magnitude, timing, and causes of calf mortality in the herd. This project also enabled us to obtain a sample of newborn calf weights from both the NAP and the SAP to further study comparative nutrition in these herds. FWS provided about $40,000 for helicopter time, 45 new and refurbished collars, and a field crew member (R Squibb) for the study. ADF&G provided a field crew of 3 (Sellers, Dale, and Valkenburg), a Bellanca Scout for radiotracking, and field supplies. We used a crew of 3 in an R-44 helicopter to capture newborn calves in both the NAP and the SAP. The crew consisted of the pilot, recorder (sitting in a rear seat), and a catcher in the left front seat. The pilot hovered the helicopter behind a cow/calf pair while the catcher climbed out on the skid and closed the door. The pilot then maneuvered so that the catcher could step off between the cow and calf, and the calf would usually run up to the catcher where it was easily caught. Sometimes, however, the catcher engaged in short sprints to capture calves. About one cow in 20 was sufficiently aggressive that calves could not be caught. Calves were only handled if they were judged to be less than 2 days old (if they appeared to be able only to barely run or run slowly). Once caught, SAP calves were sexed, weighed, radiocollared, and released in the direction of their mother. Cows usually reunited with their calves within a few minutes, but about 10 had to be checked later with the fixed-wing aircraft, and 4 of 52 were abandoned by their mothers. Detailed results of the SAP calf mortality study were presented in a separate report (Sellers et al. 1999). Calves in the NAP were caught only to sample weight of newborns as an indicator of condition; they were not collared. We had planned to obtain a sample of newborn calf weights from the Unimak Herd, but when we flew to the island on 4 June, most calves were already too old to catch. It seems that the peak of calving on Unimak is earlier than in either the NAP or the SAP.

RESULTS AND DISCUSSION

POPULATION SIZE, TREND, AND COMPOSITION IN THE DCH

The DCH has been stable since 1996 (Table 1). It appears the herd initially responded after wolf control, then declined slightly, and has now stabilized. The primary reason the herd has not increased has been low recruitment to fall (i.e., low calf:cow ratio, Table 1). Although probably not statistically significant, the trend in recruitment has been down slightly since 1996. If this trend continues, population size will decrease.

Data on bull:cow ratios are variable from year to year, depending on timing of fall counts and behavior of bulls; both of which are affected by weather and timing of rutting activities. However, the bull:cow ratio seems stable, and the herd can apparently sustain the bulls-only permit hunt.

NATALITY RATE IN THE DCH

Natality in the DCH was relatively low in 1997 and relatively high in 1998 and 1999 (Table 2). Only 50% of the 3-year-olds produced calves in 1997, compared to 90% in 1998 and 86% in 1999. We had predicted increased natality in 1998 compared to that in 1997 based on possibly larger calves in late September 1997 (Table 2). We also predicted moderately high natality in 1999 based on calf weights in October 1998.

NATALITY RATE IN THE NELCHINA, NAP AND SAP HERDS

Natality in the Nelchina Herd was low in May 1999. Only 17 of 34 (50%) radiocollared females >2 years old produced calves, and only 3 of 12 (25%) 3-year-old females produced calves. Of the radiocollared 4-year-olds, 6 of 9 (67%) were parturient, and of the 5-year-olds, 2 of 6 (33%) were parturient. There were also 7 radiocollared females older than 5 or of unknown age, and 6 of them were parturient. In most previous years, a majority of the 3-year-olds and about 90% of all older females have produced calves (ADF&G files). These data further confirm that Nelchina caribou experienced poor nutrition in summer 1998.

On the Alaska Peninsula, 3 of 6 radiocollared 3-year-old NAP females were pregnant, and 10 of 13 (77%) females older than 2 years produced calves. In the SAP Herd, 11 of 12 3-year-olds and 4 of 5 4-year-olds were parturient.

WEIGHT AND SIZE OF CALVES FROM INTERIOR HERDS

Weight and size of newborn calves remained similar in the DCH over the 5 years for which data are available (Table 3). Weight and condition of 4-month-old and 10-month-old Delta calves have not returned to the levels found in the early 1980s when herd size was low, and calves have commonly lost weight over winter since 4-month-old calves were first weighed in 1991 (Table 4). This continued to be true in the winter of 1998–1999 when mean weight of female calves declined significantly ($P = 0.05$, $t = 2.1$, $v = 27$), despite a relatively mild winter with little snow accumulation.

Newborn calves in the Nelchina Herd have been similar in size or larger than calves of other Interior herds, except Denali (Table 3). In 1999, mean weight of newborn male calves in the

Nelchina Herd was relatively high compared to newborn male weights in previous years, although differences were not significant ($P>0.1$). Nelchina calves have been consistently smaller than calves from other herds at the end of summer. Summer nutrition therefore appears to be chronically suboptimal in the Nelchina Herd, and in years when summer weather is also poor, Nelchina calves are considerably underweight compared to calves in other herds (Tables 4–6).

In contrast to the marginal summer nutrition of Nelchina caribou, winter food reserves and availability appear to be good. Nelchina calves have consistently maintained weight over winter, and in some years (e.g., 1998–1999) they have significantly increased in weight ($P = 0.08$, $t = 1.80$, $v = 38$) (Table 5). In addition, winter conditions appear to be less variable north of the Alaska Range in the newer winter ranges used by the Nelchina Herd since the early 1990s.

In fall 1998, we weighed and collared calves in the Nelchina Herd and recaptured the same individuals at the end of winter. Although the object of this effort was to more precisely measure weight loss or gain in calves over winter, we discovered that collared calves lost weight, whereas randomly captured calves had higher body weights than those caught in fall. It is possible that radio collars may be affecting nutrition over winter. We will try to confirm these findings during the next year. If this appears to be the case, we may either switch to lighter weight collars or delay collaring until calves are older.

WEIGHT AND SIZE OF CALVES FROM SOUTHWESTERN ALASKA HERDS

During 1998–1999 we had the opportunity to obtain some weights and measurements from 4 of the 5 caribou herds in southwestern Alaska (Table 4). Only caribou on Unimak Island were not sampled. Of the 4 herds sampled, Nushagak caribou (originally from NAP stock) continue to be in the best condition (i.e., highest body weight). In fall 1998, calves from this herd were significantly heavier than calves from the adjacent NAP and Mulchatna herds ($P<0.05$). SAP calves were also relatively heavy, but not significantly heavier or lighter than calves from the other 3 herds ($P>0.1$). There was no significant difference in size of newborn female calves from the SAP and the NAP in June 1999, although male calves were marginally heavier in the NAP ($P>0.1$) (Table 3) (Sellers et al. 1999).

WEATHER

Summer 1998 was relatively unfavorable for caribou, especially in the range of the Nelchina Herd where leaf-out was about 2 weeks late. Conditions on the Alaska Peninsula were about normal in late winter and spring in 1998. In 1999, however, leaf-out was at least 2 weeks late throughout southern Alaska, and severe winter conditions persisted well into May. This was especially true on the Kenai Peninsula, Kodiak Island, and on the Alaska Peninsula. There was a large die-off of deer (*Odocoileus hemionis*) on Kodiak Island, and the peak of calving for NAP and SAP caribou was a few days late. We will continue to explore the possible effects of these 2 late springs in the Interior and 1 late spring in Southwest Alaska on caribou during the next reporting period. Data from 4 snow markers in the range of the DCH are accumulating and will allow comparisons with Fairbanks data in the future.

MORTALITY OF FEMALE RADIOCOLLARED CARIBOU OLDER THAN 4 MONTHS IN THE DCH

Mortality of female calves (4–16 months of age) and female yearlings (16–28 months of age) was probably lower in 1997–1998 than in 1996–1997, and mortality of older females was unchanged from previous years (Table 7). However, due to the relatively small sample sizes, these mortality calculations have wide confidence intervals. Mortality calculations were incorporated into a population model.

CALF MORTALITY STUDY IN THE SAP

Mortality of newborn calves in the SAP was initially low (11 of 49 or 22% died). Between 18 June and 26 June, 11 more calves died. A similar pattern of mortality occurred in the NAP in 1998 (Sellers et al. 1998). However, in contrast to the NAP, wolf predation was a major cause of mortality of collared newborn calves in the SAP, and we found an active wolf den with at least 3 adults in the central portion of the calving area. As in the NAP, grizzly bears were the most important cause of mortality. Golden eagles, important calf predators in Interior and Arctic caribou herds, killed few calves on the Alaska Peninsula where these eagles are rare. Data and results of this study are still being collected and analyzed; findings will be reported elsewhere (Sellers et al. 1999) and cited in future reports on the DCH and other caribou studies.

DIVERSIONARY FEEDING IN THE DCH

Effects of Diversionary Feeding on Fall Calf:Cow Ratios

Diversionary feeding was not conducted on the Delta calving area in 1998 or 1999. These 2 summers will serve as controls for comparison with 1996 and 1997 data in years diversionary feeding occurred. The influence of diversionary feeding on pack hunting behavior and calf survival will be fully reported in the final report.

GPS Collar

A GPS collar (Telonics, Inc., Mesa, Arizona, USA) was placed on the pack's alpha male on 14 May 1998. The collar provided hourly locations until 25 June. Unfortunately, the GPS unit separated from the collar during the summer, and all of the data were lost. The original purchase price of the GPS collar was $4000, and we did not have the funds to buy a new collar for the 1999 calving season.

MOVEMENTS, DISTRIBUTION, AND HARVEST IN THE DCH

In 1998, DCH caribou spent the summer on their normal summer ranges on the Gold King Benches, Iowa Ridge, upper Buchanan Creek and upper Tatlanika/Moose Creek. Most of the herd moved to the upper Wood River and Dick Creek where the rut occurred. The main wintering areas were in the lower Yanert, and Alaska Range foothills from the Little Delta to Donnelly Dome, and near Jumbo Dome on the Totatlanika River. Four collared caribou wintered near Donnelly Dome. Calving occurred south of the Alaska Range as far south as the Denali Highway and east to the Monahan Flats. Two radiocollared caribou calved south of the Denali Highway.

A limited permit-drawing hunt was reopened in the DCH in 1996 and 22 bulls were taken. In 1997, 44 bulls were taken and in 1998, 49 bulls and 1 cow were taken.

ANALYSIS OF WINTER FECAL PELLETS

We continued to collect winter fecal pellets from selected herds including the DCH. In 1998–1999 we collected samples of pellets from all of the winter ranges of the DCH, but these will not be analyzed for a year.

MANAGEMENT IMPLICATIONS AND RESEARCH DIRECTION

The main thrust of this research project is to determine which factors are most important in driving caribou population fluctuations. The current working hypothesis is that fluctuations are primarily caused by the interaction of population density (i.e., food shortage), weather, and predation. Data collected over the last few years are consistent with this hypothesis and indicate both winter and summer food shortages. Winter food limitation seems to be most important in the Delta Herd, but summer nutrition seems most limiting in the Nelchina Herd. Variation in summer nutrition due to weather also appears to occur regardless of population size and density. When poor summer weather occurs where herds are also experiencing suboptimal nutrition due to high population size, natality can be greatly reduced (e.g., Delta Herd in 1993 and Nelchina Herd in 1999). At present, managers are maintaining the size of the Nelchina Herd at about 35,000 (summer census) to try to reduce the influence of poor nutrition and reduce fluctuations in population size. We will continue to monitor the Nelchina Herd to determine if this management regime is successful. We will also continue to monitor the Delta Herd that is now stable due to heavy predation. The NAP, SAP, and other Southwest Alaska herds will be monitored opportunistically.

We recently extended work on the NAP during a period of rapid population decline. The population decline seems to have been caused primarily by overpopulation that resulted in reduced body size, condition, and natality, and increased mortality in the herd. There has also been a high prevalence of lungworm that seems to have caused increased mortality in calves. We will continue to monitor this herd and periodically collect calves to determine how lungworm infection varies now that the population is reduced.

During the last 5 years, we have been collecting caribou to try to improve techniques for monitoring body condition. Data indicate that, in most cases, live body weight provides an adequate measure of condition and is well correlated with femur marrow fat and the amount of fat in other depots. We have therefore decided to suspend the collecting program, except in Southwest Alaska where we will continue to periodically monitor caribou for lungworm.

We have recently been cooperating with federal agencies, Yukon Department of Renewable Resources, and the University of Alberta to determine genetic variation and genetic distance among caribou herds. Initial testing indicates that Chisana caribou are quite distinct from Nelchina, Fortymile, Mentasta, and Macomb caribou, and supports the popularly held view that these caribou are more closely related to "mountain" or "woodland" caribou (*Rangifer tarandus caribou*) than to Alaskan barren-ground caribou (*Rangifer tarandus granti*). We recently obtained more money to extend this work to Southwest Alaska. This work complements the work on limiting and regulating factors because body size differences could also result from genetics. If Alaskan caribou are genetically very similar, between-herd comparisons of body weight and size will be more meaningful.

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Table 1 Fall composition counts and size of DCH caribou, 1969–1998

Approximate survey date	Bulls:100 Cows	Calves:100 Cows	Calves %	Cows %	Small bulls % of bulls	Medium bulls % of bulls	Large bulls % of bulls	Total bulls %	Composition sample size	Estimate of herd size
13–15 Oct 1969	40	28	15	53	--	--	--	21	777	
21–23 Oct 1970	77	34	14	43	--	--	--	33	896	
29–31 Oct 1971	29	15	10	65	--	--	--	19	1139	
27–31 Oct 1972	33	11	7	67	--	--	--	22	1185	
23–24 Oct 1973	29	10	7	70	--	--	--	20	1050	2804
23–25 Oct 1974	28	2	1	76	--	--	--	21	1141	
29–31 Oct 1976	38	45	24	54	--	--	--	21	1055	
26–31 Oct 1977	33	42	23	55	--	--	--	18	1365	
26 Oct 1978	75	39	17	45	--	--	--	33	725	
7 Dec 1979	39	65	32	49	--	--	--	19	361	4191
25 Oct 1980	85	49	21	43	--	--	--	36	1369	4478
2 Oct 1981	46	41	22	53	47	3	50	25	1451	4962
8 Oct 1982	42	31	18	58	48	4	48	24	1565	7335
4 Oct 1983	35	46	25	55	59	6	36	20	1208	6969
17 Oct 1984	42	36	20	56	28	32	40	24	1093	6260
9–12 Oct 1985	49	36	20	54	57	24	19	26	1164	8083
22 Oct 1986	41	29	17	59	49	30	21	24	1934	7804
5 Oct 1987	32	31	19	61	53	23	24	20	1682	8300
14 Oct 1988	33	35	21	60	50	38	12	20	3003	8300
10 Oct 1989	27	36	22	62	64	28	7	16	1965	10690
4 Oct 1990	38	17	11	65	45	39	16	24	2411	7886
1 Oct 1991	29	8	6	73	55	29	16	21	1705	5755
28 Sep 1992	25	11	8	74	46	43	11	19	1240	5877
25 Sep 1993	36	5	3	72	45	33	22	25	1525	3661
3–4 Oct 1994	25	23	16	68	33	29	39	17	2131	4341
3 Oct 1995	24	20	14	69	41	19	40	17	1567	4646
3 Oct 1996	30	21	14	66	51	20	29	20	1532	4019
27 Sep 1997	27	18	13	69	48	20	32	18	1598	3699
1 Oct 1998	44	16	10	62	31	49	20	27	1519	3829

Table 2 Natality rates of radiocollared known-aged DCH[a] females observed in late May 1980–1999

	Proportion parturient (%) in late May						
Year	Yearlings	2-year-olds	3-year-olds	4-year-olds	5-year-olds	6+ year-olds	All cows 3 years and older
1980		7/11 (64)					
1981	0/7 (0)	1/1 (100)	10/13 (77)				10/13 (77)
1982	0/10 (0)	0/7 (0)	2/2 (100)	5/8 (63)			7/10 (70)
1983	0/12 (0)	1/8 (13)	7/7 (100)		6/8 (75)		13/15 (87)
1984	0/12 (0)	0/11 (0)	8/9 (89)	6/6 (100)	1/1 (100)	6/7 (86)	21/23 (91)
1985		1/9 (11)	9/10 (90)	6/7 (86)	6/6 (100)	7/8 (88)	28/31 (90)
1986			8/9 (89)	9/9 (100)	3/4 (75)	8/9 (89)	28/31 (90)
1987	0/6 (0)	0/2 (0)		8/8 (100)	8/9 (89)	9/11 (82)	25/28 (89)
1988	0/11 (0)	0/5 (0)	1/1 (100)		8/8 (100)	15/16 (94)	24/25 (96)
1989	0/10 (0)	0/11 (0)	3/5 (60)	2/2 (100)		21/23 (91)	26/30 (87)
1990		0/4 (0)	6/10 (60)	5/6 (83)	0/1 (0)	17/17 (100)	28/34 (82)
1991	0/4 (0)		2/7 (29)	8/10 (80)	3/3 (100)	11/14 (79)	24/34 (71)
1992	0/16 (0)	0/5 (0)	0/1 (0)	6/7 (86)	8/8 (100)	12/12 (100)	26/28 (93)
1993	0/11 (0)	0/10 (0)	0/5 (0)	0/1 (0)	1/3 (33)	6/15 (40)	7/24 (29)
1994	0/10 (0)	0/12 (0)	2/9 (22)	4/5 (80)	1/1 (100)	13/15 (87)	20/30 (67)
1995	0/13 (0)	0/7 (0)	7/11 (64)	8/8 (100)	4/5 (80)	13/13 (100)	32/37 (86)
1996	0/16 (0)	1/11 (9)	5/5 (100)	9/10 (90)	6/6 (100)	15/16 (94)	35/37 (95)
1997	0/12 (0)	0/11 (0)	5/10 (50)	3/4 (75)	8/9 (89)	16/17 (94)	32/40 (80)
1998	0/17 (0)	1/8 (13)	9/10 (90)	7/7 (100)	3/3 (100)	18/22 (80)	37/42 (88)
1999	0/10 (0)	1/13 (8)	6/7 (86)	5/7 (71)	7/7 (100)	16/17 (94)	34/38 (89)

[a] Figures may differ slightly from previous reports because only DCH female were considered here (no Yanert females or those whose age was not known were used in this analysis).

Table 3 Weights of newborn caribou calves from selected Alaskan herds

Herd and year	Males			Females		
	Weight (kg)	$s_{\bar{x}}$ [a]	*N*	Weight (kg)	$s_{\bar{x}}$	*N*
Delta 1995	8.72	0.29	26	8.31	0.24	19
Delta 1996	8.39	0.23	22	7.40	0.19	28
Delta 1997	8.33	0.21	40	7.99	0.20	35
Delta 1998	8.41	0.22	15	7.70	0.29	15
Delta 1999	8.86	0.32	26	7.89	0.19	35
Denali 1986–1987[b]	9.00	0.11	67	7.80	0.11	60
Denali 1998[c]	9.4	0.30	15	8.4	0.32	14
Fortymile 1994	7.71	0.20	22	7.55	0.27	22
Fortymile 1995	8.65	0.16	24	7.94	0.19	25
Fortymile 1996	8.54	0.24	26	8.09	0.17	32
Fortymile 1997	8.52	0.25	24	7.97	0.21	32
Fortymile 1998	8.43	0.14	30	8.00	0.15	39
Fortymile 1999	8.54	0.18	35	7.71	0.17	40
Mentasta 1993[d]	8.90	0.23	15	7.91	0.20	23
Mentasta 1994[d]	8.83	0.21	18	8.09	0.19	23
Mentasta 1998[c]	8.66	0.27	15	7.98	0.32	12
Nelchina 1996	8.26	0.24	23	7.19	0.19	17
Nelchina 1997	8.43	0.18	30	7.91	0.21	30
Nelchina 1998	8.97	0.20	30	8.57	0.18	30
Nelchina 1999	9.17	0.23	26	8.14	0.21	27
NAP 1998	8.44	0.24	19	7.17	0.30	20
NAP 1999	8.35	0.25	22	7.41	0.24	22
SAP 1989	6.7	0.67	9	5.4	0.57	9
SAP 1999	7.70	0.28	25	7.14	0.16	29
Porcupine 1983[e]	7.40	0.19	24	6.60	0.16	28
Porcupine 1984[e]	7.30	0.22	33	6.70	0.18	23
Porcupine 1985[e]	7.70	0.23	27	7.30	0.20	26
Porcupine 1993[f]	--	--	--	6.2	0.7	68

[a] With standard errors of about 0.2 kg, a difference in means of 0.6 kg would be significant at the 0.05 level.
[b] Denali data is corrected for calf age; uncorrected weights would be 0.3–0.5 kg higher (Adams et al. 1995).
[c] Unpublished data from L Adams.
[d] Unpublished data from Jenkins (1996).
[e] Data from Whitten et al. (1992).
[f] Data from Whitten (1995).

Table 4 Mean weight of samples of 4- and 10-month-old female calves from the DCH, 1979–1999

	10-month-olds				4-month-olds			
Year	$\bar{x}$ (lb)	$\bar{x}$ (kg)	$s_{\bar{x}}$ (lb)	N	$\bar{x}$ (lb)	$\bar{x}$ (kg)	$s_{\bar{x}}$ (lb)	N
1979	132.3	60.1	2.4	11				
1981	137.0	62.1	7.4	5				
1982	135.1	61.3	3.9	11				
1983	137.2	62.2	3.3	13				
1984	126.9	57.5	1.3	14				
1987	120.8	54.8	2.8	9				
1988	131.3	59.6	2.9	12				
1989	133.6	60.6	2.7	9				
1990	119.9	54.4	3.3	9				
1991	113.1	51.3	2.3	9	127.6	57.9	2.6	14
1992	119.1	54.0	2.6	17	119.1	54.0	2.6	17
1993	122.3	55.5	2.9	12	122.9	55.8	3.0	11
1994[a]					131.4	59.6	3.0	15
1995	123.1	55.8	2.7	15	131.1	59.5	2.7	15
1996	120.8	54.8	3.3	15	123.0	55.8	3.0	14
1997	118.3	53.7	2.5	14	128.3	58.2	2.2	20
1998	123.7	56.1	3.0	12	124.4	56.4	2.6	16
1999	116.7	52.9	2.6	13				

[a] There were too few calves to obtain a sample of 10-month-olds in April 1994.

Table 5 Weights of 4-month-old and 10-month-old female calves from the Nelchina Herd

	10-month-olds				4-month-olds			
Year	$\bar{x}$ (lb)	$\bar{x}$ (kg)	$s_{\bar{x}}$ (lb)	N	$\bar{x}$ (lb)	$\bar{x}$ (kg)	$s_{\bar{x}}$ (lb)	N
1992	124.4	56.4	1.2	9				
1993	125.7	57.0	1.8	7				
1994	107.8	48.9	1.9	11				
1995	105.0	47.6	0.8	29	118.0	53.5	1.5	15
1996	117.1	53.1	1.2	16	106.5	48.3	2.1	10
1997	108.7	49.1	1.0	23	122.3	55.5	1.8	10
1998	121.6	57.0	1.1	15	111.5	50.6	0.9	24
1999	117.3	53.2	1.2	16				

Table 6 Weights of 4-month-old and 10-month-old females calves from the NAP, SAP, Mulchatna, Nushugak, and Unimak herds

		10-month-olds				4-month-olds			
Herd	Year	$\bar{x}$ (lb)	$\bar{x}$ (kg)	$s\bar{x}$ (lb)	N	$\bar{x}$ (lb)	$\bar{x}$ (kg)	$s\bar{x}$ (lb)	N
NAP	1995	112.6	51.4	1.3	19	98.6	44.7	1.6	10
	1996					101.5	46.0	2.4	10
	1997	106.7	48.4	1.4	14	106.5	48.3	2.1	10
	1998					108.9	49.4	1.3	29
SAP	1997	107.8	48.9	1.0	13				
	1998					115.1	52.2	1.2	13
Mulchatna	1995	110.6	50.1	1.4	10				
	1998					106.5	48.3	2.6	10
Nushagak	1995	125.8	57.1	1.3	15				
	1997	112.2	50.9	1.9	10				
	1998					123.0	55.8	1.6	5
Unimak	1997	106.5	48.4	3.0	5				

Table 7 Annual total mortality[a] of radiocollared known-aged female DCH[b] caribou, 1979–1997

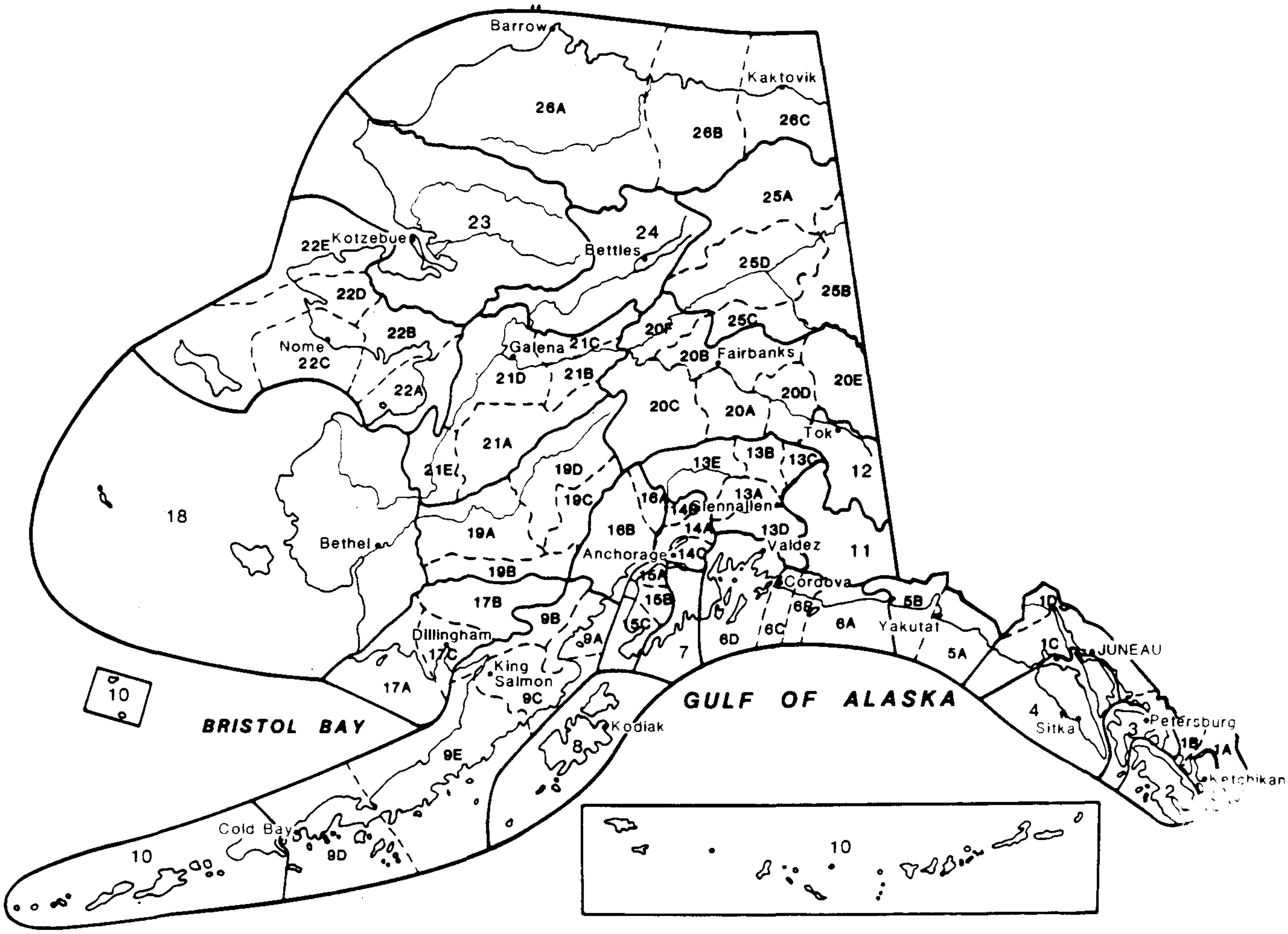
	Proportion dying (%) (cause of death) by age class			
Year	Calves (4–16-month-old	Yearlings (16–30-month-old)	Older than yearlings (>30-month-old)	Yearlings and older (>16-month-old)
1979–1980		0/11 (0)		0/11 (0)
1980–1981		0/2 (0)	0/11 (0)	0/13 (0)
1981–1982		0/7 (0)	0/11 (0)	0/18 (0)
1982–1983		2/10 (20) (2 unk)	0/18 (0)	2/28 (7)
1983–1984		0/12 (0)	2/24 (8) (1 unk, 1 hunting)	2/36 (6)
1984–1985		0/11 (0)	2/21 (10) (1 grizzly, 1 unk)	2/32 (6)
1985–1986			7/39 (18) (4 wolf, 1 hunting, 1 poached, 1 unk)	7/39 (18)
1986–1987			3/32 (9) (2 unk, 1 poached)	3/32 (9)
1987–1988		1/6 (17) (1 poached)	1/32 (3) (1 unk pred)	2/38 (5)
1988–1989		1/11 (9) (1 unk pred)	5/32 (16) (5 unk)	6/43 (14)
1989–1990		1/8 (13) (1 wolf)	5/41 (12) (4 unk, 1 wolf)	6/49 (12)
1990–1991			9/41 (22) (5 unk, 2 wolf, 2 unk pred)	9/41 (22)
1991–1992	5/12 (42) (2 wolf, 2 unk pred, 1 unk)	0/4 (0)	5/31 (16) (3 wolf, 1 unk pred, 1 unk)	5/35 (14)
1992–1993	8/15 (53) (3 lynx, 3 unk pred, 2 unk)	1/11 (9) (1 unk)	5/30 (17) (4 wolf, 1 coyote)	6/41 (15)
1993–1994	7/10 (70) (5 wolf, 1 unk., 1 poached)	0/7	4/32 (13) (3 unk, 1 wolf)	4/39 (10)
1994–1995	5/15 (33) (3 wolf, 2 unk pred)	2/7 (1 grizzly, 1 hunting)	5/41 (12) (3 wolf, 1 unk pred, 1 breached birth)	7/48 (15)
1995–1996	4/14 (29) (3 wolf, 1 unk)	1/11 (9) (1 wolf)	4/39 (10) (3 wolf, 1 unk pred)	5/50 (10)
1996–1997	6/13 (46) (2 wolf, 3 unk pred, 1 unk)	3/14 (21) (3 wolf)	3/42 (7) (2 wolf, 1 unk)	6/56 (11)
1997–1998	3/17 (18) (2 wolf, 1 unk)	1/19 (5) (1 wolf)	5/49 (10) (1 wolf, 1 avalanche, 1 poached, 2 unk)	6/68 (9)
Totals	38/96 (40)(17 wolf, 10 unk pred, 7 unk, 3 lynx,	13/151 (9)(3 unk, 6 wolf, 1 unk pred, 1 grizzly, 1	65/566 (11)(26 unk[c], 24 wolf, 6 unk pred, 2 hunting, 3 poached, 1 grizzly,	78/717 (11)

Table 7 Continued

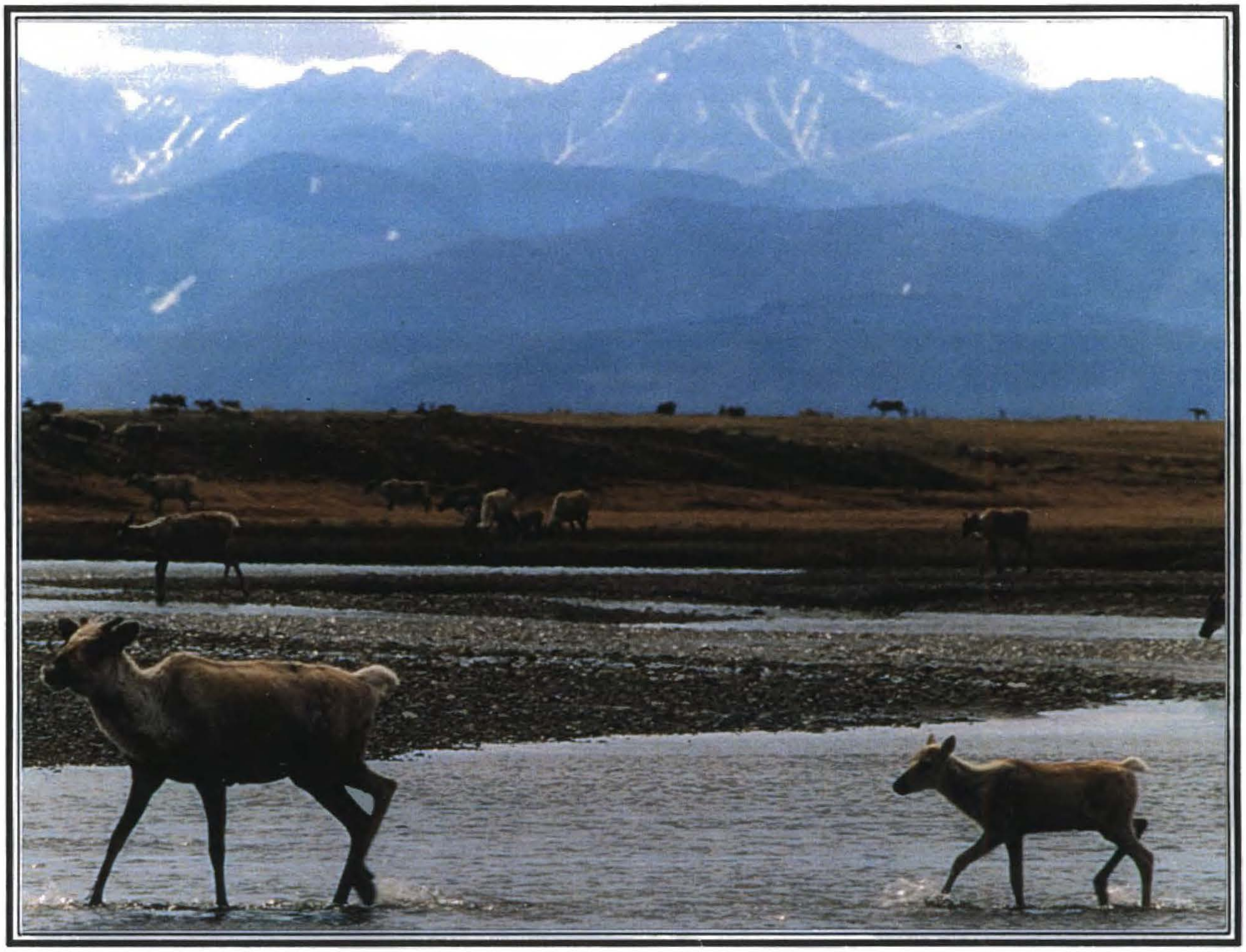
Year	Proportion dying (%) (cause of death) by age class			
	Calves (4–16-month-old	Yearlings (16–30-month-old)	Older than yearlings (>30-month-old)	Yearlings and older (>16-month-old)
Totals	38/96 (40)(17 wolf, 10 unk pred, 7 unk, 3 lynx, 1 poached)	13/151 (9)(3 unk, 6 wolf, 1 unk pred, 1 grizzly, 1 poached, 1 hunting)	65/566 (11)(26 unk[c], 24 wolf, 6 unk pred, 2 hunting, 3 poached, 1 grizzly, 1 coyote, 1 breached birth, 1 avalanche)	78/717 (11)

[a] Mortality rate was calculated from 1 Oct to 30 Sep each year.
[b] Mortality rates differ slightly from previous reports because only DCH caribou are considered here (no Yanert caribou are included).
[c] Most of these died in summer when it was difficult to determine cause of death. Wolves and grizzly bears are the most likely cause of death.

Alaska's Game Management Units



The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sales of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program allots funds back to states through a formula based on each state's geographic area and number of paid hunting license holders. Alaska receives a maximum 5% of revenues collected each year. The Alaska Department of Fish and Game uses federal aid funds to help restore, conserve, and manage wild birds and mammals to benefit the public. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes for responsible hunting. Seventy-five percent of the funds for this report are from Federal Aid.



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