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Investigation of Regulating and Limiting Factors in the Delta Caribou Herd

Patrick Valkenburg

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Cooperator: R. Eagan, T. Boudreau, R. Tobey, J. Woolington, C. Gardner, D. Grangaard, and J. Ver Hoef, ADF&G; D. Klein, University of Alaska-Fairbanks; and L. Adams and B. Dale, National Park Service, Anchorage

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SUMMARY

The decline of the Delta caribou (*Rangifer tarandus*) herd (DCH) accelerated during 1992-93. The 1993 census indicated at least a 35% decline since 1992, although population modeling using mortality, recruitment, and previous census data indicated an 18% decline. The discrepancy could be the result of underestimates of mortality and/or an undercount during the 1993 census, although all but one of the known active radio-collared caribou were present.

Natality of radio-collared and non radio-collared DCH cows and other cows in 1993 was the lowest recorded for any Alaskan caribou herd. Only 30% (7 of 23) of radio-collared cows were parturient and only 41% of 604 cows on the main calving area were parturient. Natality rates of radio-collared cows in the Denali, Macomb, Fortymile, Chisana, Mentasta, Nelchina, Western Arctic, Teshekpuk, and Central Arctic herds were higher than in the DCH but were also lower than normal. Only the White Mountains herd appeared to have a normally high natality rate. The widespread low natality rates in both high and low density herds suggested the primary influence of an unusual weather event could either have been caused by the late spring of 1992 or an unusually severe early snowstorm in September 1992 or both. The low natality rate of the DCH compared with the Denali herd is probably nutrition-related and due to differences in density, weather, or summer range characteristics between the herds.

The 1991 and 1992 fall calf:cow ratios in the DCH were some of the lowest on record and similar to those that occurred prior to a wolf control program that began

in 1975. Data from radio-collared adult females indicated a 23% mortality rate of adults from 1 October 1991 to 30 September 1992 and a 20% mortality rate from 1 October 1992 to 30 June 1993. Five of fifteen radio-collared female calves died between 1 October 1992 and 30 June 1993. Most adults were killed by wolves (*Canis lupus*), but two of the five calves were killed by lynx (*Lynx canadensis*). Cause of death of the remaining calves was unknown.

Mean weight of 10-month-old DCH calves continued to be low in 1993, although weights of Fortymile herd calves in fall 1993 increased significantly over 1992. In the Nelchina herd there were no significant differences in calf weights among wintering areas or among years.

The DCH and Denali herd were mixed on fall and winter ranges and moved much farther north and south than usual. However, by late May all but one radio-collared caribou in each herd had returned to their respective historical ranges.

Key Words: caribou, Delta herd, Denali herd, lynx, mortality, natality, Nelchina herd, noise, nutrition, predation, *Rangifer tarandus*, weather, wolf

CONTENTS

BACKGROUND

This report is the second 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. The results of the first 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). Predator/prey relationships and human harvest of moose (*Alces alces*), caribou, 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.* (1993).

Since this study began in 1979, the DCH has gone through four growth phases. The first was a period of rapid growth from 1979 to 1982 ($r = 0.18$) when recruitment was high and natural and hunting mortality was low. The second was a period of slow growth ($r = 0.05$) from 1982 to 1985 when recruitment was moderate to high, natural mortality was low to moderate, and hunting mortality was high. During the third

phase, also involving slow growth (r = 0.07), recruitment was moderate, natural mortality was moderate to high, and hunting mortality was low. From 1989 to 1992 the herd was in a rapid decline (r = -0.20) with low recruitment, high natural mortality, and low human harvest. The present study has enabled biologists to gather population data from a rapidly declining Alaskan caribou herd for the first time.

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 from 1991 to 1995 annually.

Determine the natality rate and timing of calving in the DCH annually.

Determine recruitment through fall and spring composition counts annually.

Monitor harvest annually.

Collar male and female calves in fall to assess the accuracy of April composition counts and timing of mortalities.

Determine the weight and size of calves in April to determine the influence of summer vs. winter weather on body condition, and test a model that predicts recruitment (i.e., fall calf:100 cow ratio) from April calf weights in the Delta, Fortymile, and Nelchina herds annually.

Analyze weather data to determine if weather is a factor that limits the DCH.

Assess and analyze food habits of the DCH and other Interior herds.

Monitor movements, dispersal, and mortality in the DCH.

Annually collar female calves in fall to maintain known-aged cohorts in the DCH.

Recollar adult females to maintain cohorts of collared, known-age females.

METHODS

We censused the DCH on 15 June 1993 with four aircraft, two of which were equipped with radio-tracking gear. As in 1992, the census involved both complete visual searching of some areas (i.e., upper Wood and Yanert River drainages and Wells Creek drainage) and radio-searching surrounding areas (Davis et al. 1979).

In late May 1993 we estimated the natality rate of radio-collared DCH females by observing them from a Bellanca Scout aircraft and documenting the presence or absence of a calf, hard antlers, and/or a distended udder. All yearling and 2-year-old females were observed at least twice, and older caribou were observed at least three times from 18 May to 29 May. On 25 May (estimated to be 1-2 days after the peak of calving) we used a Bell 206 Helicopter to classify caribou cows in the major calving area in Wells Creek and the upper Yanert River as parturient or nonparturient based on the presence or absence of distended udders.

We conducted only a fall composition count during this reporting period. Because calf numbers were so low by late September a further decline would have had little effect on herd growth rate. In addition, because calves were collared at 5 months of age we were able to estimate their overwinter survival rate without conducting an April composition count. We used a Bellanca Scout and Bell 206B helicopter on 28 September to locate radio-collared caribou and sample age and sex composition within the herd. Caribou were classified into five categories: large, medium, and small bulls; cows; and calves.

We did not need to monitor harvest in 1992-93 because there was no open season.

During 2-3 October 1992 we radio-collared 15 female calves from groups of caribou migrating north across the Tanana Flats 5-10 mi south of Fairbanks. Calves were darted from a Robinson R-22 helicopter with a combination of 1 mg Carfentanil and 65 mg Xylazine in 1 cc Cap-Chur darts with 3/4-inch needles. Collaring of male calves to ascertain the distribution of male vs. female calves in April was deferred until fall 1993 due to lack of funding.

We sampled weights of female DCH calves in October, in conjunction with collaring, and in late April. Capture methods used in April were the same as those used in October. Weights of Fortymile calves were sampled in fall, in conjunction with collaring, for an ongoing study of predator/prey/nutrition relationships in that herd (Wildlife Research Study No. 3.38). April weights were obtained from Nelchina calves collected along the Denali Highway and near Northway. Carcasses were distributed among local residents of Glennallen and Northway.

We continued to analyze weather data and operated a rain gauge on the upper Wood River from 2 June to 28 July in conjunction with a cooperative project with the

Alaska Cooperative Wildlife Research Unit (Study No. 19.43). This project is designed to investigate the hypothesis that the increased sunshine during warm summers results in poorer nutrition available from diamondleaf willow (*Salix pulchra*).

We continued to collect fecal samples from the DCH and other Interior herds, but due to delays in analysis the results were not available when this report was written.

We monitored movements, dispersal, and mortality by locating radio-collared caribou from fixed-wing aircraft in September, October, December, January, February, March, April, May and late June. A Robinson R-22 helicopter was used to retrieve collars from dead caribou in early March and again in late April 1993.

During early March 1993 we recollared six adult caribou whose collars were over 5 years old. Two other adults whose 5-year-old collars had been functioning in October became inactive over winter and were not found in April. They will be recollared as opportunities arise.

RESULTS AND DISCUSSION

1993 Census

During the 1993 census we counted 3,661 caribou in a 1,008-mi^2 area of the upper Wood, West Fork Little Delta, and Yanert rivers, and Wells Creek drainages (Table 1). The total count was somewhat lower than expected when compared with a mathematical model of mortality, recruitment, and previous census data that predicted an October 1993 population of about 4,500. Possible explanations for this discrepancy include underestimation of mortality rates of adult females and undercounting of caribou during the 1993 census. Because some caribou (especially bulls) may have remained on the Tanana Flats or other areas after their wider than usual dispersal during winter, they may not have been present in post-calving aggregations. One of 47 radio-collared caribou with functioning collars was in the upper Jack River drainage in Unit 13 indicating that a few caribou may not have returned to the Delta herd. In addition, we received reports of caribou in the area northeast of Eielson Air Force Base during summer.

In the adjacent Denali herd, which also dispersed widely during winter 1992-93, all collared adult females and almost all collared males returned to the calving area in May. One collared 2-year-old female also remained in the Jack River drainage (L. Adams, pers. commun.).

Natality Rate of the DCH and Other Herds in 1993

Only 30% (7 of 23) of the DCH radio-collared caribou ≥ 3 years of age and 43% (6 of 14) of those ≥ 6 were pregnant in late May 1993 (Table 2). Within the main calving area 1-2 days after the peak of calving (estimated to be 23-24 May) in upper Wells Creek, we classified 690 caribou from a helicopter, including 604 cows, 59 calves, and 27 bulls. Only 245 of the 604 cows (41%) were parturient (distended udder, hard antlers, or calf at heel). This is the lowest recorded pregnancy rate that we are aware of in caribou. In other Interior herds the proportion of parturient females was also generally low among radio-collared individuals ≥ 3 years old: Nelchina, 19 of 29 (66%); Chisana, 8 of 16 (50%); Mentasta, 26 of 37 (70%); Fortymile, 31 of 47 (66%); Macomb, 6 of 8 (75%) (ADF&G files; K. Jenkins, pers. commun.). Preliminary reports from the Western Arctic, Teshekpuk, Central Arctic, and possibly the Porcupine herd, also indicated lower than normal parturition rates (ADF&G files; B. Griffith, pers. commun.). Only in the White Mountains herd did parturition rate appear to be high or normal (five of five adults and one of six 2-year-olds), although the sample size was small. In contrast, pregnancy rates (determined by serum progesterone levels) of females in the small caribou herds in the Yukon Territory appeared normal (R. Farnell, pers. commun.).

The low parturition rates of caribou in Interior and northern Alaska were an unusual and widespread phenomenon suggesting the influence of unusual weather. During the previous year (1992) spring was unusually late (latest leafout on record in Fairbanks, 25-26 May). In addition, a severe snowstorm that dropped 18-24 inches of wet snow occurred during 11-17 September, which was about 2-3 weeks prior to ovulation in Interior and Arctic caribou herds. This storm came from northwestern Alaska and tracked southeast through the Interior. The heaviest snows occurred on the north side of the Alaska Range with lighter snowfall in the Nelchina Basin and western Yukon Territory. Snow was unusually deep from late September through late January in Interior Alaska from Delta Junction westward and north-westward. Little snow fell after January, and the winter became more mild with an early breakup and leafout in 1993.

The low pregnancy rate of the DCH compared with the Denali herd may be nutrition-related and due to differences in density, weather, or summer range characteristics.

1992 Fall Composition Count

The fall calf:cow ratio was the fourth lowest since the early 1970s and similar to 1991 (Table 3). We speculate that the bull:cow ratio probably continued to decline, despite the absence of harvest, because of the increasing mean age of bulls and low recruitment.

Weight and Size of Calves in April

Mean weight of 10-month-old DCH calves handled in April 1993 was relatively low (Table 4) and predictive of a low fall 1993 calf:cow ratio (Valkenburg 1992: Fig. 1). Female calves were rare in spring 1993 and difficult to find for sampling. In addition, Delta and Denali caribou were mixed in the western foothills of Subunit 20A until mid-April. Four calves collared by National Park Service biologists in the vicinity of Rex Dome in March were probably Delta caribou and remained with the Delta herd during summer. Three of these were weighed and their weights are included in the Delta herd sample in Table 4.

Fall weights of female DCH calves were significantly lower in 1992 than in 1991 ($t = 1.83$, $df = 26$, $0.05 < P < 0.1$), and there was a significant overwinter weight loss in female calves between fall 1991 and spring 1992 ($t = 2.27$, $df = 29$, $0.02 < P < 0.05$) (Tables 4 and 5). These data are consistent with the hypotheses that summer and/or fall weather was unfavorable for the DCH in 1992 because of the dry and short summer (Table 6), the unusual snowstorm in September, and the relatively severe 1991-92 winter.

In the Nelchina herd in April 1993 there were no significant differences in calf weights among calves that wintered in Unit 13 vs. northern Unit 12, as there were in 1992 (Valkenburg *et al.* 1993). Snow depth was less in Unit 13 in March 1993 than in 1992 (Tables 5 and 6). In the Fortymile herd, weights of female calves handled in 1993 were significantly heavier than those handled in 1992, suggesting an improvement in condition ($t = 1.77$, $df = 26$, $0.05 < P < 0.1$).

Weather as a Factor in the Decline of the DCH

We continued to monitor weather variables including mean June-August temperature, rainfall from 15 June to 15 August, and maximum March snow depth. Summers 1991 and 1992 were not as hot as 1989 and 1990, but precipitation was still generally below normal (Table 6). Preliminary results of regression analyses were presented in a previous report (Valkenburg 1992). Two graduate students are beginning projects to assess the influence of weather on the nutrition of Chisana caribou and on weather/insect/caribou interactions in the DCH.

As mentioned in a previous section, two unusual weather events occurred in 1992. One was an extremely late green-up, and the other was a severe September snowstorm. We suspect that one or both of these events contributed to the low natality rate in May 1993. Winters 1991-92 and 1992-93 were also relatively severe on the DCH range.

Movements, Dispersal, and Mortality in the DCH

The DCH exhibited unusual movements beginning in September 1992 following the severe September snowstorm. By 22 September radio-collared DCH caribou were centered in the vicinity of Rex Dome, and by 28 September (the day composition counts were done) they were moving north onto the Tanana Flats where the leaders were east of the mouth of the Wood River on the south bank of the Tanana River. The Denali herd was also moving north and east onto the flats west of Clear and were beginning to cross the Nenana River, the Alaska Railroad, and the Parks Highway. Within a few days the two herds were mixed on the Tanana Flats where a northeasterly movement continued. By 1 October caribou were crossing the Tanana River near Rosie Creek and Bonanza Creek and moving through Cripple Creek Subdivision and the community of Ester. Some of these caribou (including two DCH and two Denali animals with radiocollars) continued north as far as the White Mountains where they mixed with the White Mountains herd. Most of the caribou wintered in the Chatanika and Washington Creek drainages near the Trans-Alaska Pipeline. Another portion of the movement crossed the Tanana River in the vicinity of Eielson Air Force Base where most wintered. The major winter concentration was within a mile of the east end of the Eielson runway within the base perimeter fence. Although some caribou had trouble crossing the 5 ft high fence, most apparently jumped over it because the snow was about 2 ft from the top. Base personnel also removed some fence sections in problem areas. During daylight hours the noise of landing and departing military aircraft was intense, but the caribou remained within the Eielson vicinity until late April. A few caribou continued northeast into the North Fork Salcha and upper East Fork Chena rivers. There were also some reports of caribou moving through Delta Junction in early December, but there were no radiocollars associated with these and they probably numbered less than 100. By late December about half of all radio-collared DCH caribou were north of the Tanana River. About a half dozen radio-collared Denali caribou wintered with the groups near Eielson and a similar number wintered with the groups northwest of Fairbanks. Most Denali caribou wintered southwest of Nenana, but a few also wintered south of the Alaska Range as far as Chulitna Pass (L. Adams, pers. commun.).

Most of the remaining DCH animals were on the southern Tanana Flats in late December, but these soon moved south into the Alaska Range. In February some DCH caribou, including four with radiocollars, moved south into the Wells Creek and Jack River drainages in Unit 13.

Spring movements began late. Some caribou, including most of those from the Eielson area, started south toward the Alaska Range in late April, but those northwest of Fairbanks did not move appreciably until about 5 May. Many of these caribou moved through the Fairbanks metropolitan area and some had difficulty negotiating developed areas. Two caribou that became stranded in downtown

Fairbanks had to be immobilized and taken to the Tanana River and released. One herd of about 75 emerged from the trees at the junction of two heavily traveled roads (College Road and University Avenue) and headed south down University Avenue with state police providing assistance with traffic. Many of the caribou moving through the Fairbanks area reached the Tanana River after breakup, which occurred about 23 April. One cow was photographed by a news reporter as she tried to swim the Tanana amid ice chunks. She was unsuccessful and returned to the north side. Within a few days after breakup, ice largely ceased flowing and crossing became easier. By 25 May all radio-collared caribou had returned to the upper Wood River and Yanert River. What little calving there was occurred in the upper Wood River, Dick Creek, Yanert River, and Wells Creek. Only one radio-collared caribou (a 2-year-old female) failed to return to previously used DCH range by the time of the census in late June.

There was no known dispersal from the DCH except perhaps for the one radio-collared 2-year-old that remained in the Jack River drainage in late June. However, there were reports of individual caribou northeast of Eielson during the summer, and they were probably from the DCH. Perhaps they were bulls that failed to return to the DCH range.

Mortality of radio-collared adult female Delta caribou from 1 October 1991 to 30 September 1992 was the highest recorded since this study began (Table 7). Of the nine that died, four were killed by wolves during winter and five were killed probably by wolves during summer. Mortality was also high from 1 October 1992 to 30 June 1993. Of the six that died, three were killed by wolves during winter, one was killed by a coyote (*Canis latrans*) in winter in Goldstream Valley, and two were killed probably by wolves during May and June. The cow that was killed by the coyote also had an accumulation of ice on the front of her collar, which probably contributed to her susceptibility to predation.

From 1 October 1991 to 30 September 1992, 3 of 13 calves (23%) died (probably from wolf predation) over winter. From 1 October 1992 to 30 June 1993, 5 of 15 calves died, 3 from unknown causes and 2 from lynx predation. However, the 1992-93 sample may have underestimated mortality due to wolf predation because all of the calves were collared near Fairbanks and they wintered in the Fairbanks area where wolves were scarce. It may be significant that adult lynx were relatively abundant in 1992-93, but hares (*Lepus americanus*) were scarce. Lynx predation on caribou calves is generally rare in Interior Alaska, but in 1992-93 there were four cases of radio-collared calves or yearlings killed by lynx. Three of the those occurred in the DCH and one occurred in the Fortymile herd (R. Boertje, pers. commun.).

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PREPARED BY:

Patrick Valkenburg
Wildlife Biologist III

SUBMITTED BY:

Daniel J. Reed
Research Coordinator

APPROVED BY:

David G. Kelleyhouse, Director
Division of Wildlife Conservation

Steven R. Peterson, Senior Staff Biologist
Division of Wildlife Conservation

Table 1. Results of the Delta caribou herd photocensus, 15 June 1993.

Group rank	Size	Number of radiocollars	Location
1	1,015	17	Upper Kansas Creek
2	526	8	Upper Kansas Creek
3	261	4	Edgar Creek
4	217	2	Upper Bonnifield Creek
5	192	0	Upper Bonnifield Creek
6	175	1	Upper Wells Creek
7	173	1	Copper Creek
8	147	2	Upper Wells Creek
9	140	2	Upper Wood River
10	131	1	Upper Wells Creek
11	97	0	Upper Dick Creek
12	94	0	Upper Bonnifield Creek
13	86	0	Upper West Fork Little Delta
14	64	0	Upper Wells Creek
15	55	1	Upper Kansas Creek
16	46	0	Upper Kansas Creek
17	32	0	Upper Wood River
18	28	0	Upper Wood River
19	28	0	Upper Wood River
Subtotal	3,507	39	
	154	4	Sum of 19 groups of less than 20 caribou each
Total	3,661	43	

Table 2. Late May pregnancy rates of radio-collared Delta herd caribou, 1984-93.

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)
1993	30 (7/23)	39 (7/18)

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

Table 3. Fall composition counts and April calf:100 cow ratios in the Delta caribou herd, 1970-92.

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
10/21-23/70[a]	77	34	14	43	--	--	--	33	896
10/29-31/71[a]	29	15	10	65	--	--	--	19	1,139
10/27-31/72[a]	33	11	7	67	--	--	--	22	1,185
10/23-24/73[a]	29	10	7	70	--	--	--	20	1,050
10/23-25/74[a]	28	2	1	76	--	--	--	21	1,141
10/29-31/76[a,b]	38	45	24	54	--	--	--	21	1,055
10/26-31/77[a]	33	42	23	55	--	--	--	18	1,365
10/26/78	75	39	17	45	--	--	--	33	725
12/7/79	39	65	32	49	--	--	--	19	361
10/25/80	85	49	21	43	--	--	--	36	1,369
10/2/81	46	41	22	53	47	3	50	25	1,451
10/8/82[c]	42	31	18	58	48	4	48	24	1,565
10/4/83	35	46	25	55	59	6	36	20	1,208
10/17/84	42	36	20	56	28	32	40	24	1,093
10/9-12/85	49	36	20	54	57	24	19	26	1,164
10/22/86	41	29	17	59	49	30	21	24	1,934
10/05/87	32	31	19	61	53	23	24	20	1,682
10/14/88	33	35	21	60	50	38	12	20	3,003
10/10/89	27	36	22	62	64	28	7	16	1,965
10/4/90	38	17	11	65	45	39	16	24	2,411
10/1/91	29	8	6	73	55	29	16	21	1,705
9/28/92	25	11	8	74	46	43	11	19	1,240

[a] Indicates ratios may not be comparable because yearlings were classified in this count.
[b] Wolf control began in 1975.
[c] Wolf control ended in 1982.

Table 4. Mean weight of 10-month-old Delta caribou herd calves and fall calf:cow ratio, 1979-93.

Year	Mean weight of calves (lb) (kg, *n*)	Calves:100 cows (number of cows counted)
1979	132.3 (60.0, 11)	65 (176)
1981	137.0 (62.1, 5)	41 (776)
1982	135.1 (61.3, 11)	29 (908)
1983	137.2 (62.2, 13)	41 (666)
1984	126.9 (57.5, 14)	36 (612)
1987	120.8 (54.8, 9)	36 (1,026)
1988	131.3 (59.6, 12)	35 (1,801)
1989	133.6 (60.6, 9)	36 (1,213)
1990	119.9 (54.4, 9)	17 (1,567)
1991	113.1 (51.3, 9)	8 (1,237)
1992	119.1 (54.0, 17)	11 (1,240)
1993	122.3 (55.5, 12)	na

Table 5. Mean weights of female caribou calves from some Interior and Arctic caribou herds, 1989-93.

Herd	Time of collection	Mean body weight (lbs) (*n*, SE)
Delta	Late April 1979	132.3 (11, 2.33)
	Late April 1981	137.0 (5, 3.01)
	Late April 1982	135.1 (11, 3.67)
	Late April 1983	137.2 (13, 3.16)
	Late April 1984	126.9 (14, 1.23)
	Late April 1987	120.8 (9, 2.63)
	Late April 1988	131.3 (12, 2.81)
	Late April 1989	133.6 (9, 2.59)
	Late April 1990	119.9 (12, 3.15)
	Late April 1991	113.1 (10, 2.16)
	Late April 1992	119.1 (17, 2.56)
	Late April 1993	122.3 (12, 2.77)
	Early October 1991	127.6 (14, 2.51)
	Early October 1992	120.4 (4, 2.92)
Chisana	Early October 1990	112.6 (14, 3.62)
Fortymile	Early October 1990	117.3 (14, 2.45)
	Mid-October 1991	120.7 (14, 2.90)
	Early October 1992	129.2 (14, 3.60)
Galena Mountain	April 1992	only 2 weighed: 154, 127
Macomb	April 1988	117.1 (4, 1.26)
	April 1990	107.3 (12, 2.45)
Nelchina		
Unit 12	Late April 1992	124.4 (9, 2.56)
Unit 13	Late April 1992	109.4 (8, 6.70)
Unit 12	Late April 1993	125.7 (7, 3.67)
Unit 13	Late April 1993	118.0 (11, 3.14)
Porcupine	November 1991	123.2 (12, 2.09)
Western Arctic	April 1992	87.0 (16, 1.97)
	October 1992	89.2 (13, 3.91)
	April 1993	82.1 (14, 2.13)
White Mountains	Early October 1991	131.6 (9, 4.46)

Table 6. 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) (15 Jun-15 Aug)	Mean summer temperature (°F)	Maximum March snow depth (in) at nearest climate station
Chisana Herd (Nabesna climate station)				
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	3.20	51.0	17
1992	0	8.45	52.0	18
Delta Herd (Healy and Delta climate stations)				
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	4.48	56.3	41
1992	11	4.79	58.0	33
Denali Herd (Minchumina climate station)				
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

Table 6. Continued.

Year	Calves: 100 cows	Total rainfall (in) (15 Jun-15 Aug)	Mean summer temperature (° F)	Maximum March snow depth (in) at nearest climate station
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	3.34	57.0	35
1992	16	4.08[a]	58.0	12
Fortymile Herd (summer data from Delta, Eagle, and Circle climate stations)				
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	2.97	56.0	27
1992	30	3.87	58.7	20
Mentasta Herd (summer data from Nabesna and Gulkana climate stations)				
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	3.51	52.7	17
1992	6	6.42	53.7	18

Table 6. Continued.

Year	Calves: 100 cows	Total rainfall (in) (15 Jun-15 Aug)	Mean summer temperature (° F)	Maximum March snow depth (in) at nearest climate station
Nelchina Herd (summer data from Talkeetna and Cantwell climate stations)				
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	5.85	55.3	13
1989	39	7.08	55.7	12
1990	33	4.33	56.3	28
1991	45	6.04	54.5	17
1992	40	4.01	54.3	18, 25[b]

[a] Healy

[b] Northway, Gulkana

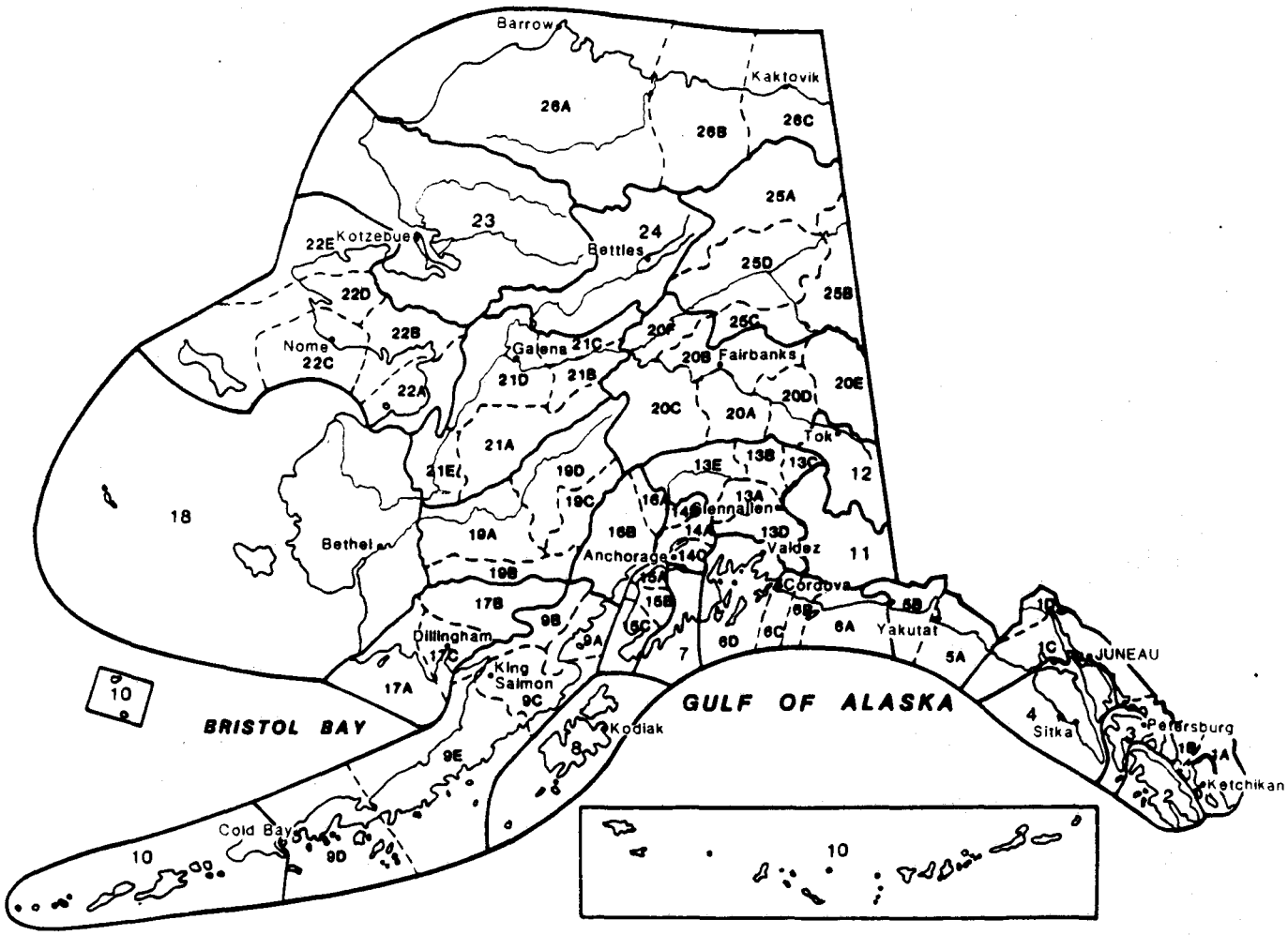
Table 7. Annual total mortality rates of radio-collared female caribou older than 16 months.

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	9	23
1992-93	30	6	20[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 27%.

Alaska's Game Management Units



Federal Aid in Wildlife Restoration

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 then allots the funds back to states through a formula based on each state's geographic area and the number of paid hunting license holders in the state. Alaska receives 5% of the revenues collected each year, the maximum allowed. The Alaska Department of Fish and Game uses the funds to help restore, conserve, manage, and enhance wild birds and mammals for the public benefit. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes necessary to be reponsible hunters. Seventy-five percent of the funds for this project are from Federal Aid.