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Investigation of Regulating and Limiting Factors in the Delta Caribou Herd

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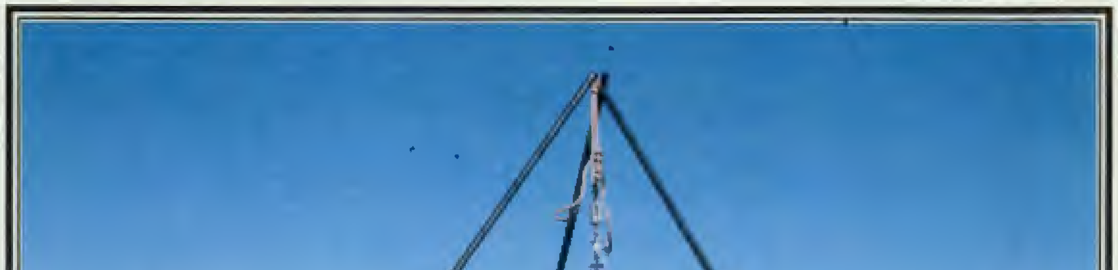

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RESEARCH PERFORMANCE REPORT

STATE: Alaska **STUDY:** 3.42

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

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SUMMARY

Since 1992 Alaska Department of Fish and Game has extended the study of limiting and regulating factors in Alaskan caribou (*Rangifer tarandus*) to herds other than the Delta because of pressing research and management questions. Area management biologists in Regions II and III have become actively involved in the study and the work has become more statewide in scope. Besides the Delta Herd, the Nelchina, Northern Alaska Peninsula (NAP), Southern Alaska Peninsula (SAP), Kenai Mountains, Killey River, White Mountains, Ray Mountains, Unimak, and Nushagak herds have yielded particularly valuable information in the study of limiting and regulating factors and determination of optimum herd sizes. Parallel studies conducted by other researchers of the Denali and Mentasta herds have provided additional insights.

From July 1999 through June 2000, in addition to routine collection of population data (i.e., fall composition counts and annual census), we weighed and measured 4-month-old and 10-month-old female caribou calves in the Delta and Nelchina herds. Most of these calves were also radiocollared. In the Chisana, Macomb, NAP, Rainy Pass and Unimak caribou herds, we weighed and measured only 4-month-old calves, and in the Nushagak, Mulchatna, Kilbuck, and White Mountains herds we weighed, measured, and collared only 10–12-month-old female calves. We also weighed newborn calves in the Delta and Nelchina caribou herds. Similar data were also collected in the Denali, Mentasta, and Fortymile herds in related studies by other biologists. Additional work in the Nelchina Herd will also be reported in more detail in a separate Federal Aid Study 3.44, *The Influence of Seasonal, Spatial Distribution on Growth and Age of First Reproduction of Nelchina Caribou with Comparisons to the Mentasta Herd.*

The Delta Herd declined slightly from just over 3600 in 1999 to about 3200 in 2000. Fall calf:cow ratios have been near 20:100 since 1994. Mortality of calves collared in fall 1998 and 1999 continued to be high while adult female mortality continued to be low.

Condition (i.e., weight) of 4-month-old female caribou calves in the Delta Herd in 1999 was similar to 1998 ($P > 0.1$, $t < 1.0$) and, as expected, natality rates of all age classes of females in 2000 were similar to those in 1999. In the Nelchina Herd, however, 4-month-old calves were significantly lighter in 1999 than in 1998 or 1997 ($P < 0.05$), and subsequent natality rate of 3-year-old females was low (0%). Summer weather conditions were relatively poor for the Nelchina Herd again in 1999.

Nelchina Herd caribou experienced unusually severe weather conditions from summer 1999 through late May 2000. Summer 1999 was relatively poor because caribou calves were light in October compared to weights in 1998. In addition, and more importantly, winter 1999–2000 was unusually difficult for Nelchina caribou. Female calves apparently lost weight over winter, which is unusual for caribou that have consistently gained weight during winter in most years. The relatively severe winter of 1999–2000 was also reflected in lower weights of newborn calves. Caribou were relatively late in leaving Units 12 and 13 where snow was relatively deep in November and December. Once Nelchina caribou left these units, they initially encountered better wintering conditions, but conditions deteriorated rapidly in late December with heavy, wet snow followed by very low temperatures. 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. Migration back to the calving range in spring 2000 was about a week later than normally observed. When caribou arrived near the calving area, they encountered unusually deep snow due to deeper than normal snow accumulation and a very late spring with the average May temperature among the coldest on record. Calving occurred at lower than normal elevations and peaked 2–3 days later than normal.

In contrast to calf mortality studies conducted previously on Interior caribou herds and similar to the 1998 study in the NAP, golden eagles (*Aquila chrysaetos*) were not important predators of caribou calves on the calving area of the SAP Herd. Golden eagles were rarely seen on the calving area (we recorded only 1 confirmed sighting during the 3 weeks we lived in the area). Although 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. Predation by wolves (*Canis lupus*) and grizzly bears (*Ursus arctos*) was the primary cause of death for newborn calves. Several calves also died from hypothermia or drowning after falling into deep, fast-flowing streams in the Caribou River Flats. As in the NAP, it is apparent that many or most grizzly bears do not prey heavily on caribou calves, but because bear densities are so high (about 1 bear/5 km^2), bears are still important predators of caribou calves. 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.

Key words: body condition, caribou, Delta Herd, genetics, Mulchatna Herd, natality, Nelchina Herd, Northern Alaska Peninsula Herd, Nushagak Herd, Rainy Pass Herd, Unimak Herd.

CONTENTS

BACKGROUND

A continuing long-term population dynamics study of the Delta caribou (*Rangifer tarandus*) 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 (Boertje et al. 1996; Valkenburg et al. 1996). Predator/prey relationships and human harvest of moose (*Alces alces*), caribou, sheep (*Ovis dalli*), grizzly bears (*Ursus arctos*), and wolves (*Canis lupus*) 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 5 growth phases. Herd size rapidly grew after wolf control from 1979–1982 ($r = 0.18$), with high recruitment and low mortality from hunting and natural causes. The herd then 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 1989–1993, with low recruitment, high natural mortality, and low hunting mortality. The fifth phase from 1994 to 2000 has been one of relative stability with low recruitment, moderate adult mortality, and insignificant 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 3 annual calf mortality studies from 1995 to 1997.

Population decline in the DCH was reversed in 1994, coincident with the wolf control program, and the herd increased somewhat to over 4000. However, after wolf control ended in December 1995, the herd once again began slowly declining. Since 1997, work in the DCH has been concentrated on monitoring body conditions to determine if lowered population size will eventually result in improved condition and long-term weight gain.

In recent years, the study of limiting and regulating factors in caribou has been extended to other herds where pressing research and management questions have resulted in greater availability of funding, and the study has become statewide in scope. This new approach has only been possible because of the active interest taken by cooperating area biologists and cooperating federal agencies in establishing a coordinated research and management program. Besides the DCH, the Nelchina, Northern Peninsula (NAP), Southern Peninsula (SAP), 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. In 1999 a new caribou research biologist position was filled in the Palmer office. Future reports containing more detailed data on the Nelchina Herd will be forthcoming under a separate research project. For simplicity, and to make it easier for readers to access information on Alaskan caribou research, we have compiled and reported much information in this report that was collected with funding other than that for federal aid Pittman-Robertson projects. These other funds have included state management funds (nonfederal aid) and funds from cooperating federal agencies (BLM, FWS, and NPS). For a complete review of caribou research done in Alaska in the late 1990s, readers should also refer to the biennial survey-inventory management reports written by ADF&G area biologists, special reports (e.g., Sellers et al. 1998*a*,*b*, 2000), and reports from the Biological Resources Division (BRD) of the US Geological Survey.

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-aged females.
- Monitor density, natality, mortality, body weight, condition, and weather in Alaskan caribou herds on an opportunistic basis as time and funding allow.
- Improve and develop techniques for monitoring body condition in caribou.
- Begin investigating genetic relationships of Alaskan caribou to determine if genetic differences might contribute to differences in body size.

METHODS

DELTA HERD

After relocating all active radiocollared caribou on 29 September 1999, we conducted a fall composition count on the DCH on 2 October using 2 R-22 helicopters for caribou classification and a Bellanca Scout for radiotracking. The sample was distributed in proportion to the distribution of radiocollared caribou. On the same day, we then captured, weighed, measured, and radiocollared a sample of 14 female caribou calves. Subsequently, after rutting activities were over, on 2 November we changed collars on 2 adults whose collars were 5 years old or older. During winter 1999–2000 we monitored distribution and mortality of radiocollared caribou by tracking them on 9–10 December, 4, 7, and 27–28 February, and 1 and 11 April. The 4 snow stations were read on 9–10 December, 4 February, 27–28 February, and 1 April. On 13–14 April 2000 we immobilized, weighed, and measured 13 female calves to evaluate their size and condition at the end of winter. We also changed collars on 3 adults we were unable to capture the preceding fall. Two yearlings were immobilized after being mistaken for calves. From 17–26 May we observed all collared caribou in the DCH 1–3 times to determine if they were pregnant, and on 22 May we captured and weighed 12 male and 11 female newborn caribou calves. Due to the later than normal calving, we returned on 26 May and were able to capture 4 more newborn female calves and 13 more newborn males. On 24 June we conducted the DCH census using 2 Bellanca Scouts and 3 Piper Super Cubs. All groups of caribou larger than 185 were photographed with 35-mm cameras. We visually searched all of the drainages of the Wood River, Little Delta, Last Chance Creek, Upper Healy, and Wells Creek. In the Yanert River drainage, we searched all of the drainages on the south side of the river and all of the drainages above Moody Pass on the north side of the River. East of the Little Delta and south and east of Wells Creek, we conducted a high altitude search for missing radio collars. On 25 June we also conducted a thorough high altitude search for missing radio collars over the Chulitna Mountains, the mountains of the Susitna and McLaren River drainages, and we repeated coverage of the areas flown the previous day.

Nelchina Herd

In addition to the standard fall composition survey 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. Details of the capture and evaluation of condition of Nelchina caribou will be reported separately in Federal Aid Study 3.44. On 8 July 2000 we successfully completed an aerial photocensus of the Nelchina Herd. Results will be reported in the biennial caribou management report.

Mulchatna, NAP, SAP, Nushagak, and Unimak Herds

Due to the availability of outside funding (primarily from US Fish and Wildlife Service and BLM), we were able to continue work on caribou herds in southwestern Alaska. For the second year, we conducted a coordinated round of fall composition counts with a helicopter (R-44) on all 5 herds in Southwest Alaska. We were also able to place more radio collars on female calves in the NAP and Unimak herds and collect blood samples for a pilot project on caribou genetics. Counts on the Mulchatna Herd were completed on 12 and 20 October 1999. We flew out of Bethel in an R-44 helicopter on 12 October to sample Mulchatna caribou west of the Kilbuck Mountains and out of Dillingham on 20 October to sample Mulchatna caribou distributed east of the Kilbuck Mountains. On 21 October we used the helicopter to conduct composition counts and collar female calves south of King Salmon. The following day we continued south along the Alaska Peninsula as far as Bear Lake while conducting composition counts and collaring female calves. We used an ADF&G Bellanca Scout to radiotrack caribou and carry extra fuel for the helicopter. On 22 October we continued south past Port Moller to Cold Bay where we worked from the FWS hangar while conducting composition counts on the SAP and Unimak caribou. We captured 13 Unimak caribou to assess condition and to obtain blood samples for the genetics pilot project. We also collared 1 caribou calf.

In April 2000 we sampled condition of 10-month-old female calves in the Nelchina, Delta, Nushagak, and Mulchatna herds. Results of work in the Nelchina Herd will be reported separately. Work in the Nushagak and Mulchatna herds was funded by FWS, BLM, and ADF&G management funds. In early June 2000, we worked with staff from Clarence Rhode National Wildlife Refuge in Bethel to collar Kilbuck caribou. The Kilbuck Herd has been flooded with Mulchatna caribou on all seasonal ranges in recent years and it has been difficult to collar animals that use the Kilbuck Mountains for calving. For this reason, we collared yearlings on the Kilbuck calving area in June, after all Mulchatna caribou had probably left the area and headed east to their calving area. The measurements and blood samples obtained were of some value for evaluating condition and investigating genetic relationships in comparison with Mulchatna and other caribou in Southwest Alaska.

OTHER INTERIOR HERDS

While we had a helicopter present for routine fall composition work in the Macomb, Chisana, and White Mountains herds, we also collared a few caribou for management purposes and to assess condition. In addition, we made a special effort this year to increase work on the White Mountains and Rainy Pass herds. The Rainy Pass Herd has had considerable hunting pressure and is one of the least known herds in the state. We were also planning to allow increased hunting in the White Mountains and wanted to have enough radio collars to ensure a good census estimate in 2000. While the R-44 helicopter was en route from work in Southwest Alaska in October 1999, we used it to conduct a fall composition count and to put 6 collars on female calves and 2 collars on adult females in the Rainy Pass Herd. Due to scheduling and weather constraints, collaring in the White Mountains was delayed until April 2000.

GENETICS OF INTERIOR AND SOUTHWESTERN ALASKA CARIBOU HERDS

In 1998 and 1999 we cooperated with biologists in the Yukon Territory and federal agencies in Alaska to determine the relatedness of caribou herds in which we have been collecting data on body condition. The primary reason for our interest in this subject was to begin to determine how much the differences in body weight, size, and conformation between herds could be due to genetics rather than nutrition. For most herds, we sent 20 samples of whole blood that had been collected over the years during research projects and routine handling of live animals for collaring to the University of Alberta Genetics Laboratory. Most blood samples were from female calves. DNA from the whole blood was amplified using standard techniques, and allele frequencies at 8 heterozygous loci of neutral selectivity were compared between herds. Genetic distance between herds was computed based on allele frequencies at each of the 8 loci. In addition, the lab conducted an assignment test in which each sample was assigned to a particular herd, based on the likelihood of finding that particular genotype in the herd.

RESULTS AND DISCUSSION

POPULATION SIZE, TREND, AND COMPOSITION IN THE DCH

The DCH has been relatively stable since 1993 (Table 1). After wolf control was initiated, it appears the herd may have initially responded; the 1994 and 1995 census estimates were higher than in 1993. Subsequently, the herd declined slightly and then stabilized. From 1999 to 2000 the herd may have declined slightly again because the high mortality of calves through 16 months of age could not balance even the relatively low adult mortality. However, caribou groups were widely dispersed during the census, and the census estimate could be low. In addition, neonatal calf survival was probably lower than average in 2000 because newborn calf weights were low, and there may have been fewer calves than normal in the herd in late June (Table 2).

Data on bull:cow ratios are variable from year to year, depending on timing of fall counts, late summer distribution of bulls, and behavior of bulls, which is affected by weather. A running 3-year average of the bull:cow ratio reached a low during the mid-1990s and has increased since then. The herd can sustain the small, bulls-only permit hunt.

NATALITY RATE IN THE DCH

Natality of females (3 years old and older) in the DCH has been variable since the early 1990s (Table 3). In 2000 it may have been slightly below the average of the preceding 5 years (88%), although the 2000 results did not differ significantly from the 5-year average ($P > 0.1$, $\chi^2 = 1.4$, df = 1) or from 1998 and 1999 ($P > 0.1$, $\chi^2 = 1.5$, df = 1). Only two-thirds of the 3-year-olds produced calves in 2000, compared to 90% in 1998 and 86% in 1999, but the difference was not statistically significant ($P > 0.25$, $\chi^2 = 0.97$, df = 1). No 2-year-olds produced calves in 2000. Presumably due to the very late snow melt and continued cold in May 2000, the peak of calving was delayed and occurred on 22–23 May. Even in Fairbanks, leaf flush occurred on 22 May compared to a range of 30 April–25 May that has occurred since 1975. We had predicted moderately high natality in 2000 based on calf weights in October 1999.

NATALITY RATE IN THE NELCHINA , NAP AND SAP HERDS

Natality in the Nelchina Herd was low in May 2000. Of 8 radiocollared 3-year-olds, none produced a calf. Among older collared females, 6 of 10 4-year-olds, 4 of 10 5-year-olds, and 5 of 5 ≥6-year-olds were parturient. In most previous years, most 3-year-olds and about 90% of all older females produced calves (ADF&G files). In 2000 only 60% of females older than 3 years produced calves. These data further confirm that Nelchina caribou experienced poor nutrition in summer and fall 1999.

In the NAP Herd in early June 2000, 76% of 1146 females older than yearlings were parturient, and in the SAP Herd 74% of 341 females older than yearlings were parturient. Although natality rates appear similar in the NAP and SAP, younger females may be more productive in the SAP. Yearling females collared in the NAP in recent years have experienced high mortality, and the population structure is biased toward older cows that tend to have higher natality rates.

WEIGHT AND SIZE OF CALVES FROM INTERIOR HERDS

Weight of newborn male calves was significantly lower in the DCH in 2000 compared with those in 1995–1999 ($P = 0.017$, $t = 2.46$, df = 49) (Table 2). Weights of newborn females were similar to weights in previous years ($P > 0.1$). Weight and condition of 4-month-old and 10-month-old Delta calves have not returned to levels 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). Overwinter weight loss may have been even greater in 1999–2000 with the relatively severe winter. Calves lost an average of over 5 kg during winter (Table 4).

Until this year, newborn calves in the Nelchina Herd have been similar in size or larger than calves of other Interior herds, except Denali (Table 3). However, after the poor summer of 1999, followed by the severe winter of 1999–2000, newborn calf weights declined to the lowest levels seen in Interior caribou (Table 2). Nelchina calves have been consistently smaller than calves from other Interior herds at the end of summer. This continued to be true in 1999, but in contrast to previous years when calves have consistently gained weight over winter, Nelchina calves lost weight during winter 1999–2000. A more detailed analysis of these data will be reported separately.

For the first time, we sampled calf weight and size in the Rainy Pass Herd in October 1999. As expected, these calves were relatively large (Table 5). These data support the idea that the Rainy Pass Herd is a low-density, predator-limited herd on good summer range. We were interested in delineating range size and counting the herd in June–July 2000 but the exceptionally late spring, large amount of lingering snow, and wet July precluded a census. In fall 1999 and spring 2000, we were also able to radiocollar and sample calf weights in the Macomb and White Mountains Herd (Table 5).

WEIGHT AND SIZE OF CALVES FROM SOUTHWESTERN ALASKA HERDS

During 1999–2000 we had the opportunity to obtain weights and measurements (5-month-old and 10-month-old calves) from 4 of the 5 caribou herds in southwestern Alaska (Table 5). Only SAP caribou were not sampled. Nushagak and Unimak caribou calves continued to be relatively heavy and in excellent condition, despite high density on the Nushagak Peninsula. In contrast, weights of NAP calves, which were very low in the mid-1990s during the population decline, continued to show improvement in 1998 and 1999. Weights of Mulchatna calves have continued to decline and are now as low as NAP calves were during that herd's recent population decline. It is possible that a population decline has begun or is imminent in the Mulchatna Herd.

WEATHER

Judging from fall calf weights in the Nelchina Herd in 1999, we believe summer 1999 was a relatively poor summer for caribou nutrition in the Nelchina Basin. Feeding conditions during winter 1999–2000 must also have been relatively poor. Snowfall was relatively light until late December, and then it became very heavy and was accompanied by wildly fluctuating temperatures. Most radiocollared Delta caribou were in the lower Yanert drainage until late December at which time they dispersed in all directions. Most moved to the Healy-Lignite area but some moved to the Reindeer Hills and Wells Creek drainage. Snow was unusually deep south of the Yanert drainage and it was also exceptionally late in melting. Leafout in Fairbanks occurred about 20 May compared to a range in dates from 30 April to 25 May over the last 25 years. Nelchina caribou calved at much lower elevations than normal and peak calving dates in the Delta and Nelchina Herds were late. The cold spring with deep lingering snow also persisted in southwestern Alaska, although the peak calving date for Mulchatna caribou was probably not delayed (J Woolington, ADF&G, personal communication).

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

Mortality of female calves (4–16 mo of age), female yearlings (16–28 mo of age), and older female caribou from 1 October 1998 to late June 2000 was similar to previous years (Table 6).

However, due to the relatively small sample sizes, these mortality calculations have wide confidence intervals. Mortality calculations were incorporated into a population model.

MOVEMENTS, DISTRIBUTION, AND HARVEST IN THE DCH

In 1999 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. About two-thirds of the radiocollared caribou began the winter in the lower Yanert drainage but dispersed after heavy snows fell at the end of December. The remaining third wintered in the drainages of the Little Delta River, Delta Creek, and the vicinity of Donnelly Dome. After late December most of the caribou that had been in the Yanert drainage moved to the Totatlanika drainage and the Healy-Lignite area in Unit 20A. Calving occurred south of the Alaska Range as far south as the Denali Highway and east to the East Fork Susitna River. Calving was more dispersed than usual. One collared caribou (a 4-year-old with hard antlers) was located near Lower Tangle Lake on 17 May, and it was not found later on the calving area or during the census. This was the farthest southeast location of any collared Delta caribou to date. This caribou was accompanied by Nelchina caribou that began wintering in the Monahan Flats but moved to Tangle Lakes after the deep snow in late December.

A limited permit-drawing hunt was reopened in the DCH in 1996 and 22 bulls were taken. In 1997, 44 bulls were reported harvested and in 1998, 49 bulls and 1 cow were reported taken. In 1999, 38 bulls were reported. In summer 2000, 50–60 bulls were seen near Donnelly Dome. These caribou most likely were Delta caribou, and some may have been taken in the Macomb hunt in mid-September 2000.

ANALYSIS OF WINTER FECAL PELLETS

We continued to collect winter fecal pellets from selected herds including the DCH. Results of this work will be reported in future reports. Analysis of these samples is very slow and it often takes several years to get results back from labs.

GENETICS OF INTERIOR AND SOUTHWESTERN ALASKA CARIBOU HERDS

Genetic distance comparisons and assignment tests indicate 5 or 6 Interior Alaskan caribou herds tested (i.e., Nelchina, Mentasta, Macomb, Fortymile, and Porcupine) are relatively closely related (Tables 7 and 8). The Chisana Herd, however, is very different from other Interior herds, and seems to be most closely related to Yukon "woodland" or "mountain" caribou herds that also appear to be very different from each other (Strobeck et al., in press). In contrast, 4 of 5 herds tested in southwestern Alaska appear to be quite different from each other. As expected, Nushagak Peninsula and NAP caribou were similar, and in the assignment test, more Nushagak caribou were assigned to the NAP than any other herd (including the Nushagak). The Nushagak Herd arose from a transplant from the NAP in 1988 (Hinkes and Van Daele 1996). Differences in allele frequencies between the Nushagak and the NAP can be attributed to the founder effect (a small number of males in the transplant) and genetic drift.

We plan to explore genetic relationships in Alaskan caribou but this project may be expanded in the future to be a separately funded Pittman-Robertson project with Kris Hundertmark as project leader.

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 population 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 indicative of 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 seems 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 and 2000). At present, managers are striving to maintain the size of the Nelchina Herd at about 35,000 (summer census) to try to reduce the influence of poor nutrition, dampen fluctuations in population size, and promote more stable harvests. We will continue to monitor the Nelchina Herd to determine if this management regime is successful. A companion study of winter range/fire relationships in the Nelchina Herd is also underway. We will continue to monitor the Delta Herd, which is now stable due to heavy predation. The NAP, SAP, Mulchatna, and other Southwest Alaska herds will be monitored opportunistically as funding allows.

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 overused winter range, reduced body size and condition, lower natality, and increased mortality in the herd. There has also been a high prevalence of lungworm that has probably 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. The adjacent Mulchatna Herd also appears to be experiencing poor nutrition (lowered calf weights during Oct and Apr), and we will begin monitoring this herd more closely for the prevalence of lungworm.

During the last 5 years we have been collecting caribou 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.

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LITERATURE CITED

ADAMS LG, FJ SINGER, AND BW DALE. 1995. Caribou calf mortality in Denali National Park, Alaska. *Journal of Wildlife Management* 59(3):584–594.

BOERTJE RD, P VALKENBURG, AND ME MCNAY. 1996. Increases in moose, caribou, and wolves following wolf control in Alaska. *Journal of Wildlife Management* 60(3):474–489.

DAVIS JL, AND P VALKENBURG. 1985. Demography of the Delta Caribou Herd under varying rates of natural mortality and harvest by humans. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Final Report. Grants W-21-2, W-22-1, W-22-2, W-22-3, and W-22-4. Juneau.

———, ———, ME MCNAY, RM BEASLEY, AND VL TUTTERROW. 1991. Demography of the Delta Caribou Herd under varying rates of natural mortality and human harvest and assessment of field techniques for acquiring demographic data. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Final Report. Grants W-22-5, W-23-1, W-23-2, and W-23-3. Juneau.

GASAWAY WC, RO STEPHENSON, JL DAVIS, PEK SHEPHERD, AND OE BURRIS. 1983. Interrelationships of wolves, prey, and man in Interior Alaska. *Wildlife Monographs* 84.

HINKES MT AND LJ VAN DAELE. 1996. Population growth and status of the Nushagak Peninsula caribou herd in Southwest Alaska following reintroduction, 1988–1993. *Rangifer*, Special Issue. 9:301–309.

JENKINS KJ. 1996. Population dynamics of the Mentasta Caribou Herd, Wrangell-St Elias National Park and Preserve: Progress Report and Preliminary Assessment. WRST Research and Management. Report 95-1. US National Park Service, Anchorage, Alaska.

SELLERS RA, P VALKENBURG, RL ZARNKE, AND RC SQUIBB. 1998*a*. Natality and early calf mortality of Northern Alaska Peninsula caribou, 1998. Alaska Department of Fish and Game. US Fish and Wildlife Service, Anchorage. Final Report. Cooperative Agreement 98-079. Juneau, Alaska.

———, P VALKENBURG, BW DALE, RC SQUIBB, AND M ROY. 2000. Fall sex/age composition, genetic screening and collaring of Northern and Southern Alaska Peninsula herds, 1999. Alaska Department of Fish and Game. US Fish and Wildlife Service, Anchorage. Final Report. Cooperative Agreement 00-020. Juneau, Alaska.

———, P VALKENBURG, RL ZARNKE, RC SQUIBB, AND M ROY. 1998*b*. Fall sex/age composition, body condition, disease screening, and collaring of Northern and Southern Alaska Peninsula caribou herds, 1998. Alaska Department of Fish and Game.

US Fish and Wildlife Service, Anchorage. Final Report. Cooperative Agreement 99-014. Juneau, Alaska.

STROBECK C, K ZITTLAU, J COFFIN, R FARNELL, AND GW KUZYK. 2000. Determination of the genetic relationships of caribou populations by DNA typing using micro-satellites. *Rangifer* 20:In press.

VALKENBURG P. 1997. Investigation of regulating and limiting factors in the Delta caribou herd. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Study 3.42. Grant W-24-5. Juneau.

———, JL DAVIS, JM VER HOEF, RD BOERTJE, ME MCNAY, RM EAGAN, DJ REED, CL GARDNER, AND RW TOBEY. 1996. Population decline in the Delta caribou herd with reference to other Alaskan herds. *Rangifer* Special Issue 9:53–62.

WHITTEN KR. 1995. Influence of body condition on productivity of adult female caribou in the Porcupine caribou herd. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Final Report. Grants W-24-1, W-24-2, and W-24-3. Juneau.

———, GW GARNER, FJ MAUER, AND RB HARRIS. 1992. Productivity and early calf survival in the Porcupine Caribou Herd. *Journal of Wildlife Management* 56:201–212.

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Table 1 Fall composition counts and size of DCH caribou, 1969–1999

Approximate survey date	Bulls:100 Cows	3-Yr Avg	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	49	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	30	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	49	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	57	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	40	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	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	33	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	30	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	26	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	38	16	10	62	31	49	20	27	1519	3829
1 Oct 1999	44		19	11	62	37	40	23	27	674	3227

Table 2 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
Delta 2000	7.82	0.28	25	7.76	0.32	16
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
Fortymile 2000	8.30	0.17	27	7.64	0.18	39
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
Nelchina 2000	7.66	0.19	25	7.02	0.15	31
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 3 Natality rates of radiocollared known-aged DCH[a] females observed in late May 1980–2000

Year	Proportion parturient (%) in late May						
	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)
2000	0/9 (0)	0/10 (0)	8/12 (66)	5/5 (100)	6/6 (100)	14/18 (78)	33/41 (80)

[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 4 Mean weight of samples of 4- and 10-month-old female calves from the DCH, 1979–2000

	10-mo-olds				4-mo-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	126.0	57.1	2.9	14
2000	114.9	52.1	2.6	12				

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

Table 5 Weights (kilograms unless noted) and measurements (centimeters) of 5-month-old and 10-month-old caribou calves from Alaskan caribou herds

Herd	Year	Season	Weight (lb)	Weight	Metatarsus	Total length	Girth	Mandible length	Weight/ Metatarsus	*n*
Chisana	1990	Fall	114.1	51.7	35.4	154.1	89.1		1.46	13
Chisana	1998	Fall	147.1	64.6	38.0	171.3	99.8	23.0	1.75	3
Chisana	1999	Fall	139.9	63.5	37.2	164.1	99.3	22.0	1.71	8
Delta	1979	Spring	132.3	60.0	37.8	168.5	102.9		1.58	11
Delta	1981	Spring	137.0	62.1	39.5	174.5	105.0		1.68	5
Delta	1982	Spring	135.1	61.3	38.1	165.0	96.9		1.62	11
Delta	1983	Spring	137.2	62.2	38.1	168.3	97.8		1.64	13
Delta	1984	Spring	126.3	57.3	37.9	164.0	97.6		1.51	12
Delta	1987	Spring	120.8	54.8	36.8	163.1	94.4	23.6	1.48	9
Delta	1988	Spring	130.7	59.3	38.0	171.4	101.7	24.1	1.56	16
Delta	1989	Spring	133.6	60.6	37.9	171.6	98.2	24.3	1.59	9
Delta	1990	Spring	112.4	51.0	37.1	167.6	96.0		1.37	14
Delta	1991	Spring	112.8	51.2	36.9	164.6	92.1		1.38	10
Delta	1991	Fall	127.6	57.9	35.6	162.2	94.6	21.9	1.63	14
Delta	1992	Spring	120.3	54.6	36.3	163.8	91.5	22.5	1.50	16
Delta	1992	Fall	120.3	54.6	35.3	158.8	90.8	21.5	1.55	14
Delta	1993	Spring	122.3	55.5	36.9	165.6	92.8	23.1	1.50	12
Delta	1993	Fall	122.5	55.6	35.1	161.1	91.4	21.3	1.58	14
Delta	1994	Fall	131.3	59.6	36.1	167.9	96.5	22.2	1.65	15
Delta	1995	Spring	123.3	55.9	37.2	169.5	96.1	23.3	1.50	15
Delta	1995	Fall	131.1	59.5	35.7	169.4	93.8	22.2	1.66	13
Delta	1996	Spring	120.8	54.8	37.0	167.6	95.0	23.5	1.48	15
Delta	1996	Fall	122.9	55.7	35.8	161.1	94.1	22.1	1.56	14
Delta	1997	Spring	118.3	53.7	37.8	166.1	96.0	23.4	1.43	14
Delta	1997	Fall	128.3	58.2	36.0	159.4	95.0	22.4	1.60	20
Delta	1998	Spring	123.7	56.1	36.7	168.9	98.4	23.3	1.53	12
Delta	1998	Fall	124.4	56.4	35.7	159.1	95.2	21.6	1.58	16
Delta	1999	Spring	118.3	53.7	37.2				1.44	14
Delta	1999	Fall	126.0	57.1	35.7				1.58	14
Delta	2000	Spring	114.9	52.1	36.6				1.42	12
Denali	1987	Spring	131.0	59.4	37.7	163.5	97.5	23.6	1.57	5

Table 5 Continued

Herd	Year	Season	Weight (lb)	Weight	Metatarsus	Total length	Girth	Mandible length	Weight/ Metatarsus	*n*
Denali	1988	Spring	130.6	59.2	37.3	167.0	97.3	23.4	1.58	9
Denali	1989	Spring	131.3	59.5	36.9	169.2	96.8	24.9	1.61	13
Denali	1990	Spring	126.3	57.3	36.8	165.4	95.2	24.1	1.56	15
Denali	1991	Spring	111.7	50.7	36.1	157.2	91.5	23.6	1.40	15
Denali	1992	Spring	123.5	56.0	37.4	165.7	94.2	24.3	1.50	16
Denali	1993	Spring	125.4	56.9	37.1	164.7	93.5	23.1	1.53	9
Denali	1994	Spring	125.5	56.9	37.3	167.5	95.7	23.8	1.53	11
Denali	1995	Spring	132.3	60.0	37.2	168.0	95.7	23.8	1.61	6
Denali	1996	Spring	132.6	60.1	37.7	165.4	94.9	23.6	1.59	7
Denali	1997	Spring	134.5	61.0	37.5	167.0	102.3	24.3	1.63	3
Denali	1998	Fall	133.3							12
Fortymile	1990	Fall	116.3	52.7	35.8	157.9	93.0		1.47	14
Fortymile	1991	Fall	118.9	53.9	35.2	157.0	94.1	22.0	1.53	14
Fortymile	1992	Spring	110.6	50.2	36.8	158.5	89.7	22.2	1.31	7
Fortymile	1992	Fall	121.5	55.1	35.0	154.5	96.7	21.4	1.57	14
Fortymile	1993	Fall	123.7	56.1	35.3	158.5	93.9	21.3	1.59	15
Fortymile	1994	Fall	120.0	54.4	36.0	159.5	94.1	22.4	1.53	14
Fortymile	1995	Fall	125.0	56.7	35.4	163.6	94.1	22.1	1.60	15
Fortymile	1996	Fall	121.4	55.1	35.5	156.9	94.5	22.0	1.55	15
Fortymile	1997	Fall	130.8	59.3	36.3	158.7	96.5	22.2	1.63	15
Fortymile	1998	Fall	116.9	53.0	35.8	152.1	91.8	21.7	1.48	17
Fortymile	1999	Fall	120.5	54.7	36.2	158.5	95.9	21.9	1.51	17
Galena Mountain	1993	Fall	146.5	66.5	36.5	170.3	96.3	22.4	1.82	4
Galena Mountain	1994	Fall	144.6	65.6	35.9	177.3	99.2	23.5	1.83	9
Kenai Mountains	1996	Spring	126.9	57.6	38.2	166.6	97.6	23.4	1.48	11
Kenai Mountains	1998	Spring	122.1	55.4						
Kenai Mountains	2000	Spring	120.1	54.6						10
Killey River	1996	Spring	144.8	65.7	39.4	174.4	102.4	24.6	1.66	10
Killey River	1998	Spring	140.0	63.5						
Killey River	2000	Spring	129.8	58.4						10
Macomb	1988	Spring	116.8	53.0	37.0	164.8	99.3	23.1	1.43	4
Macomb	1990	Spring	107.3	48.7	36.3	166.0	94.3	23.0	1.34	12
Macomb	1994	Spring	118.8	53.9	37.4	162.5	97.0	23.1	1.44	10
Macomb	1996	Fall	128.8	58.4	36.1	165.4	96.8	21.9	1.62	8

Table 5 Continued

Herd	Year	Season	Weight (lb)	Weight	Metatarsus	Total length	Girth	Mandible length	Weight/ Metatarsus	*n*
Macomb	1998	Fall	132.8	60.2	36.1	165.7	96.4	22.7	1.67	12
Macomb	1999	Fall	128.2	58.1	35.4	158.3	94.8	23.0	1.64	4
Mentasta	1998	Fall	119.9	54.4						6
Mentasta	2000	Spring	129.2	58.6	38.6	167.5	97.1		1.52	7
Mulchatna	1995	Spring	110.6	50.1	36.9	156.0	93.9	22.4	1.36	10
Mulchatna	1998	Fall	106.6	48.3	34.9	152.5	91.7	21.1	1.38	10
Mulchatna	2000	Spring	103.5	46.9	35.6				1.31	11
Nelchina (12)	1992	Spring	124.4	56.4						9
Nelchina (13)	1992	Spring	109.4	49.6						7
Nelchina (12)	1993	Spring	125.7	57.0	36.9	162.7	93.6	23.7	1.55	7
Nelchina (13)	1993	Spring	118.7	53.8	36.9	156.7	93.6	22.6	1.46	12
Nelchina	1994	Spring	107.7	48.9						11
Nelchina	1995	Spring	105.0	47.6	36.7	159.8	92.2	22.6	1.30	29
Nelchina	1995	Fall	118.0	53.5	35.6	160.2	94.1	21.4	1.50	15
Nelchina	1996	Fall	106.5	48.3	35.5	149.5	88.3	21.2	1.36	16
Nelchina	1996	Spring	117.1	53.1	37.2	167.4	94.0	22.7	1.42	10
Nelchina	1997	Spring	108.3	49.1	36.8	159.9	93.9	23.0	1.32	23
Nelchina	1997	Fall	122.3	55.5	35.9	156.6	92.1	21.8	1.55	10
Nelchina	1998	Spring	125.7	57.0	37.5	168.6	94.4	23.1	1.52	15
Nelchina	1998	Fall	111.6	50.6	35.4	153.8	93.0	20.9	1.43	25
Nelchina	1999	Fall	114.7	52.0	35.9	154.6	91.3	21.7	1.45	38
Nelchina	2000	Spring	107.1	48.6	37.5	159.5	91.7		1.30	29
N Alaska Peninsula	1995	Spring	113.3	51.4	35.8	161.1	92.6	22.5	1.43	19
N Alaska Peninsula	1995	Fall	98.6	44.7	34.2	145.1	88.6	20.2	1.31	10
N Alaska Peninsula	1996	Fall	101.5	46.0	34.2	143.5	89.1	20.3	1.34	10
N Alaska Peninsula	1997	Fall	106.6	48.3	34.0	152.8	92.9	20.3	1.42	14
N Alaska Peninsula	1997	Spring	106.6	48.4	35.6	157.4	91.8	22.2	1.36	10
N Alaska Peninsula	1998	Fall	109.0	49.4	33.9	151.4	90.9	20.6	1.46	29
Nushagak Peninsula	1995	Spring	125.8	57.1	36.9	167.5	98.3	23.4	1.55	15
Nushagak Peninsula	1997	Spring	112.2	50.9	37.5	151.9	96.8	22.8	1.36	10
Nushagak Peninsula	1998	Fall	123.0	55.8	35.3	156.2	94.8	21.7	1.58	5
Nushagak Peninsula	2000	Spring	108.4	49.2	35.3				1.39	10
Ray Mountains	1994	Fall	134.4	60.9	35.5	170.7	96.7	22.3	1.72	20
Rainy Pass	1999	Fall	140.1	63.6	37.0	170.8	102.8	22.8	1.72	5

Table 5 Continued

Herd	Year	Season	Weight (lb)	Weight	Metatarsus	Total length	Girth	Mandible length	Weight/ Metatarsus	*n*
S Alaska Peninsula	1997	Spring	107.7	48.9	35.6	153.9	93.6	22.3	1.37	13
S Alaska Peninsula	1998	Fall	115.2	52.2	33.9	153.9	91.9	20.9	1.54	13
Unimak	1997	Spring	106.8	48.4	35.1	157.6	93.0	21.7	1.38	5
Unimak	1999	Fall	123.4	56.0	34.5	166.2	96.1	21.4	1.62	12
Western Arctic	1992	Spring	87.0	39.5						16
Western Arctic	1992	Fall	89.2	40.4						13
Western Arctic	1993	Spring	82.1	37.2						14
Western Arctic	1994	Fall	71.5	32.4						15
Western Arctic	1994	Spring	88.3	40.1						15
Western Arctic	1995	Fall	81.1	36.8						9
White Mountains	1988	Fall			36.0	166.5	103.9	22.4		10
White Mountains	1991	Fall	128.9	58.5	35.9	164.8	95.4	22.2	1.63	9
White Mountains	1995	Spring	130.1	59.0	37.6	172.5	98.5	24.4	1.56	8
White Mountains	1995	Fall	133.6	60.6	36.4	170.0	96.2	23.0	1.66	6
White Mountains	1997	Fall	135.8	61.6		164.8	98.3	22.7		6
White Mountains	2000	Spring	118.9	53.9	37.5	167.5	94.3	23.1	1.44	4
Wolf Mountain	1995	Fall	131.4	59.6	35.7	166.1	97.0	22.7	1.67	8

Table 6 Annual total mortality of radiocollared known-aged female DCH[b] caribou, 1979–1998

	Proportion dying (%) (cause of death) by age class			
Year[a]	Calves (4–16 mo old)	Yearlings (16–30 mo old)	Older than yearlings (>30 mo old)	Yearlings and older (>16 mo 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)

Table 6 Continued

	Proportion dying (%) (cause of death) by age class			
Year[a]	Calves (4–16 mo old)	Yearlings (16–30 mo old)	Older than yearlings (>30 mo old)	Yearlings and older (>16 mo old)
1998–1999	6/15 (47) (5 wolf, 2 unk	0/15 (0)	5/49 (10) (3 wolf, 2 unk)	5/64 (8)
Totals	44/111 (40)(22 wolf, 10 unk pred, 9 unk, 3 lynx, 1 poached)	13/166 (8)(3 unk, 6 wolf, 1 unk pred, 1 grizzly, 1 poached, 1 hunting)	70/615 (11)(28 unk[c], 27 wolf, 6 unk pred, 2 hunting, 3 poached, 1 grizzly, 1 coyote, 1 breached birth, 1 avalanche)	83/781 (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.

Table 7 Genetic distances in 10 Alaskan caribou herds

	MAC	MENT	MU	NAP	NEL	NUSH	PORC	SAP	UNI	WHITE
Macomb	0.00									
Mentasta	0.14	0.00								
Mulchatna	0.24	0.23	0.00							
Northern Alaska Peninsula	0.32	0.28	0.32	0.00						
Nelchina	0.17	0.13	0.28	0.31	0.00					
Nushagak	0.31	0.30	0.26	0.14	0.32	0.00				
Porcupine	0.14	0.14	0.23	0.23	0.16	0.25	0.00			
Southern Alaska Peninsula	0.51	0.48	0.51	0.23	0.57	0.33	0.42	0.00		
Unimak	0.68	0.65	0.71	0.35	0.83	0.53	0.58	0.22	0.00	
White Mountains	0.39	0.40	0.50	0.57	0.44	0.56	0.39	0.71	0.86	0.00

Table 8 Assignment tests of 218 samples of DNA from 10 Alaskan caribou herds

	MAC	MENT	MU	NAP	NEL	NUSH	PORC	SAP	UNI	WHITE	Total samples
Macomb	10	2	1	0	4	0	2	1	0	0	20
Mentasta	4	19	2	3	2	0	2	0	0	0	32
Mulchatna	3	1	12	0	0	1	1	0	0	1	19
Northern Alaska Peninsula	0	0	2	7	3	3	1	3	1	0	20
Nelchina	5	5	1	3	4	0	1	1	0	0	20
Nushagak	0	2	3	8	0	4	0	2	1	0	20
Porcupine	8	4	6	5	5	3	13	0	0	1	45
Southern Alaska Peninsula	0	0	0	3	0	0	0	16	1	0	20
Unimak	0	0	0	0	0	0	0	1	15	0	16
White Mountains	0	1	0	0	1	0	1	0	0	3	6
										Grand total:	218

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.

James L Davis