Alaska Department of Fish and Game
Division of Wildlife Conservation

Federal Aid in Wildlife Restoration
Research Progress Report

Factors Limiting the Fortymile Caribou Herd

by

Rodney D. Boertje
Craig L. Gardner
and
Patrick Valkenburg

Project W-24-1
Study 3.38
October 1993

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PROGRESS REPORT (RESEARCH)

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SUMMARY

Adverse weather conditions and the simultaneous declines of the Fortymile caribou (*Rangifer tarandus granti*) herd and several Interior herds in 1989-90 and 1990-91 stimulated research on several herds where historical data prevailed. Study of the Fortymile herd was also stimulated by proposals to increase the herd using wolf control. This initial work was aimed at evaluating whether malnutrition was a significant factor limiting the herd in 1992; if malnutrition is a major factor limiting the herd, then wolf control may be ill-advised. Progress this period focused on: (1) estimating herd size, (2) estimating mortality and natality rates and cause of death, and (3) evaluating whether malnutrition was a significant factor affecting herd demographics.

Census data indicate the adult portion of the herd declined 8-9% in 2 years from June 1990 to June 1992. We counted 21,884 caribou in the herd during June 1992.

Mortality rates of adult collared caribou were consistently high during 1989-92 (>16%), and these values, combined with data on lowered recruitment, predicted prior to the census that the herd had declined slightly from 1989 or 1990 through June 1992. The annual mortality rates for the period 1 October 1991 through 1 October 1992 were 17% for adult collared females older than yearlings (n = 35) and 8% for collared yearlings (birth year 1990, n = 12). Overwinter mortality (1 Oct-30 Apr) was 50% for collared calves (birth year 1991, n = 14), but we assumed an overwinter calf mortality of only 14%, as observed in winter 1990-91, because many collared calves were inadvertently orphaned in fall 1991.

Of the 15 collared caribou that died during 1 October 1991-1 October 1992, at least 13 (87%) were killed by wolves, based on evidence of a violent death (blood on collar), sign at the death site, and timing of death. Wolf predation was also the major cause of adult female mortality in the early and mid-1980s when the herd was growing at 10% per year (Valkenburg and Davis 1989), but mortality from predation has apparently increased in recent years.

Caribou nutritional status during May-September 1992 was high, and apparently has improved since 1990 and 1991. High nutritional status was indicated by (1) a significant increase ($P \leq 0.09$) in fall calf body weights during 1992 compared with 1990 and 1991, (2) a high pregnancy rate (87%, n = 39) among females $\geq$36 months old, and (3) insignificant (3%, n = 30) loss of calves during the first 48 hours of life. High loss of

caribou calves during the first 48 hours of life (20-30%) is indicative of malnutrition (L. Adams *et al.*, unpubl. data).

We conclude from this initial work and past studies that the Fortymile herd can be expected to increase rapidly ($\geq$ 15% annually) if predation is significantly reduced and caribou productivity and body condition remain similar to or better than those observed during summer and fall 1992. Further, it appears the draft management objective of attaining 60,000 caribou by the year 2000 is achievable if the herd grows at 15% annually during 1993-2000.

Key Words: Alaska, caribou, condition, Fortymile caribou herd, mortality, nutritional status, pregnancy rate.

CONTENTS

BACKGROUND

The Fortymile caribou (*Rangifer tarandus granti*) herd has a great potential for growth. Potential for growth is indicated by Murie's (1935) estimate of 568,000 caribou during a 20-day migration across the Steese Highway in 1920 compared with an aerial count of 21,884 caribou in 1992. Virtually all of the historical range of the herd is currently available for use by the herd if herd growth would occur.

Population objectives for increasing the Fortymile caribou herd have wide public support, both in Alaska and the Yukon, because much of the herd's former range was abandoned as herd size decreased. Both nonconsumptive and consumptive uses of the herd declined as herd size decreased. Interim draft objectives call for increasing the herd to 50,000 adults or 60,000 caribou by the year 2000 (Kelleyhouse 1990). These management objectives were written in the mid-1980s when the herd was growing at 10% per year and when population objectives were likely to be attained naturally without predator control. However, the adult portion of the herd declined between 1990 and 1992. Current expectations are that the herd will not naturally reach 60,000 by the year 2000. Wolf (*Canis lupus*) control has been proposed to help reach population objectives.

The decline in the herd from about 50,000 in 1960 to only 6,500 in 1973 was partly a result of errors in the prevailing management beliefs. Overharvesting was allowed in the early 1970s, and simultaneous high numbers of wolves helped cause the herd to decline to critically low levels (Davis *et al.* 1978, Valkenburg and Davis 1989). Had this overharvest been prevented, the herd would likely have declined to only 10,000-20,000 animals and may have increased to 40,000-50,000 caribou during favorable conditions in the 1980s. The prevailing management belief at the time was that the growth rate of the herd would increase as density declined, so reduced densities and high harvests were encouraged. In addition, it was mistakenly believed that hunters and predators killed many animals that otherwise would die before successfully reproducing. A major

error was the mistaken belief that wolf and bear (*Ursus* spp.) predation were minor influences on the herd. Also, the size of the Fortymile herd was grossly overestimated and the trend in herd size inadequately monitored (Davis *et al.* 1978, Valkenburg and Davis 1989).

Today, harvest programs for caribou are managed much more conservatively than in the 1970s, especially during natural declines of caribou to low levels. Since 1980, radiotelemetry has provided the ability to efficiently estimate herd size, recruitment, mortality, causes of mortality, and nutritional status. Today, managers know that adverse weather can initiate declines in caribou herds. Adverse weather in Interior Alaska in 1989-90 and 1990-91 and the simultaneous decline of several Interior caribou herds was, in part, the stimulus for this renewed study of the Fortymile herd. Following periods of adverse weather, prolonged declines in caribou herds are often caused by increased wolf predation because declines in wolf numbers lag behind declines in caribou (predator lag). The proportion of the herd killed by wolves each year increases as caribou decline, because the same number of wolves are preying on fewer caribou each year for several years following the initial decline. It is a well-accepted belief today that wolf and bear predation are often the major factors limiting caribou and moose (*Alces alces*) at low densities (Davis *et al.* 1978, 1983; Gasaway *et al.* 1983, 1992; Boertje *et al.* 1987, 1988; Adams *et al.* 1989; Larsen *et al.* 1989; Valkenburg and Davis 1989).

Ungulate-predator relationships were studied in a portion of the Fortymile herd's range during the mid-1970s and the 1980s (Davis *et al.* 1978; Boertje *et al.* 1987, 1988; Valkenburg and Davis 1989; Gasaway *et al.* 1992). These studies summarized historical and recent predator-prey relationships and documented that predation was the major factor limiting recovery of caribou and moose populations in the area. From 1981 through 1987, management actions were implemented to reduce grizzly bear (*Ursus arctos*) and wolf predation in a portion of the Fortymile herd's range (Valkenburg and Davis 1989, Gasaway *et al.* 1992). Planned reductions in wolf numbers by department personnel were prematurely terminated for political reasons, and grizzly bear numbers were only moderately reduced in a small portion of the range. Subsequent slow increases in moose and caribou numbers could not be definitively linked to predator control.

A test for the effectiveness of predator control necessarily involves large reductions in predator abundance (Crete and Jolicoeur 1987; Farnell and Hayes, in prep.). Large reductions in wolf numbers resulted in dramatic increases in caribou numbers in central Alaska (Gasaway *et al.* 1983) and eastcentral Yukon (Farnell and Hayes, in prep.). In both studies, only 15-31% of the original precontrol wolf numbers remained by spring during the 4 to 6 years of effective control efforts.

Failure to address management objectives for the Fortymile herd will reduce agency credibility and public support. However, recommendations for predator control must be well substantiated, and monitoring programs must be in place to evaluate the efficacy of predator control. If factors other than predation are largely limiting the herd, then predator control should not be implemented. Detailed studies of herd demographics and nutritional status, together with results of past studies, can help predict the effects of predator control on the herd.

GOAL

Our goal is to determine demographics of the Fortymile caribou herd, herd condition (nutritional status), and factors limiting the herd for the purpose of (1) predicting how herd growth rate will respond to various potential predator management and harvest management programs and (2) evaluating responses to programs implemented by the current planning process. Historical data will be used to help predict growth rates.

JOB OBJECTIVES

Objective 1. Literature review.

Objective 2. Assess extent and cause of death among collared caribou $\geq$5 months old.

Objective 3. Estimate herd condition.

Objective 4. Estimate age-specific mortality rates by collaring 5-month-old calves.

Objective 5. Determine total numbers and population trend.

Objective 6. Estimate recruitment and mortality rates of different age classes by annually classifying caribou during June and October 1993-97.

Objective 7. Evaluate winter range condition with respect to relative lichen versus moss abundance in the feces.

Objective 8. Determine extent and cause of death among calves during the first year of life.

Objective 9. Determine what weather factors are related to poor herd condition.

Objective 10. Analyze data and draft figures for written and oral presentations of the data.

Objective 11. Write progress reports and either publish a final report or recommend continuation of this study for 5 additional years.

Objective 12. Incorporate results into appropriate Alaska wildlife management plans and survey-inventory activities.

PROCEDURES

Estimating Herd Numbers and Growth Rate From Censuses

The Fortymile caribou herd was censused during June 1990 and 1992 using an aerial photo-direct count technique (Davis *et al.* 1979) similar to four previous estimates in the 1980s (Valkenburg and Davis 1989). We will use census data to calculate growth rates (Objective 5), unless trend data from natality, recruitment, and mortality are inconsistent with census data. Davis *et al.* (1991) concluded that caribou census precision is inadequate to accurately predict population change over a 1- or 2-year interval.

Estimating Growth Rate From Recruitment and Mortality Data

Caribou were classified from a helicopter on 10 October 1991 and 21 June and 26 September 1992 using the distribution of radio-collared caribou to randomly select caribou for counting. Cows, calves, and small, medium, and large bulls were counted. The extent of calf mortality during the first 4 months of life was estimated by comparing reproductive rates of the herd in May with proportions of calves remaining in the herd in late June and September (Objectives 4 and 6).

Age-specific mortality rates were estimated (Objectives 2 and 8) during October 1991-October 1992 by radio-locating all collared caribou in early January, early March, mid-May, mid- and late June, and late September. Data are incomplete to report the annual mortality rate during October 1992-October 1993, but we radio-located collared caribou once a month from October through June, the end of this reporting period. Radiocollars contained a mortality sensor that doubled the pulse rate if the collar remained motionless for 6 hours. Mortality rate during the year (M) was calculated as $M = A / B \times 100$, where A = the number of caribou dying during the 12-month period following October, and B = the total number of animals collared at the beginning of the 12-month period (Oct).

We radio-collared (Telonics, Mesa, Ariz.) 41 caribou during 27 September-22 October 1991, 3 on 7 March 1992, and 14 during 28-30 September 1992. We also assisted the Bureau of Land Management collar 17 caribou during 3-29 April 1992. Caribou were darted from a helicopter using 2 cc Cap-Chur darts with 1.9 cm barbed needles. Except during fall 1992, darts contained 1.5 mg Carfentanil (0.5 cc), 65 mg Rompun (0.65 cc), and 0.85 cc of propylene glycol. During fall 1992, we darted only calves and used 1 mg Carfentanil (0.33 cc) and 67 mg Rompun (0.67 cc). Most calves were heavily sedated by this dose. For recovery, we administered 300 mg Nalaxone (6 cc) intramuscularly and 8 mg Yobine (4 cc) intravascularly.

Evaluating Causes of Mortality

To assess cause of death (Objectives 2 and 8), we examined death sites using a helicopter during January, March, April, May, June, August, September, and November 1992 and March and April 1993. Blood on collars or remnants of hide served as evidence of a violent death. In these cases scats, tracks, other signs, and whether the caribou was killed during summer or winter (bears hibernating) served to identify the predator involved.

No funding was provided for radio-collaring newborn calves during this reporting period (Objective 8). Collaring of neonatal calves and closely monitoring of mortality is required to identify the major causes of early calf mortality.

Evaluating Herd Condition

Five indices will be used to evaluate relative condition of the herd (Objective 3): (1) fall calf weights, (2) percent mortality of calves of collared cows during the first 48 hours of life, (3) percent natality of collared cows, (4) first age of reproduction, and (5) median calving date. We weighed 14 female calves in September and October 1991, 7 in April 1992, and 14 in September 1992. Weights were compared between years using a Student's *t*-test. High percent calf mortality during the first 48 hours of life (e.g., 20-30%) is often caused ultimately by malnutrition and is, therefore, considered an index to herd condition or nutritional status (Whitten *et al.* 1992; L. Adams, unpubl. data). Thirty radio-collared cows 3 years old or older were radio-located on 14 May and from

19 May through 3 June 1992 until they gave birth and on 2 consecutive days following birth. These radiolocations also allowed estimates of natality rate, age of first reproduction, and the median calving date. Cows were judged to be parturient based upon one or more of the following: distended udders, hard antlers, or the presence of a calf (Bergerud 1964). The median calving date was the date by which 50% of the adult collared cows had given birth.

Nutritional indices will be compared with weather indices to determine what weather indices, if any, can be linked to poor caribou nutrition (Objective 9). For example, do hot, dry summers or deep snows or both predictably reduce herd condition or nutritional status? We summarized available weather data in this report from the Eagle weather station (National Oceanic and Atmospheric Administration), but weather data were incomplete at this writing. Analytical procedures will follow those of Boertje *et al.* (in prep.), who summarized similar data for the Delta caribou herd.

Evaluating Lichen Versus Moss Component of the Herd's Winter Diet to Assess Range Condition

We collected six fecal samples from the Fortymile herd winter range in March and early April 1992. Samples were from Sixtymile Butte, upper Mosquito River (2), upper Goodpaster River, Mansfield Lake, and the upper Salcha River. During March 1993, we collected five samples from Dome Creek, Fortymile Dome, lower East Fork Dennison, and near Chicken and Franklin. Each sample contained 25 pellets from each of 25 different piles found afield (Boertje *et al.* 1985). Samples were sent to the Composition Analysis Laboratory in Fort Collins, Colorado but have not yet been analyzed.

RESULTS AND DISCUSSION

Herd Numbers and Growth Rate

The Fortymile herd totaled 21,884 caribou on 28 June 1992. This represents an 8-9% decline in adults and a 4% decline in the total herd size since June 1990, when 22,766 caribou were censused. This decline was consistent with computer spreadsheet modeling using observed data on low recruitment during 1991 and high adult mortality during 1992 (Table 2). Stability in the herd is expected from June 1992 to June 1993 based on moderate recruitment to fall 1992 (Table 2), low adult mortality during winter 1992-93, and low recruitment to June 1993. The herd will not reach the population objective of 60,000 by the year 2000 unless growth rates of $\geq$15% are realized and maintained. Predator control will be required to attain such growth rates (Gasaway *et al.* 1983; Farnell and Hayes, in prep.). Also, annual harvest rates will have to be minimal ($\leq$3% on average) as prescribed in draft management plans for the Fortymile herd (e.g., Kelleyhouse 1990).

From May pregnancy counts to late June and September composition counts, calf numbers declined substantially in 1992, but less than in 1991. Pregnancy rates in 1992 suggest 87 calves were born per 119 cows $\geq$1 year old or 73 calves:100 cows $\geq$1 year old. This estimate was based on 87 calves:100 radio-collared cows $\geq$3 years old (Table 2), no births among cows 12 or 24 months old, 14% overwinter mortality of previous calf cohorts, and a 50% sex ratio. Telemetry data indicated 32% of calves (n = 31) died by 3 June. About 37% of the calves died by 21 June when 46 calves:100 cows were observed, and 59% died by 26 September when 30 calves:100 cows were observed. These or higher mortality rates are common among caribou herds in Interior

Alaska, and the major cause of this mortality has been identified as predation in the Delta and Denali herds (Gasaway *et al.* 1983; Adams *et al.* 1989, in press).

We inadvertently separated 12 of the 14 collared calves from their dams during fall 1991 by simultaneously immobilizing calves and their dams. We had not previously immobilized calves and their dams simultaneously. By orphaning calves, we possibly made them more vulnerable to wolf predation. Overwinter mortality of collared calves was 50% during winter 1991-92, compared with only 14% during the previous winter when snowfall was deeper (Table 2). For modeling and interpretive purposes, we assumed collared calves would have died at a rate of 14% had the calves not been orphaned. Thus, the 50% mortality rate was disregarded when we predicted growth rates for the herd. Implications of these data are that human hunting of cows with calves in fall or early winter can reduce the survival of orphaned calves where fall wolf densities are $\geq$7 wolves/1,000 km^2 and prey density is low, however more studies of the survival of orphaned calves are needed.

A trend toward high adult female mortality (>16%) was observed beginning in 1989-90 in the Fortymile herd (Table 2). This trend continued in the Fortymile herd during the period October 1991-October 1992; adult female mortality was 17% (n = 35). The yearling mortality rate (birth year 1990, n = 12) was 8% during this period.

Causes of Mortality

In total, wolves killed 13 (87%) of the 15 collared caribou that died between October 1991 and October 1992. Wolves killed 5 (14%) of the 35 adults and 1 (3%) was scavenged. Wolves killed 6 (43%) of the 14 calves and 1 (7%) was scavenged. Wolves also killed one yearling and one adult bull. Wolf predation was also the major cause of adult female mortality in the Fortymile herd in the 1980s (Valkenburg and Davis 1989), but predation rates were lower in the 1980s (Table 2).

No funding was provided for radio-collaring newborn caribou calves in the Fortymile herd. The only mortality study using radio-collared calf caribou in Interior Alaska occurred on the Denali herd during 1984-93. In Denali, wolves have been the major predator on calves during the last several years, and grizzly bears were the major predator in prior years (Adams *et al.* 1989, in press). In all years, predation was by far the major cause of death. Wolves were the most important predator on caribou calves in the Delta herd in the 1970s, as evidenced by the significant increases in calf survival following wolf control (Gasaway *et al.* 1983).

Chronology of Fortymile caribou calf mortality suggests that wolf predation, not bear predation, was the major cause of death among calves during their first 12 months. For example, bears are only an effective predator on calves when calves are $\leq$10 days old (Adams *et al.* 1988), yet calf survival declined significantly between 3 June (68%) and 26 September 1992 (41%). Furthermore, late June calf counts in the Fortymile herd are often much higher than September counts (Table 2). In contrast, late June and September calf counts are relatively similar in the Denali herd.

Condition of the Herd

The major stimulus of this initial study was to evaluate the condition or nutritional status of the herd (Objectives 3 and 9) to help predict how the herd may respond if predation rates were reduced. Several indices suggest the herd is in excellent nutritional condition and would increase at a high rate (about 15% annually) if predation were significantly reduced (Gasaway *et al.* 1983; Farnell and Hayes, in prep.).

First, 4-month-old calves in 1992 were significantly heavier than calves in 1990 and 1991 (Table 1). Second, only 1 (3%) of 30 newborn calves died during the first 48 hours after birth in 1992, suggesting adult females achieved a nutritional status adequate to produce viable calves. Third, pregnancy rates were high (87%, n = 39) among females $\geq$36 months old in 1992. The age of first reproduction was 3 years; no 24-month-old collared females (n = 13) gave birth in 1992. Median calving date was 22 May in 1992, similar to that observed in the 1980s when the herd was growing at 10% annually (Valkenburg and Davis 1989).

Because of the simultaneous decline of five widespread Interior Alaska caribou herds beginning in 1989-90, adverse weather was suggested as a major cause of the decline. Current theory suggests declines in ungulates are often precipitated by adverse weather, which causes malnutrition and increased vulnerability to predation. Prolonged declines of ungulates after weather improves are common and are caused by continued high wolf numbers, because declines in wolves follow declines in prey (Gasaway *et al.* 1983). Thus, wolves consume greater proportions of the declining prey population each year for several years until wolves also decline. Also, wolves may switch their diet to consuming the prey most affected by adverse weather (e.g., caribou) and, subsequently, fail to immediately switch back to other prey (e.g., moose) when the weather improves. Increased vulnerability of caribou can also coincide with increases in wolf numbers, e.g., in the Denali herd's range (T. Meier, pers. commun.) and the Delta herd's range (Boertje *et al.*, in prep.).

Valkenburg (1992) proposed to document weather indices, predation indices, and growth and condition of several herds to describe adverse and favorable weather patterns and the effects of weather on caribou population dynamics. Progress to date for the Fortymile herd is summarized in Table 2, but weather data are incomplete at this writing and the decline in the Fortymile herd was less pronounced than declines in the other herds. Adverse weather, e.g., drier summers and deeper snowfalls, was observed in the Fortymile herd's range consistent with that observed in other declining herds, but adverse weather was less pronounced in the Fortymile range. Also, because wolf numbers (ADF&G, unpubl. data) increased only slightly in the Fortymile herd's range (Table 2), in contrast to significant increases in wolves in the ranges of the Delta and Denali herds, predation likely did not reach the same elevated levels in the Fortymile range. We hypothesize that an increase in predation on the Fortymile herd may have occurred from wolves switching from consuming primarily moose (Gasaway *et al.* 1992) to consuming primarily caribou. Cesium samples have been collected from wolves in this area to test this hypothesis, but results have not yet been analyzed.

Range Condition

Analyses from fecal samples were not complete at the time of this writing (Objective 7).

CONCLUSIONS

We conclude from this initial work and past studies that the herd can be expected to increase rapidly ($\geq$15% annually) if predation can be reduced significantly and caribou productivity and caribou body condition remain similar or better than those observed during summer and fall 1992. Further, it appears the draft management objective of attaining 60,000 caribou by the year 2000 is achievable if the herd grows at 15% annually during 1993-2000.

Objective 1. Literature review complete.

Objective 2. Radio-collared cows ≥27 months old died at a rate of 17% for the 12 months ending 1 October 1992; the yearling annual mortality rate (15 months to 27 months old) was 8%. Overwinter calf mortality was 50%. In total, wolves killed 13 (87%) of the 15 collared caribou that died between October 1991 and October 1992. The remaining two were scavenged by wolves.

Objective 3. Several indices suggest the condition or nutritional status of the herd was excellent during June 1992-June 1993. Calves (4 months old) were heavy (58.6 kg), calf mortality during the first 48 hours was low (3%), pregnancy rates were high (87%), age of first reproduction was 36 months, and median calving date was 22 May.

Objective 4. Fourteen calves were collared to contribute to a known-age sample of collared caribou.

Objective 5. A census was completed on 28 June 1992; 21,884 caribou were counted. This represents a 4% decline in the herd size since June 1990.

Objective 6. Calf survival was relatively high by late June (46 calves:100 cows) 1992, but had declined to moderate levels by September (30 calves:100 cows) indicating a significant level of wolf predation.

Objective 7. Fecal samples were collected during late winter 1992 and 1993 but analyses were incomplete at this writing.

Objective 8. Funding for newborn calf collars was not allocated during 1992 or 1993.

Objective 9. Weather data were incomplete at this writing.

Objective 10. A presentation to the Board of Game was completed in November 1992.

Objective 11. Progress report was written.

Objective 12. Results to date were incorporated into Alaska's Area-Specific Wolf Management Plans and presented to the Board of Game in November 1992 to assist the Board in decisions regarding wolf control for the Fortymile herd.

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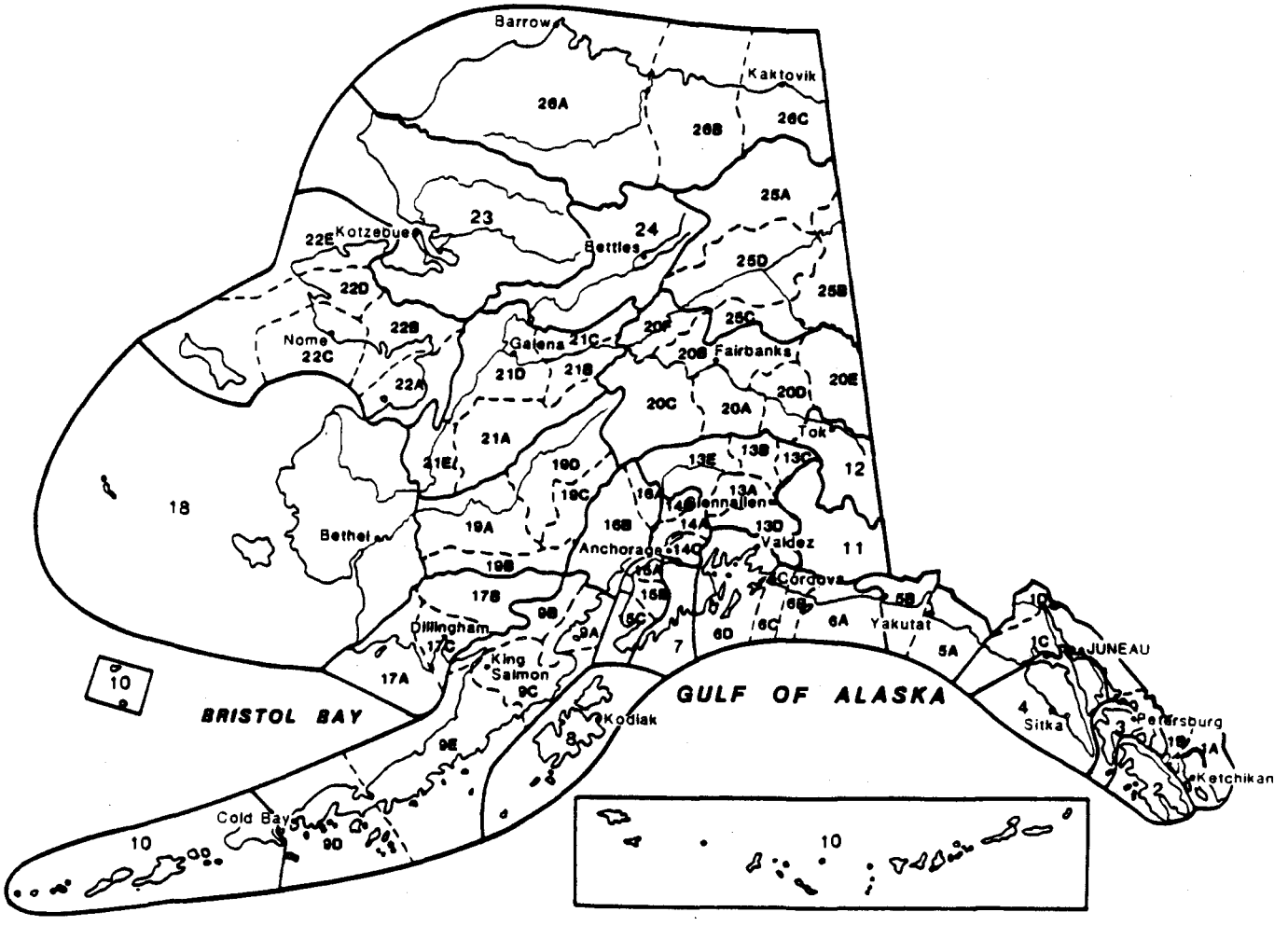
Table 1. Fall (late Sep-late Oct) weights (kg) of female calves radio-collared in the Fortymile caribou herd, 1990-92.

	1990	1991	1992
	56.2	55.3	54.0
	56.7	55.3	58.1
	52.2	55.3	68.9
	59.9	49.0	54.4
	54.0	59.9	61.7
	52.2	62.1	57.2
	43.5	57.2	55.8
	55.8	52.6	54.9
	50.3	58.1	70.8
	57.2	56.2	64.0
	49.4	49.4	49.0
	56.2	42.2	53.1
	53.1	58.5	54.9
	48.1	55.3	64.0
Mean	53.2	54.7	58.6
SD	4.33	5.11	6.33
SE	1.16	1.37	1.69

Table 2. Indices to caribou population dynamics, weather, and predation in the range of the Fortymile herd, 1980-92. Weather data are from Eagle, and wolf density is from a 15,500-km^2 study area in the southcentral portion of the herd's range.

Year	Mid- to late June calves:100 cows (*n*)	Fall calves: 100 cows (*n*)	% mortality of cows ≥36 months old for year ending 1 Oct (*n*)	% pregnancy of cows ≥36 months old (*n*)	% perinatal mortality (*n*)	Fall weight of calves in kg (*n*)	Total rainfall 15 Jun-15 Aug (cm)	Mean summer temp. (^{o}F)	Max. March snow depth (cm)	Fall wolf density per 1,000 km^2
1980	41 (2,400)	--	--	--	--	--	12.2	58.1	35.6	--
1981	31 (2,955)	31 (1,004)	--	--	--	--	14.0	55.4	43.2	8
1982	--	27 (1,625)	--	--	--	--	8.8	56.9	50.8	4
1983	38 (1,252)	36 (1,953)	--	--	--	--	10.3	57.1	68.6	6
1984	45 (3,940)	--	9.5 (21)	87 (23)	--	--	10.8	55.7	48.3	5
1985	48 (3,803)	36 (1,067)	9.1 (22)	100 (19)	--	--	11.4	56.2	68.6	6
1986	--	30 (1,381)	16.7 (24)	95 (21)	--	--	8.1	57.0	61.0	7
1987	47 (3,596)	37 (2,253)	5.3 (19)	95 (19)	--	--	10.2	57.6	33.0	7
1988	36 (1,799)	30 (1,295)	9.1 (33)	95 (20)	--	--	10.5	59.2	68.6	6
1989	--	24 (1,781)	18.5 (27)	--	--	--	12.3	60.3	53.3	7
1990	--	29 (1,742)	40.0 (20)	88 (16)	--	53.2 (14)	6.9	60.0	83.8	8
1991	25 (2,998)	16 (1,445)	16.7 (12)	91 (11)	--	54.7 (14)	--	--	68.6	7
1992	46 (3,313)	30 (2,530)	17.1 (35)	87 (39)	3 (30)	58.6 (14)	--	--	--	7

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 licensehold- ers 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.

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