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Investigation of Regulating and Limiting Factors in the Delta Caribou Herd

Patrick Valkenburg

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SUMMARY

Census data from 1990 to 1992 revealed a 40% decline in numbers in the Delta caribou (*Rangifer tarandus*) herd (DCH) since 1989. The decline was caused by poor calf survival from birth to October, increased mortality of adult females during winter and summer, and lowered May parturition rates in females $\geq$36 months old. Neither hunting nor dispersal was a factor in the decline. Most calves survived at least 48 hours after birth. Wolf (*Canis lupus*) predation was the primary cause of adult deaths, but the cause of death of calves is unknown. Because the low-density Denali herd also declined from similar causes, it appears that density played only a minor role, if any, in the decline.

Other herds that declined during the same period included the Chisana, Fortymile, Macomb, and Mentasta herds. The Nelchina herd continued to increase during the same period even though it shared winter range with the Mentasta herd and wintered adjacent to the Chisana herd where winter snow depth did not exceed 28 inches (70 cm).

We hypothesize that warmer and perhaps drier than normal summer weather played a key role in reducing parturition, and probably conception, rates of adult females and reducing body condition in calves and adults. The relatively severe winters of 1989-90, 1990-91, and 1991-92 probably contributed to increased adult, yearling, and winter calf mortality primarily from wolf predation. Conditions have favored wolves, and the fall 1991 wolf population estimate of 266 is the highest ever recorded in the DCH's range. Wolf predation may be a major factor affecting summer calf survival.

A March 1989 kill rate study of four radio-collared wolf packs demonstrated that wolves were eating about twice as much moose (*Alces alces*) as caribou (by weight), despite an abundance of caribou within their ranges. At that time the moose population was stable while the caribou herd was growing. Presently, moose numbers are growing and we hypothesize that wolves have switched to eating mostly caribou.

Peak calving dates have become later in the relatively high-density DCH since 1979, but they have remained the same in the relatively low-density Fortymile herd.

Key Words: caribou, Delta caribou herd, mortality, natality, population dynamics, weather.

CONTENTS

SUMMARY i
BACKGROUND 1
STUDY OBJECTIVES 2
Job Objectives 2
METHODS 2
1991 and 1992 DCH Censuses 2
Natality Rate of the DCH in 1990, 1991, and 1992 3
Peak Calving Dates of the DCH and Other Interior Herds 3
Determining Recruitment in the DCH 3
Harvest Monitoring 4
Determining When Major Mortality Occurs 4
Movements and Dispersal 4
Monitoring Body Condition and Weight, Determining the Influence of Summer vs. Winter Weather on Body Condition and Recruitment, and Testing a Model That Predicts Calf:100 Cow Ratio From Weight of 10-month-old Calves 4
Food Habits of Interior Herds 5
Censusing Wolves 5
Wolf Kill-rate Study 5
RESULTS AND DISCUSSION 5
1991 and 1992 DCH Censuses 5
Natality Rate of the DCH in 1990, 1991, and 1992 5
Peak Calving Dates of the DCH and Other Interior Herds 6
Determining Recruitment in the DCH 6
Harvest Monitoring 6
Determining When Major Mortality Occurs 6
Movements and Dispersal 7
Fall and Winter 1989-90 7
Calving 1990 7
Fall and Winter 1990-91 7
Calving 1991 7
Fall and Winter 1991-92 8
Calving 1992 8
Dispersal 8
Monitoring Body Condition and Weight, Determining the Influence of Summer vs. Winter Weather on Body Condition and Recruitment, and Testing a Model That Predicts Calf:100 Cow Ratio From Weight of 10-month-old Calves 8
Food Habits of Interior Herds 9
Censusing Wolves 9
Wolf Kill-rate Study 9
ACKNOWLEDGMENTS 10
LITERATURE CITED 10
FIGURE 11
TABLES 12

BACKGROUND

This report is the first annual progress report of the continuation of a long-term population dynamics study of the Delta caribou (*Rangifer tarandus*) herd (DCH) that began in 1979. Results of the 11 years of research were presented in eight

progress reports, two final reports (each covering 5 years) (Davis and Valkenburg 1985, Davis et al. 1991), and numerous scientific papers (see Davis et al. 1991).

After the last final report was published in 1991, it became apparent that the DCH was beginning a precipitous decline, and we made the decision to continue the research project. Biologists have not had an opportunity to study population declines using modern technology, and there is considerable debate over their cause (c.f. Van Ballenberghe 1985, Bergerud and Ballard 1989). This report covers data collected from 1 July 1990 to 30 June 1992. It also includes analysis of pregnancy data for 1990 that was not covered by Davis et al. (1991) and a summary of a wolf kill-rate study completed in March 1989 that was not reported on previously.

STUDY OBJECTIVES

To evaluate the influence of weather, density, food limitation, hunting, and predation on the population dynamics of the DCH and other Interior herds.

Job Objectives

Census the DCH annually from 1991 to 1995.

Annually determine the age-specific natality rate of the radio-collared caribou in the DCH.

Determine the timing of peak calf production in the DCH and other Interior herds.

Determine recruitment in the DCH.

Measure harvest by hunters in the DCH.

Determine when major mortality occurs to both calves and adults.

Monitor movements and distribution to see how range use changes with population size, and to see if dispersal occurs.

Monitor body condition and changes in body size and weight in calves and adults. Determine the influence of summer vs. winter weather on body condition and test a model that predicts recruitment from April calf weight in the Delta, Fortymile, and Nelchina herds.

Compare winter food habits of the Chisana, Delta, Denali, Macomb, Mentasta, Nelchina, and White Mountains herds.

Census the wolf population within the range of the DCH to determine if it has increased since the early to mid-1980s when the DCH was increasing.

METHODS

1991 and 1992 DCH Censuses

We censused the DCH on 23 June 1991. Three aircraft were used: Bellanca Scout with pilot and observer M. McNay and R. Hunter, Beaver with P. Valkenburg and

D. Reed, and Super Cub with D. Miller and E. Crain. All three aircraft were equipped with radio-tracking gear, but most tracking was done while visually searching assigned areas. The census method involved a complete visual search without extrapolation (Davis et al. 1979), where the radio-collared caribou were used as a supplemental check to ensure that all aggregations occurred in the area searched and that all groups were accounted for. We found all except one radio-collared caribou during the census. There were no collars on bulls.

The 1992 census took place on 29 June after a period of unusual weather. May had been extremely cold with considerable snow. In early June, daily air temperatures rose abruptly to near record highs from 8 to 12 June. The census was planned for 14 June but was delayed because of strong south winds and unseasonably cool weather that did not abate until the 28th. P. Valkenburg flew a reconnaissance flight on the evening of 28 June and found the caribou aggregating despite a fairly stiff south wind. The caribou apparently continued aggregating through the night because they were aggregated by morning and most were clustered on snow beds despite the wind. The temperature was 55 F at 5,000 foot elevation at 0800 hours on 29 June, and there was a south wind at 10-15 mph.

Three aircraft were used in the 1992 census: Beaver (P. Valkenburg, J. Ver Hoef, and R. Seavoy), Scout (M. McNay and E. Lenart), and Super Cub (J. Schnurr and R. Eagan), but because the caribou aggregations were more widely distributed, only the upper Wood River drainages were visually searched. We used the radio-census technique (Valkenburg et al. 1985) in which only groups with radio-collared individuals and groups found incidentally to radio-searching were located (except in the upper Wood River).

Natality Rate of the DCH in 1990, 1991, and 1992

In 1990, J. Davis and L. Tutterrow estimated the natality rate of the DCH through helicopter composition counts during the peak of calving (22 May) and by locating radio-collared caribou every 2-3 days from 17 to 29 May. Females with distended udders were considered pregnant in the composition counts, and radio-collared female caribou were considered pregnant if they developed a distended udder during the calving period.

In 1991 and 1992, P. Valkenburg and E. Lenart monitored only the radio-collared caribou, but each was visually located 4-5 times between 18 May and 2 June.

Peak Calving Dates of the DCH and Other Interior Herds

In 1990, in addition to the DCH, we monitored the Chisana, Fortymile, Macomb, Ray Mountains, and White Mountains caribou herds once or twice each to determine peak calving dates.

Determining Recruitment in the DCH

We estimated recruitment in the DCH through composition counts on 4 October 1990, 18 April 1991, and 1 October 1991. Composition samples were allocated based on the distribution of radio-collared caribou. We did not conduct counts in April 1992 because the calf:100 cow ratio the previous fall indicated few calves had survived the summer.

We calculated survival rates of DCH calves collared at 10 months of age in 1990 and 5 months of age in 1991 (Trent and Rongstad 1974). Caribou calves were not collared in 1989, so survival rates of this cohort could not be measured.

Harvest Monitoring

We monitored harvest through the Harvest Ticket/Harvest Report Card system for the general hunt (1-15 Sep 1989, 1-10 Sep 1990 and 1991) that was open in all of Subunit 20A except the Ferry Trail Management Area. Other hunts included a 1-15 January general open season in the Yanert Controlled Use Area, a drawing permit hunt from 1 to 31 March in Subunit 20A outside the Yanert and Ferry Trail Controlled Use Areas, and a Registration Permit Hunt from 1 to 28 February outside the Yanert Controlled Use Area. All winter hunts (except the permit drawing hunt) in Subunit 20A were closed by emergency order because of poor recruitment and the population decline. During fall 1989 and 1990, we maintained check stations at Gold King airstrip and the entrance to the Yanert trail system. Hunters were also checked at other small airstrips.

Determining When Major Mortality Occurs

We estimated calf mortality by the decline in ratio method from the peak of calving to fall in 1990, 1991, and 1992, and from fall to April in 1990 and 1991. Fifteen 5-month-old female calves were collared in November 1991 and their survival to one year of age was also estimated (Trent and Rongstad 1974). We estimated adult female mortality from survival rates of radio-collared caribou (Trent and Rongstad 1974). All functioning radiocollars not on live caribou were retrieved from the field in late March 1992 with a Robinson (R-22) piston helicopter equipped with a global positioning system (Garmin GPS100) and radio-tracking gear.

Movements and Dispersal

We located radio-collared caribou during June, August, late September, early November, and late December 1990, February, April, late August, late September, and early November 1991, and February and March 1992. In addition, all radio-collared caribou were also located several times during calving in 1990, 1991, and 1992. From May 1991 on, only one "Yanert" caribou still had a functioning radiocollar. In this report we refer to all caribou within the ranges of the Delta and Yanert herds as Delta herd caribou.

Frequencies of missing caribou were given to other researchers and agencies working in surrounding areas, including the range of the Chisana, Denali, Fortymile, Macomb, Mentasta, and Nelchina herds.

Monitoring Body Condition and Weight, Determining the Influence of Summer vs. Winter Weather on Body Condition and Recruitment, and Testing a Model That Predicts Calf:100 Cow Ratio From Weight of 10-month-old Calves

We weighed, measured, condition scored, and radio-collared a sample of 10-month-old female caribou in late March or April 1991 and 1992. In addition, we handled a sample of 5-month-old female calves in early November 1991, and replaced collars on six adult females.

Winter and summer weather data from the Big Delta, Circle, Clear, Eagle, Fairbanks, Gulkana, McKinley Park, Nabesna, and Northway climate stations were

collected and partially analyzed for the period from 1960 to 1991 to determine the possible influence of weather on the declines of Interior caribou herds. A considerable amount of work remains, but preliminary results of correlation analyses are presented in this report.

Food Habits of Interior Herds

We collected fecal pellets from the winter ranges of the Delta, Fortymile, Galena Mountain, Nelchina, Ray Mountains, and White Mountains herds. Results of microhistological analyses will be available in winter 1992-93.

Censusing Wolves

We completed a wolf census covering entire Subunit 20A in March 1992. Four Super Cubs were used over a 3-day period, and subsequent flights were made to cover inadequately monitored areas in succeeding weeks. Two wolves were collared out of one pack of 14 grays in the Dry Creek drainage, and two other wolves were collared out of a pack of 7 grays in the Tatlanika drainage to facilitate separation from adjacent packs with similar numbers and pelage color.

Wolf Kill-rate Study

From 6 March to 4 April 1989, we monitored four wolf packs two to three times a day to determine kill rates of moose, caribou, and Dall sheep (*Ovis dalli*). We were successful backtracking wolves between kills and believe that few, if any, caribou kills were missed. However, because of the 8 to 10 hours of darkness and scant evidence left at sheep kills, we believe that we could easily have missed some sheep kills.

RESULTS AND DISCUSSION

1991 and 1992 DCH Censuses

During the 1991 census, we located 36 of 37 radio-collared caribou and counted 5,755 caribou from photos and in direct counts of smaller groups (Table 1). Visual estimates of larger groups and counts of smaller groups made during the census totaled 6,654 caribou. Census conditions were good, but by the time all larger groups had been found it was late in the morning (ca. 1100 hours) and clouds were building up, making photography difficult. The 1991 census estimate was lower than expected and was about 1,000 caribou less than the population size predicted through spreadsheet computer modeling.

During the 1992 census, we found 45 of 46 active radio-collared caribou and counted 5,877 caribou (Table 2). Visual estimates made during the census totaled 4,839. The photos were generally of high quality, and some composition data could be gathered from the photos, although this had not been done at the time this report was written.

Natality Rate of the DCH in 1990, 1991, and 1992

In 1990 and 1991 the pregnancy rate of radio-collared caribou cows $\geq$36 months old declined significantly (Table 3). The mean pregnancy rate for cows $\geq$36 months was 87.7% (n = 202) from 1984 to 1989 and 71.6% (n = 74) in 1990 and 1991 (χ^2 = 9.99,

$P < 0.01$). The major component for the decline in pregnancy in 1990 and 1991 was the greatly reduced fecundity of 3-year-old females. In 1990 only 6 of 10 3 year olds produced calves and in 1991 only 2 of 7 produced calves.

In 1992 the pregnancy rate of radio-collared cows $\geq$48 months old was significantly higher than in 1990 or 1991. In 1992, 96% of those $\geq$48 months old were pregnant ($n = 28$) compared with only 79% of those $\geq$48 months old in 1991 ($n = 28$) ($\chi^2 = 4.08$, $P < 0.05$). Until 1992 we were unaware of any data on caribou that demonstrated significant variability in fecundity rates of caribou cows $\geq$36 months of age. Most variability in pregnancy rates (from counts of distended udders) in caribou herds is due to differing proportions of yearling and 2-year-old caribou in the herd and/or to the age of puberty that varies from 17 to 41 months (Bergerud 1971).

Peak Calving Dates of the DCH and Other Interior Herds

Peak calving dates for Interior herds and the Western Arctic herd are presented in Table 4. The peak of DCH calving has become later, but the peak of calving in the Fortymile herd has not changed since 1983.

Determining Recruitment in the DCH

Davis et al. (1991) confirmed findings by Bergerud (1971) and others that fall composition counts generally provide the best recruitment data for caribou herds. After fall, adult and calf mortality rates are usually similar. During the 1990s, based on findings from the Delta herd study, the Alaska Department of Fish and Game has largely abandoned late June and April composition counts except in caribou herds where it was important to know whether summer mortality occurs early (presumably perinatal mortality or bear (*Ursus americanus* and *Ursus arctos*) and wolf predation), or late (primarily wolf predation), or where it was difficult to do fall composition counts. Because winters 1989-90, 1990-91, and 1991-92 were relatively severe, we decided to continue April composition counts in the Delta herd's range. For the first time since the study began, results of these surveys demonstrated a dramatic decline in calf numbers from fall to spring (Table 5).

Harvest Monitoring

Harvest data for the 1989-90 through 1991-92 seasons are summarized in Table 6. Data from the 1989-90 and 1990-91 hunting seasons are also summarized in more detail in the biennial Caribou Management Report (McNay 1992).

Determining When Major Mortality Occurs

Calf mortality was extreme during summers 1990 and 1991. However, despite almost daily radio-tracking in May 1991, we saw no dead calves. At least 95% of calves born lived more than 48 hours. By the last few days in May (about 5 days after the peak of calving) most calving groups appeared to have few calves still with them. One wolf was seen capturing a caribou calf and appeared to be playing with the live calf and letting it go periodically, indicating that the wolf was not particularly hungry. Golden eagles (*Aquila chrysaetos*) were abundant on the calving grounds, but we saw none feeding on caribou calves.

Calf mortality was high in winters 1989-90 and 1990-91 (Table 5) as determined from the decline in the calf:cow ratio from fall to spring. In winter 1991-92

mortality of radio-collared calves from early November to late May was 12.5% (n = 8).

Adult mortality was also relatively high (Table 7). The preliminary estimate of 20% annual adult female natural mortality (6 out of 40 adults and yearlings died from 1 October 1991 to 30 June 1992) was the highest ever recorded for the DCH.

Movements and Dispersal

Fall and Winter 1989-90. During the September hunting season most DCH caribou were distributed from Dry Creek east to Hundred Mile Creek and hunters were quite successful near all of the airstrips in that area. Caribou were scarce west of the Wood River. Sometime in late September there was a westerly movement, and when composition counts were done on 10 October most caribou were in Moody Creek, the upper Tatlanika drainage, and the vicinity of Walker Dome. Virtually the entire herd moved onto the western Tanana Flats during early November. In late January, about two-thirds of the radio-collared caribou were concentrated on the southwestern Tanana Flats within 10 miles of the junction of the Rex Trail and Totatlanika River. About half of the remaining radio-collared animals were in the western foothills in the Totatlanika drainage, with the rest in the southwest Yanert drainage. All seven radio-collared caribou in the Yanert drainage were "Yanert" caribou. Snow became relatively deep by early March on the Tanana Flats and most caribou had moved south into the western foothills where the snow was also deep and hard- packed. Most of the caribou were on the ridgetops where the snow was shallow but the food was scarce. Most of the caribou trails in the area went from ridge to ridge. There were few feeding craters on sideslopes and valleys.

Calving 1990. In mid-May most caribou were on the old traditional calving area around Delta Creek. About 18 May, just as calving began, a major movement to the southwest began. Lines of caribou traveled up the West Fork Little Delta River into the Wood River and Dick Creek and across the Yanert River to Wells Creek in Unit 13. Shortly after 1 June all caribou returned to the normal postcalving range in Subunit 20A.

Fall and Winter 1990-91. Caribou were widely distributed in the foothills during the hunting season but weather was poor from 1 to 7 September. The combination of bad weather and the restricted season (1-10 Sep) combined to produce a significant harvest reduction even though caribou distribution was favorable for hunters. During the rut in early October, most caribou were in the western foothills but they moved onto the western Tanana Flats by early November. Some caribou were within 5 miles of the Fairbanks International airport by mid-November. A major snowstorm occurred in late December, and within a few days most caribou were moving south into the foothills. By mid-January only one collared animal remained on the flats. For the remainder of the winter, the herd was divided about evenly between the western foothills and the southwest Yanert drainage. This was the first winter that a large segment of the DCH used the Yanert drainage for winter range. All but one of the radio-collared "Yanert" caribou had ceased transmitting. The two herds are now mixed on all seasonal ranges and it is no longer possible to discern and collar "Yanert" herd caribou.

Calving 1991. Movements and distribution were similar to 1990 although the movement to the southwest started a few days later (about 21 May) in 1991.

Fall and Winter 1991-92. During the hunting season most caribou were on the eastern portion of the range, especially in the area north of Iowa Ridge. Because of the poor access in this area, the shortened season, and the young age structure of the remaining bulls, harvest was the lightest it has been since 1982 when the permit drawing hunt was still in effect. By October the herd had split in two groups. One group remained far to the east in the Little Delta and Delta Creek drainages and most of the rest were in the southwest Yanert drainage. Distribution remained the same throughout winter. Snow was relatively deep and hardpacked once again, especially in the trees and gullies. However, there were several "open" periods when snow on the ridges blew and/or melted off.

Calving 1992. All radio-collared caribou remained on the old traditional calving area until 22 May. After that date, half of the collared animals moved southwest into the upper Wood River with one or two continuing to Dick Creek. No collared animals or tracks crossed the Yanert and no tracks were seen in the pass to Wells Creek. Spring was very late. On 20 May the only bare ground was in the Delta Creek Impact Area and many calves were born among the target arrays on the tussock flats east of Delta Creek. Upon notification, the Air Force used spotter planes to ensure that caribou were not bombed. The caribou that moved into the Wood River moved into an area of virtually 100% snow cover. However, by the time most calves were born (24 May), a few bare patches were showing on the steeper southfacing slopes in the Wood River drainage.

Avalanching was extreme during the calving period and many caribou trails crossed avalanche chutes. Entire mountain slopes slid into valleys, forming rivers of snow in areas that are normally much too gentle for avalanches to occur. No radio-collared caribou were known to have died in avalanches although two died during the calving period, probably from other causes. During the census in late June there was a much greater number of snow fields in the mountains than in recent memory. This was despite the fact that there were several record warm days in early June in Fairbanks.

Dispersal. During the last 3 years, two radio-collared caribou could not be relocated or otherwise accounted for. Their frequencies were given to researchers in surrounding areas and we listened for them from high altitude over the ranges of the Chisana, Denali, Fortymile, Macomb, and Nelchina herds, but they were never heard. There was no evidence of dispersal of individuals from the DCH.

Monitoring Body Condition and Weight, Determining the Influence of Summer vs. Winter Weather on Body Condition and Recruitment, and Testing a Model that Predicts Calf:100 Cow Ratio From Weight of 10-month-old Calves

The primary measure of body condition in this study is body weight. Data on body weight of adults were not analyzed for this report. Mean body weights of 10-month-old calves in 1990, 1991, and 1992 were the lowest recorded since data collection began in 1979 (Table 8), and these weights were significantly different from all previous years except 1987 and 1984 (Kruskal-Wallis nonparametric ANOVA and Student Newman-Keuls multiple comparison of ranks test, $P < 0.05$). The decline in mean weight of 4 kg from fall 1991 to spring 1992 was not significant ($P > 0.05$).

There was a significant correlation between mean weight of 10-month-old calves and the fall calf:100 cow ratio from 1979 to 1991 (Fig. 1, Table 8). There was also a significant relationship between the caribou:wolf ratio and the fall calf:100 cow ratio. Using multiple regression, 10-month-old calf weight was the most important

variable in predicting fall calf:cow ratio, and the caribou:wolf ratio did not explain significant additional variation. Weight data from the Fortymile, Galena Mountain, Macomb, Nelchina, Porcupine, Western Arctic, and White Mountains herds are presented in Table 9 for comparison.

The fact that there was a significant reduction in pregnancy rate of adult (4 years and older) females in 1990 and 1991 and a significant reduction in mean body weights of 10-month-old females in 1990-92 indicates that nutrition of DCH caribou has been relatively poor in recent years. Whether the effects are primarily from poor winter or summer nutrition is still unclear; however, summer nutrition is generally agreed to be the primary factor influencing pregnancy rate. Because we have measured pregnancy rate at calving, and it is possible that in utero loss of calves could be occurring, it may not be correct to conclude that summer nutrition has been poor. However, no significant in utero loss of calves is documented in free-ranging caribou.

We are investigating the hypothesis that warmer and drier than usual summer weather has caused lowered pregnancy rates, poorer condition in adult cows, and hence lowered fall calf:100 cow ratios in the DCH and other Interior herds. Weather data and preliminary correlations with calf:100 cow ratios are presented in Tables 10 and 11. We also hypothesize that deeper than usual snow in some areas has contributed to poor performance in the herds by making it easier for wolves to catch caribou that may already be in relatively poor condition, thus increasing adult mortality. Wolves have prospered in recent years and wolf numbers are now at their highest recorded level within the range of the DCH.

Food Habits of Interior Herds

We collected about 30 fecal pellet samples but results of the analyses were not available at the time this report was written.

Censusing Wolves

There were an estimated 266 wolves within Subunit 20A in fall 1991 (Table 12). This is the highest number of wolves ever reported in 20A and exceeds the 1975 (precontrol) estimate of 239.

Wolf Kill-rate Study

During the 30 days of study the pack of 14 wolves killed six caribou, six moose, one sheep, and one wolf. The pack of seven killed two caribou and eight moose; the pack of four killed three caribou, two moose, and several snowshoe hares; and the pack of two killed seven caribou and one sheep.

Although the kill rate study indicated that wolves in the foothills were killing primarily moose (by weight) in 1989, we believe they are now (1991-92) killing a higher percentage of caribou. The foothills moose population is growing, whereas formerly it was stable (McNay 1992), and the natural mortality rate of female radio-collared caribou has probably increased.

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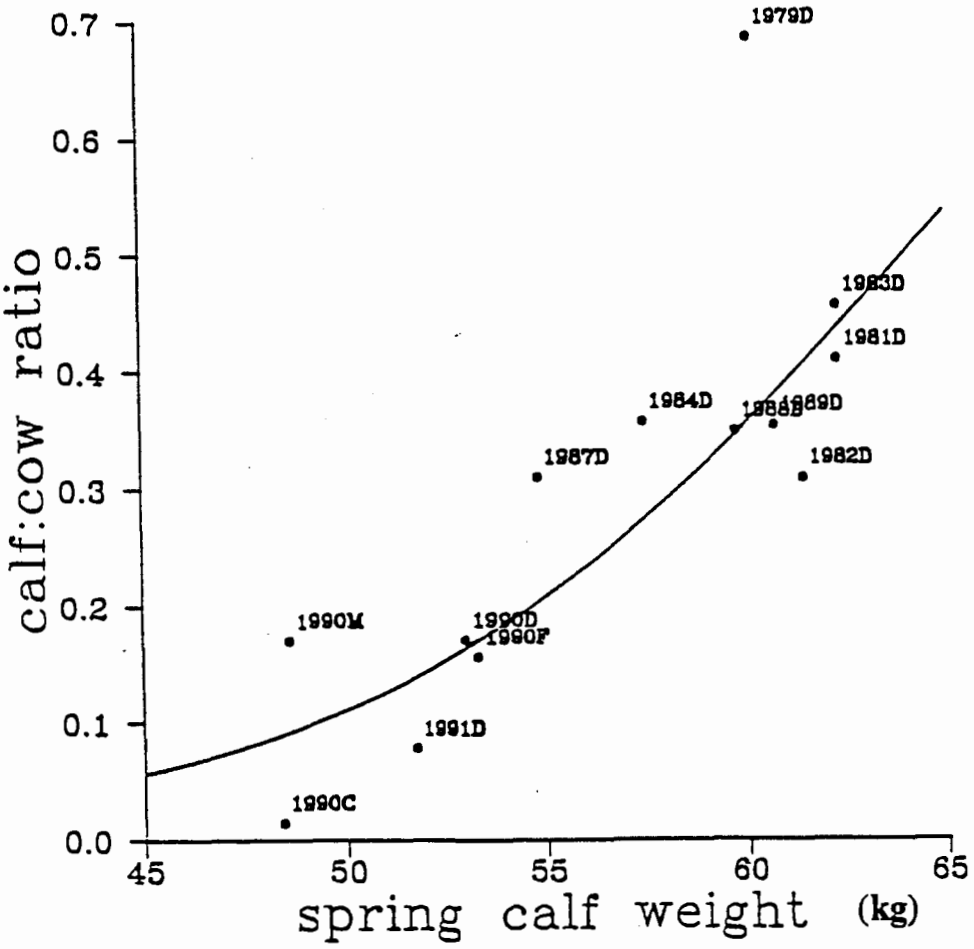


Fig. 1. Mean weight of 10-month-old female calves as a predictor of fall calf:cow ratio.

Table 1. Results of the Delta caribou herd photocensus, 23 June 1991.

Group rank	Size	Number of radiocollars	Location
1	2,666	20	Kansas, Dry, and Virginia Creeks
2	1,228	5	Upper West Fork Little Delta River
3	555	2	West Fork/East Fork/Buchanan River
4	469	1	Last Chance Creek
5	194	0	Last Chance Creek
6	191	1	Big/Little Grizzly Creeks
7	155	0	West of Wood River
8	131	1	Upper West Fork Little Delta River
9	115	4	Upper West Fork Little Delta River
10	40	0	Mystic Creek
11	5	0	Dry Creek
12	3	0	Virginia Creek
13	1	1	Tanana Flats
14	1	1	Tanana Flats
15	1	1	Yanert River
Totals	5,755	37[a]	

[a] One radio-collared caribou was not located during the census but was found alive in October.

Table 2. Results of the Delta caribou herd photocensus, 29 June 1992.

Group rank	Size	Number of radiocollars	Location
1	1,616	7	Mystic Creek
2	824	4	McIntyre Creek
3	780	5	Dry Creek
4	715	7	Upper West Fork Little Delta River
5	439	1	McIntyre Creek
6	391	4	McIntyre Creek
7	302	1	Upper Gold King Creek
8	266	4	Dry Creek
9	138	2	Wood River Glacier
10	70	1	Dry Creek
11	66	0	Head of Young Creek
12	60	2	Moose Creek (Yanert)
13	48	0	Head of Young Creek
14	47	0	Upper Wood River
15	36	0	Upper Wood River
16	25	0	Upper Wood River
17	13	0	Upper Wood River
18	7	1	Upper Revine Creek
19	7	1	Upper Healy Creek
20	4	0	Upper Wood River
21	4	0	Upper Wood River
22	3	1	Upper Moose Creek (Yanert)
23	2	0	Upper Wood River
24	2	0	Upper Wood River
25	1	0	Upper Wood River
26	1	1	Upper Yanert River
27	1	1	Tanana Flats
28	1	1	Middle Yanert
29	1	1	Moose Creek
Totals	5,870	45[a]	

[a] One radio-collared caribou was not located during the census.

Table 3. Late May pregnancy rates of radio-collared Delta herd caribou, 1984-92.

Year	Percent parturient (proportion)	
	≥36 months old	≥48 months old
1984	90 (28/31)	92 (22/24)
1985	93 (38/41)	94 (29/31)
1986	83 (33/40)	77 (24/31)
1987[a]		89 (25/28)
1988	88 (28/32)	90 (27/30)
1989	83 (25/30)	92 (22/24)
1990	72 (28/39)	76 (22/29)
1991	71 (25/35)	79 (22/28)
1992[a]		96 (27/28)

[a] In 1987 and 1992 there were no 3-year-olds in the sample of radio-collared cows.

Table 4. Peak calving dates of some Interior and Arctic caribou herds.

Herd	Year	Peak calving date
Chisana	1988	25 May
Delta	1980	17-19 May
	1981	17-19 May
	1982	17-19 May
	1983	18-19 May
	1984	18-21 May
	1985	19-20 May
	1986	17-20 May
	1987	20-25 May
	1988	20 May
	1989	after 20 May
	1990	after 20 May
	1991	24 May
	1992	24-25 May
Fortymile	1983	22 May
	1984	21-22 May
	1985	21-22 May
	1986	22 May
	1987	22 May
	1988	20-21 May
	1989	no data
	1990	20-21 May
	1991	before 25 May
	1992	23 May
Macomb	1990	24 May
	1991	24 May
Ray Mountains	1988	16 May
Western Arctic	1977	8-10 June
	1982	2 June
	1992	7-8 June
White Mountains	1990	17 May

Table 5. October and April calf:100 cow ratios in the Delta caribou herd, 1987-91.

Year	October	Following April
1987	31	29
1988	35	21
1989	36	16
1990	17	9
1991	9	n.a

Table 6. Harvest of Delta herd caribou, 1989-91.

	Reported harvest			Estimated total harvest[a]		
Year	Females	Males	Total	Females	Males	Total[b]
1989	16	464	480	18	663	681
1990	64	291	355	64	476	543
1991	22	269	294	22	322	344

[a] Estimated harvest includes reported harvest, known illegal harvest, and unreported harvest from the general hunt. These figures do not include a factor for wounding loss.

[b] Row totals include caribou of unknown sex.

Table 7. Annual total mortality rates of radio-collared female caribou older than 16 months.

Year[a]	Number on the air	Number dying	Percent mortality
1979-80	11	0	0
1980-81	29	0	0
1981-82	39	0	0
1982-83	47	3	7
1983-84	55	2	4
1984-85	50	2	4
1985-86	48	9	22
1986-87	39	4	10
1987-88	43	4	10
1988-89	46	7	15
1989-90	48	5	11
1990-91	40	6	15
1991-92	40	6	15[b]

[a] Calculated from 1 October to 30 September.

[b] Period was from 1 October to 30 June; if the same mortality rate continued through 30 September, the annual mortality rate would be 20%.

Table 8. Mean weight of 10-month-old Delta caribou herd calves, and fall calf:cow ratio, 1979-92.

Year	Mean weight of calves (n)	Calves:100 cows (number of cows counted)
1979	60.1 (11)	65 (176)
1981	62.3 (5)	41 (776)
1982	61.4 (11)	29 (908)
1983	62.3 (13)	41 (666)
1984	57.4 (12)	36 (612)
1987	54.8 (9)	36 (1,026)
1988	59.7 (12)	35 (1,801)
1989	60.7 (9)	36 (1,213)
1990	53.0 (9)	17 (1,567)
1991	51.7 (9)	8 (1,237)
1992	54.0 (17)	n.a

Table 9. Mean weights of female caribou calves from some Interior and Arctic caribou herds, 1989-92.

Herd	Time of collection	Mean body weight (kg) (n, SE)
Chisana	Early October 1990	51.2 (14, 1.70)
Fortymile	Early October 1990	53.3 (14, 1.16)
	Mid-October1991	54.4 (14, 3.03)
Galena Mountain	April 1992	only 2 weighed: 154, 127
Macomb	April 1988	53.1 (4, 0.57)
	April 1990	48.6 (12, 1.16)
Nelchina		
Unit 12	Late April 1992	56.4 (9, 0.91)
Unit 13	Late April 1992	49.7 (8, 3.24)
Porcupine	November 1991	55.9 (12, 0.95)
Western Arctic	April 1992	40.0 (14, 0.95)
White Mountains	Early October 1991	59.6 (9, 0.72)

Table 10. Fall calf:cow ratio, rainfall, summer temperature, and maximum March snow depth from 1980 to 1991 on the ranges of six Interior caribou herds.

Year	Calves: 100 cows	Total rainfall (in)	Mean summer temperature (° F)	Maximum March snow depth (in)
Chisana Herd				
1980				11
1981		4.14	49.3	7
1982	21	3.10	52.3	28
1983		6.92	51.7	22
1984		7.31	50.0	13
1985		8.89	48.7	17
1986	33	3.06	51.0	18
1987	28	3.50	51.3	11
1988	31	11.32	51.7	13
1989	13	4.23	53.3	22
1990	11	2.55	53.0	17
1991	1			17
Delta Herd				
1980		4.75	56.5	4
1981	41	5.08	54.2	4
1982	34	7.64	56.0	8
1983	41	4.62	55.3	12
1984	36	7.82	54.5	11
1985	36	4.82	55.7	25
1986	29	4.72	56.9	6
1987	31	4.56	57.5	4
1988	35	6.37	58.3	12
1989	36	6.89	59.2	10
1990	17	3.38	59.5	43
1991	8			41
Denali Herd				
1980				19
1981				8
1982				18
1983		3.76	57.3	18
1984	36	6.20	57.3	16
1985	28	2.26	56.7	37
1986	38	4.73	57.0	14
1987	37	3.35	58.7	15
1988	33	4.60	60.3	23
1989		5.63	59.0	20
1990	17	2.66	60.0	28
1991	7			35

Table 10. Continued.

Year	Calves: 100 cows	Total rainfall (in)	Mean summer temperature (° F)	Maximum March snow depth (in)
Fortymile Herd				
1980		4.81	58.1	14
1981	31	5.50	55.4	17
1982	27	3.45	56.9	20
1983	36	4.07	57.1	27
1984		4.26	55.7	19
1985	36	4.47	56.2	27
1986	28	3.19	57.0	24
1987	37	4.03	57.6	13
1988	30	4.15	59.2	27
1989	24	4.86	60.3	21
1990	29	2.70	60.0	33
1991	16			27
Mentasta Herd				
1980				11
1981	40	4.28	51.2	4
1982	39	2.45	53.8	20
1983	28	5.21	53.7	14
1984	29	5.77	52.5	20
1985	46	4.73	50.7	32
1986		2.31	52.0	15
1987	12	3.43	53.0	8
1988	18	8.58	53.3	14
1989	25	4.31	55.3	28
1990		2.36	55.3	28
1991	2			17
Nelchina Herd				
1980				11
1981	43			4
1982	54			20
1983	27			14
1984	34			20
1985	46	6.09	53.0	6
1986	42	6.87	53.2	14
1987	51	5.76	54.2	1
1988	48	7.08	55.3	13
1989	39	4.78	55.7	12
1990	33	6.04	56.3	28
1991	45			17

Table 11. Results of regressions of March snow depth, previous[a] summer rain, and previous summer temperature on fall calf:100 cow ratio in six Interior caribou herds (data in Table 10).

Herd	Correlation coefficient (r^2)		
	Previous summer rainfall	Previous summer temperature	March snowdepth
Chisana	.12	-.75[b]	-.25
Delta	.35	-.67[b]	-.8[b]
Denali	.06	-.89[b]	-.77
Fortymile	.11	-.56[c]	-.21
Mentasta	.49	-.57	.64[c]
Nelchina	.39	-.52	-.39

[a] Previous; i.e., the preceding year as opposed to the current year (e.g., rain in 1986 regressed on fall calf:cow ratio in 1987).

[b] $P < 0.05$.

[c] $P < 0.1$.

Table 12. Fall 1991 wolf population estimates for Subunit 20A.[a]

Location	Estimated number of wolves		Survey area size (km^2)	Estimated density[b] (wolves/1,000 km^2)	
	"Best" estimate	Range		"Best" estimate	Range
Total 20A	266	220-296	16,265.7[c]	16.4	13.5-18.2
Tanana Flats	124	89-131	7,680.3[c]	16.1	11.6-17.1
Tanana Foothills	142	131-165	8,585.4[c]	16.5	15.3-19.2
Non habitat	0	0	1,051.1[d]	0.0	0.0

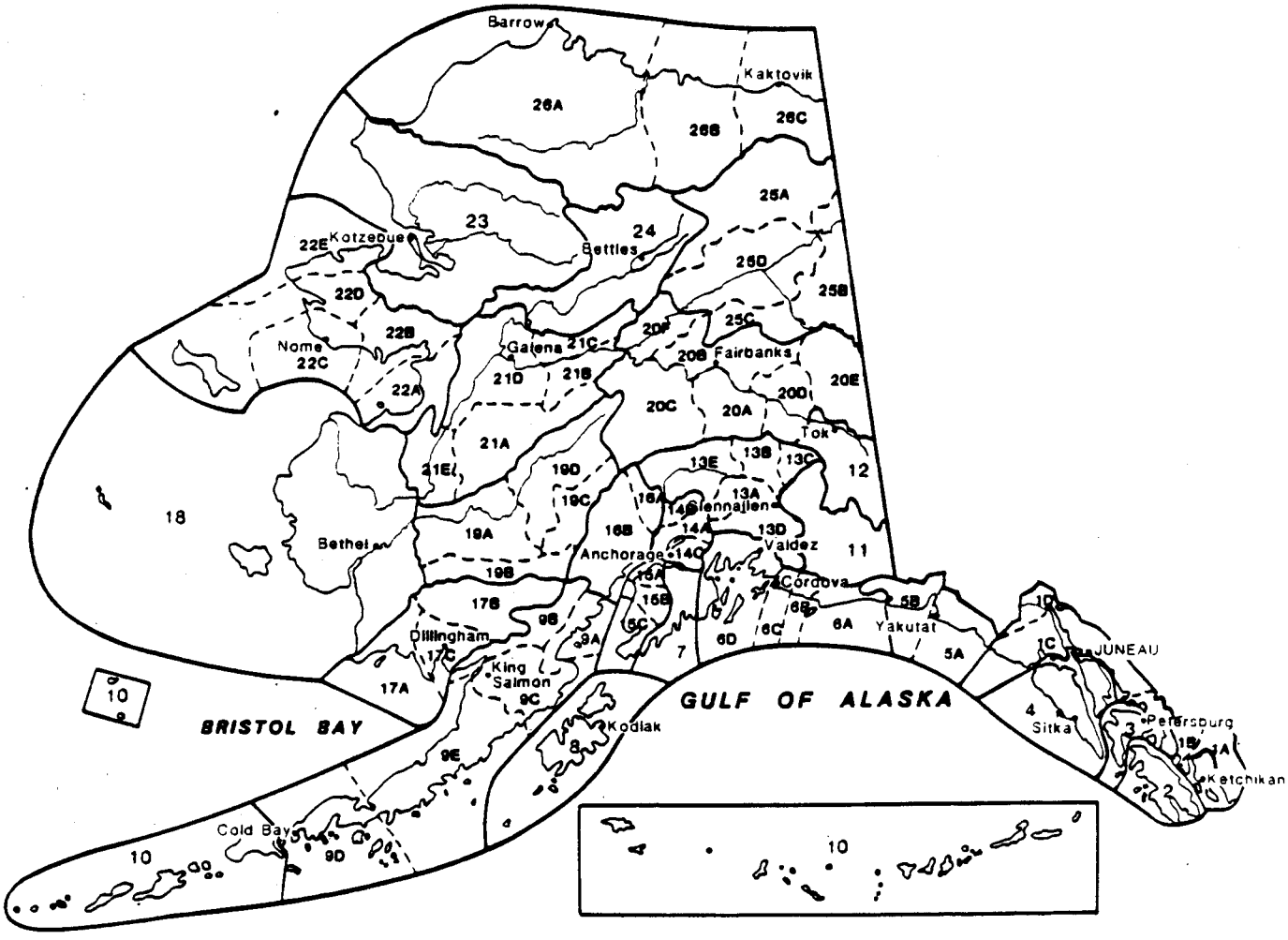
[a] Estimates based on estimated pack sizes in March 1992, plus reported harvest August-March 1991-92, plus 10% of spring estimate to account for single wolves. Minimum range estimates do not include any potential duplicate packs and include lowest pack size estimate where a range of pack size was estimated from tracks or incomplete sightings. Maximum estimate includes all potential packs, plus harvest, plus 10% of spring estimate. "Best" estimate derived by eliminating most probable duplicate counts.

[b] Densities based on wolf habitat only.

[c] Wolf habitat.

[d] Generally, glaciers and ice fields above 6,000 ft in foothills of southeastern Subunit 20A.

Alaska's Game Management Units



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