Grant W-24-2
Study 3.38
October 1994

Federal Aid in Wildlife Restoration
Research Progress Report

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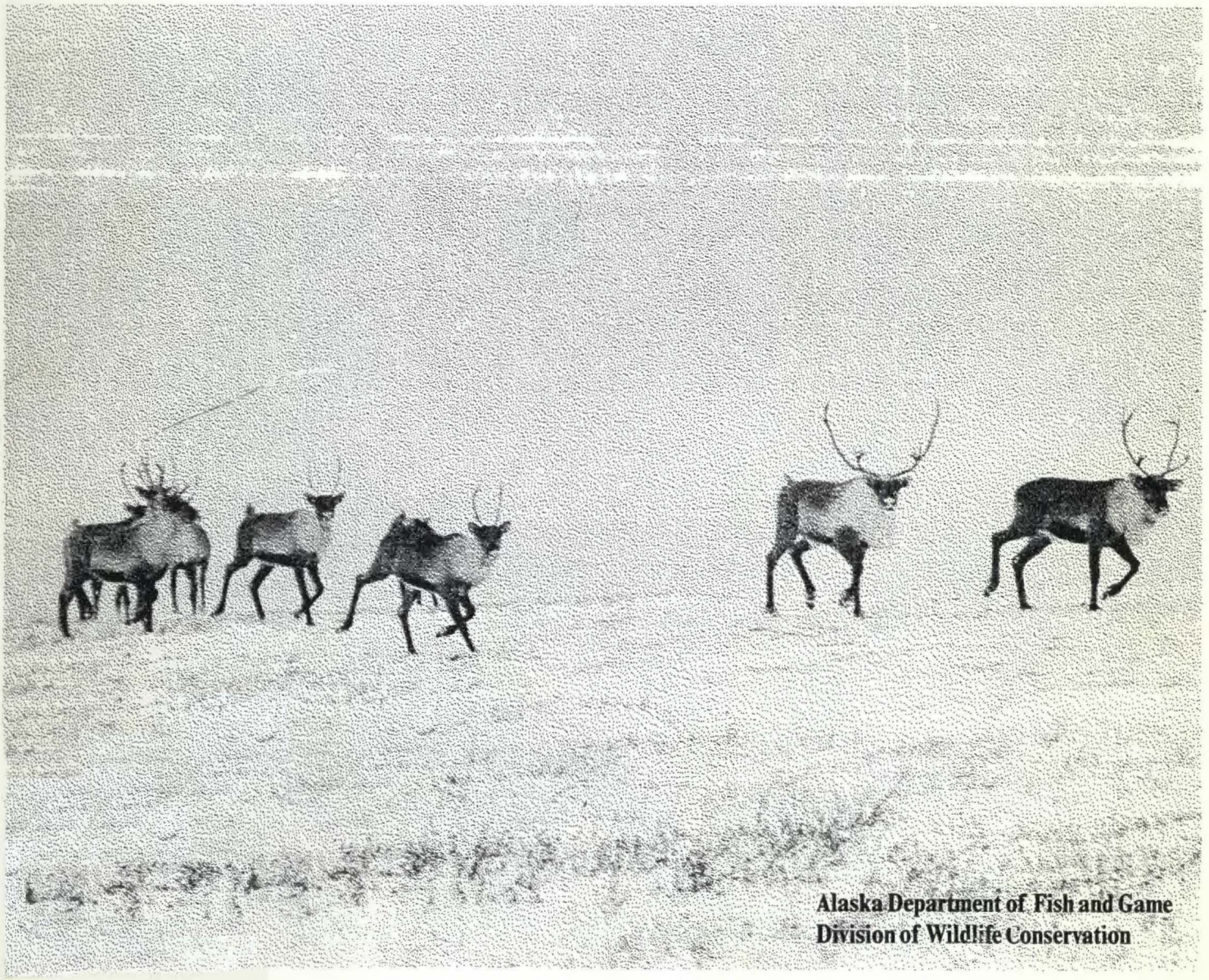

Alaska Department of Fish and Game
Division of Wildlife Conservation

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PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperator: Rick Farnell and Dorothy Cooley, Yukon Department of Renewable Resources; Winston Hobgood, Bureau of Land Management, Fairbanks; Layne Adams, National Park Service, Anchorage

Project No.: W-24-2 Project Title: Wildlife Research and Management

Study No.: 3.38 Study Title: Factors Limiting the Fortymile Caribou Herd

Period Covered: 1 July 1993-30 June 1994

SUMMARY

Progress this period focused on assessing condition (nutritional status) of the Fortymile herd, causes and extent of mortality, and range condition. During spring 1993, 3 indices suggested poor nutritional status: 1) reduced pregnancy rates, 2) low calf survival during the first 2 days of life, and 3) delayed first reproduction. Two other nutritional indices failed to indicate malnutrition: 1) median calving date was not delayed, and 2) weights of 4-month-olds were not reduced compared with previous years. Wolf (*Canis lupus*) predation was by far the most common cause of mortality among collared caribou $\geq$4 months old, but adult mortality was lower during winter 1992-93 and 1993-94 compared with winters 1989-90 through 1991-92. Also, recruitment was higher during October 1992 and 1993 compared with 1991, so the herd has probably grown slightly since the last census in June 1992. Range conditions appeared excellent during winters 1991-92 and 1992-93 as indicated by a high relative abundance of lichen fragments in feces and low abundance of mosses and evergreen shrubs.

Evaluation of management programs aimed at achieving 60,000 Fortymile caribou (*Rangifer tarandus granti*) by the year 2000 was a primary focus of this research. Last year we concluded this objective was achievable if wolf control was implemented and favorable weather occurred during 1993-2000. Wolf control was not implemented. In this report we conclude the management objective should be reconsidered because, even if wolf control was implemented in 1995, biological and time constraints do not allow for growth to 60,000 caribou by the year 2000. Furthermore, we recommend new management objectives be described that are both attainable and time specific. If objectives are for elevated caribou numbers, managers must have a plan and ready means of action for achieving the objectives. Minimizing caribou

harvest has simply allowed for near natural population fluctuations, not necessarily growth. Management programs have successfully increased public wolf and grizzly bear (*Ursus arctos*) harvests in recent years, but the effects of these programs on caribou numbers vary annually and require further study. A major factor limiting growth of the herd is low calf survival during spring and summer. Causes of this poor survival will be investigated during 1994.

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

CONTENTS

BACKGROUND

The Fortymile caribou (*Rangifer tarandus granti*) herd has the potential to be the most economically important wildlife population in Interior Alaska and the southern Yukon - both for consumptive and nonconsumptive uses. 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. The herd has not migrated across the Steese Highway for several decades because of its reduced size. Yet, virtually all of the historical range of the herd is currently available for use by the herd.

Population objectives for increasing the Fortymile caribou herd have wide public support, both in Alaska and the Yukon. This public support has developed because most of the herd's former range was abandoned as herd size declined and because current low numbers are, in part, a result of past mismanagement. Both nonconsumptive and consumptive uses of the herd declined as herd size declined. Interim international draft objectives call for increasing the herd to 50,000 adults or 60,000 caribou by the year 2000. 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. However, the adult portion of the herd declined between 1990 and 1992, and the herd will not reach 60,000 by the year 2000.

We have learned much from management and mismanagement of the Fortymile Herd. Valkenburg *et al.* (in press) detailed a case history of the herd from 1920 to 1990. 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, simultaneously, high numbers of wolves contributed to the herd's 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 caribou during the early 1970s and may have increased to 40,000-50,000 during favorable conditions in the 1980s. Overharvest was allowed in part because of the belief that poor range condition was the major factor causing low yearling recruitment. Thus, biologists allowed high harvests and ignored wolf predation while awaiting a compensatory rebound in yearling recruitment from improved range. However, it was a futile vigil; calf caribou became increasingly scarce through 1973. It was mistakenly believed that hunters and predators mostly killed animals that 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 1984 radiocollaring of Fortymile caribou has provided the ability to efficiently estimate herd size, recruitment, mortality, causes of mortality, and nutritional status (Valkenburg and Davis 1989; Valkenburg *et al.*, in press). Today managers know that adverse weather can initiate declines in caribou herds (Valkenburg *et al.*, in press; Boertje *et al.*, unpubl. rep.). Adverse weather in Interior Alaska in the early 1990s 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 can occur from increased wolf predation because declines in wolf numbers lag behind declines in caribou (predator lag). Examples exist where the proportion of a herd killed by wolves has increased following adverse weather, because caribou were more vulnerable and because wolf numbers increased as caribou declined (Boertje *et al.*, unpubl. rep.). Today it is a well-accepted belief 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; Boertje *et al.*, unpubl. rep.).

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, unpubl. rep.). 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, unpubl. rep.). In both studies, only 15-31% of the original precontrol wolf numbers remained by late winter during the 4-6 winters of effective control efforts.

Failure to address management objectives for the Fortymile herd will reduce agency credibility and public support. However, recommendations for management strategies potentially involving 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 natality, mortality, nutritional status and range condition, together with results of past studies, 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$4 months old.

Objective 3. Estimate herd condition.

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

Objective 5. Determine total numbers and population trend.

Objective 6. Estimate recruitment and mortality rates during the first 4 months of life by annually classifying caribou about 1 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

We estimated minimum numbers of Fortymile caribou during June 1990 and 1992 using a radio-search, total search, aerial photo technique (Valkenburg *et al.* 1985), as in previous estimates of herd size during the 1980s (Valkenburg and Davis 1989). We used census data to calculate growth rates, except when trend data from recruitment and mortality were inconsistent with census data. Experience has shown we cannot accurately detect annual trends in caribou numbers by comparing 2 consecutive censuses; the degree of underestimation during each census varies and is strongest when adverse weather interrupts the census (Davis *et al.* 1991).

Estimating Growth Rate From Recruitment and Mortality Data

Caribou were classified from a helicopter on 10 October 1991, 26 September 1992, and 3 October 1993 using the distribution of radiocollared 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 collared caribou in May with proportions of calves remaining in the herd in late September or early October.

Age specific mortality rates for caribou >4 months old were estimated during October 1991-October 1992 by radiolocating all collared caribou in early January, early March, mid May, mid and late June, and late September. From October 1992 to October 1993, mortality rates were estimated by radio-locating caribou monthly. Radiocollars contained a mortality sensor that doubled the pulse rate if the collar remained motionless for 6 hours. Annual mortality rate (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 estimated the annual finite rate of growth (λ) from Bergerud and Elliot (1986) as:

$$\lambda = \frac{1 - \bar{M}}{1 - \bar{R}}$$

where $\bar{M}$ = annual mortality of radio-collared cows (M)/100, and

$$\bar{R} = \frac{\text{number of 4-month-old calves observed about 1 October}}{\text{number of caribou} \geq 4 \text{ months old observed about 1 October}}$$

We also used computer spreadsheet modeling to estimate λ (ADF&G files).

We radiocollared (Telonics, Mesa, Ariz.) 41 caribou from 27 September to 22 October 1991, 3 on 7 March 1992, 14 from 28 September to 30 September 1992, and 14 on 4 October 1993. We also assisted the Bureau of Land Management collar 17 caribou from 3 April to 29 April 1992. Caribou were darted from a helicopter using 2 cc Cap-Chur darts with 1.9 cm barbed needles. Except during autumns 1992 and 1993, darts contained 1.5 mg Carfentanil citrate (Wildnil, Wildlife Pharmaceuticals, Fort Collins, CO), 67 mg Xylazine hydrochloride, and 0.85 cc of propylene glycol. During autumns 1992 and 1993, we darted only calves and used 1 mg Carfentanil citrate and 67 mg Xylazine hydrochloride. Most calves were heavily sedated by this dose. For recovery of calves, we administered 100 mg Naltrexone hydrochloride (Trexonil) and 10 mg Yohimbine hydrochloride (Antagonil) intramuscularly.

Evaluating Causes of Mortality

To assess cause of death, we examined death sites within a few days to a few weeks of each mortality using a helicopter, Bellanca Scout, or Super Cub. Blood (noncoagulated) on collars or remnants of hide served as evidence of a violent death. In these cases scats, tracks, other signs, and season of kill (bears hibernating in winter) served to identify the predator involved. A collar soaked in blood was indicative of lynx predation, based on evidence of lynx predation in the snow at several sites.

We plan to radiocollar newborn calves during May and June 1994, but data were not available at this writing. Collaring of neonatal calves and close monitoring of mortality is required to identify the major causes of early calf mortality.

Procedures for estimating total and female caribou harvest varied, depending on the type of harvest reporting system. We included estimates of illegal harvest made during road and trail surveys, and applied a correction factor to general season hunts. During general season hunts, harvest was reported by mandatory mail-in report cards without the benefit of reminder letters. Correction factors were derived from road surveys and surveys of transporter services during 1973. To avoid biased reporting, hunters were not told the purpose of the road surveys. The surveys and subsequent mail-in harvest reports were treated as a mark-recapture sample to estimate total harvest. Harvest from general season hunts was multiplied by 1.59. We considered harvest reports collected from permit hunts to be accurate estimates of total harvest because reminder letters were sent to permittees and 97-98% of permittees responded.

Evaluating Herd Condition

Five indices were used to evaluate relative condition of the herd: (1) autumn calf weights, (2) percent mortality of calves of collared cows during the first 2 days of life, (3) percent natality of collared cows, (4) age of first reproduction, and (5) median calving date. We weighed 14 female calves in September and October 1991, 7 in April 1992, 14 in September 1992, and 15 in October 1993. Weights were compared between years using a Student's t-test. High percent calf mortality during the first 2 days of life (e.g., 20-30%) has been linked to malnutrition and is, therefore, considered an index to herd condition or nutritional status (Whitten *et al.* 1992). Thirty radiocollared cows 3 years old or older were radiolocated on 14 May and from 19 May through 3 June 1992 until they gave birth and on 2 consecutive days following birth. During 1993, 48 radiocollared cows 3 years old or older were radiolocated on 13 May, 16-28 May, and 3 June using the same guidelines. 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, Lent 1965). 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. For example, are hot, dry summers or deep snows or both correlated with herd condition or nutritional status? Also, is performance of the herd strongly linked to malnutrition during adverse weather? Or can recruitment vary independent of nutrition because of overwhelming effects of predation? We will use Eagle summer weather to describe summer temperature and precipitation, because the herd usually spends the summer in subalpine areas near Eagle. Snow data will be analyzed from 6 weather stations surrounding the Fortymile range (Fig. 1). Snow data will be corrected for elevation and distribution using universal block kriging (Cressie 1991:179).

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

We collected 13 fecal samples from the Fortymile herd winter range during March and early April 1992 and 1993. Each sample contained 25 pellets, 1 pellet was collected from each of 25 different piles found afield (Boertje *et al.* 1985). Samples were analyzed at the Composition Analysis Laboratory in Fort Collins, Colorado.

RESULTS AND DISCUSSION

Herd Numbers, Trend, and Condition

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 1). A slight increase (<10%) in the herd was predicted from June 1992 to June 1994, based on moderate recruitment in autumns 1992 and 1993 (Table 1) and low adult mortality during winters 1992-93 and 1993-94.

Data from radiocollared cows suggested nutritional stress occurred during spring 1993; e.g., pregnancy rates were unusually low and early calf mortality was high (Table 1). Pregnancy rates were only 66% (n = 47) during 1993 and were 87-100% during 1984-92. Mortality during the first 2 days of life was 18% during 1993 compared with 3% during 1992. Also, 65% of the calves of radio-collared cows (n = 31) died by 3 June 1993, compared with only 32% (n = 31) by 3 June 1992. Age of first reproduction was delayed compared with the Delta herd; only 42% of 12 3-year-olds produced calves in 1993.

These data suggest that malnutrition occurred during spring 1993, but the herd probably grew because calf recruitment to autumn 1993 and adult survival during October 1992-October 1993 were moderate. Malnutrition indices were biased by the young sample of radiocollared cows; 16 of 47 cows were 3 or 4 years old, and 44% were pregnant. Of the 31 cows ≥5 years old, 77% were pregnant. We will attempt to restrict future relevant data analysis to an age-structure of cows more representative of the herd. Two other nutritional indices did not indicate malnutrition. The median calving date (22 May) and chronology of calving were similar in 1992 and 1993, and calf weights did not differ significantly (Table 2).

A trend toward high adult female mortality (>16%) was observed from 1989-90 through 1991-92 in the Fortymile herd (Table 1). Reduced adult mortality was again observed during 1992-93 (10%, n = 51) and during winter 1993-94 (6%, n = 34).

Causes of Mortality from October 1991 through March 1994

Of the 24 collared caribou ≥4 months old for which causes of mortality were determined, wolves killed 19 (79%), lynx killed 2 (8%), and 3 (13%) died from causes other than predation. Lynx killed only calves. Of the 11 calves that died between 4 and 11 months old, wolves killed 8, lynx killed 2, and 1 died from nonpredation causes. All deaths of collared caribou occurred from November through April, except 2.

Estimated total annual harvest averaged 2.8% of the herd during the 6 years prior to 1990, when a slight decline in herd size began (Table 1). Since 1990 harvest has averaged about 1.8%. Virtually all legal harvest has consisted of bull caribou, and 93% of all harvest since 1984 consisted of bulls. Bull:cow ratios remain high (46 bulls:100 cows in October 1993) because harvests have intentionally been held low since 1973 to encourage herd growth. However, it is apparent that low harvests do not necessarily provide for herd growth; rather, low harvests allow for near natural fluctuations.

Range Condition

Range condition appeared excellent during winters 1991-92 and 1992-93, as evidenced by high proportions ($\bar{x}$ = 72-81%) of lichen fragments in caribou fecal samples (Table 3). Samples were collected from different wintering areas each year (Fig. 2). Boertje (1981) and Boertje *et al.* (1985) provided data showing the usefulness of fecal samples in evaluating use of lichens on winter ranges. Lichens are slower growing than vascular plants and are a highly preferred winter forage. Fecal samples from overgrazed winter ranges contained higher proportions of mosses and evergreen shrubs and reduced proportions of lichens compared with values observed in this study.

Job Objectives

Objective 1. Literature review complete.

Objective 2. Radio-collared cows $\geq$28 months old died at a rate of 17% for the 12 months ending 1 October 1992 and 10% for the 12 months ending 1 October 1993; the yearling annual mortality rate (16-28 months old) was 8%. Overwinter calf mortality was 50% during 1991-92 when collared calves were largely orphaned, and 8% during 1992-93. In total, wolves killed 19 (79%) of the 24 collared caribou that died of known causes between October 1991 and March 1994.

Objective 3. Indices suggested the condition or nutritional status of the herd was excellent during May 1992. Calf mortality during the first 2 days was low (3%, n = 30), and pregnancy rates were high (87%, n = 39). During May 1993, nutritional stress was evidenced by increased mortality during the first 2 days of life (18%, n = 28) and reduced pregnancy rates (66%, n = 47). Only 5 (42%) of 12 3-year-olds were pregnant during 1993.

Objective 4. Fourteen calves were collared each autumn during 1992 and 1993 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 herd size since June 1990. The camera malfunctioned during the 1993 census, and a new camera was purchased for 1994.

Objective 6. Calf survival was relatively high by late June (46 calves:100 cows) 1992 but had declined to moderate levels by 26 September (30 calves:100 cows) suggesting a significant level of summer wolf predation typical of previous years. Surveys in 1993 indicated 23 calves:100 cows in late June and 29 calves:100 cows on 3 October; most calf mortality occurred very early and causes were unknown.

Objective 7. Fecal samples were collected during late winter 1992 and 1993, and results indicate lichens are abundant in the diet. These data suggest the range can support increased caribou numbers.

Objective 8. Causes of death among newborn calves was first studied during May 1994 but results were not available at this writing.

Objective 9. Weather data were incomplete at this writing, and analytical methods are under investigation.

Objective 10. A presentation to the Board of Game was completed in November 1992. Data were presented at an interagency and international management meeting on the Fortymile herd in Tok on 9 February 1994.

Objective 11. Progress reports were 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. Data were incorporated into management reports.

CONCLUSIONS

We conclude from this initial study and past studies (Davis *et al.* 1978; Valkenburg and Davis 1989; Valkenburg *et al.*, in press; Boertje *et al.*, unpubl. rep.) that the Fortymile herd will increase rapidly ($\geq$15% annually) if predation can be significantly reduced and weather conditions are favorable. Adverse weather and associated nutritional stress have likely helped slow or halt growth of the Fortymile herd in some recent years. However, predation is the major mortality factor that has kept the Fortymile herd from growing fast enough to reach the management objective of 60,000 caribou by the year 2000.

This objective needs to be reconsidered, because, even with wolf control, it is unlikely the herd will reach this desired level, given biological and time constraints. One possibility for a new objective is to allow caribou to fluctuate at near natural levels with a minimal harvest. Alternative objectives requiring management action should be attainable and time specific. If objectives are for elevated caribou numbers, managers must have a ready means of action for achieving the objectives. The current management action of minimizing caribou harvest is inadequate as a means of action for achieving time specific objectives for elevated caribou numbers. With minimum harvest allowed, the population declined in some years and grew slowly in others ($\leq 10\%$, Valkenburg *et al.*, in press). Minimizing harvest simply allows for near natural population fluctuations. Management programs have been initiated to increase public wolf and grizzly bear harvests in the Fortymile range, but the effects of these programs on caribou numbers vary annually and require further study.

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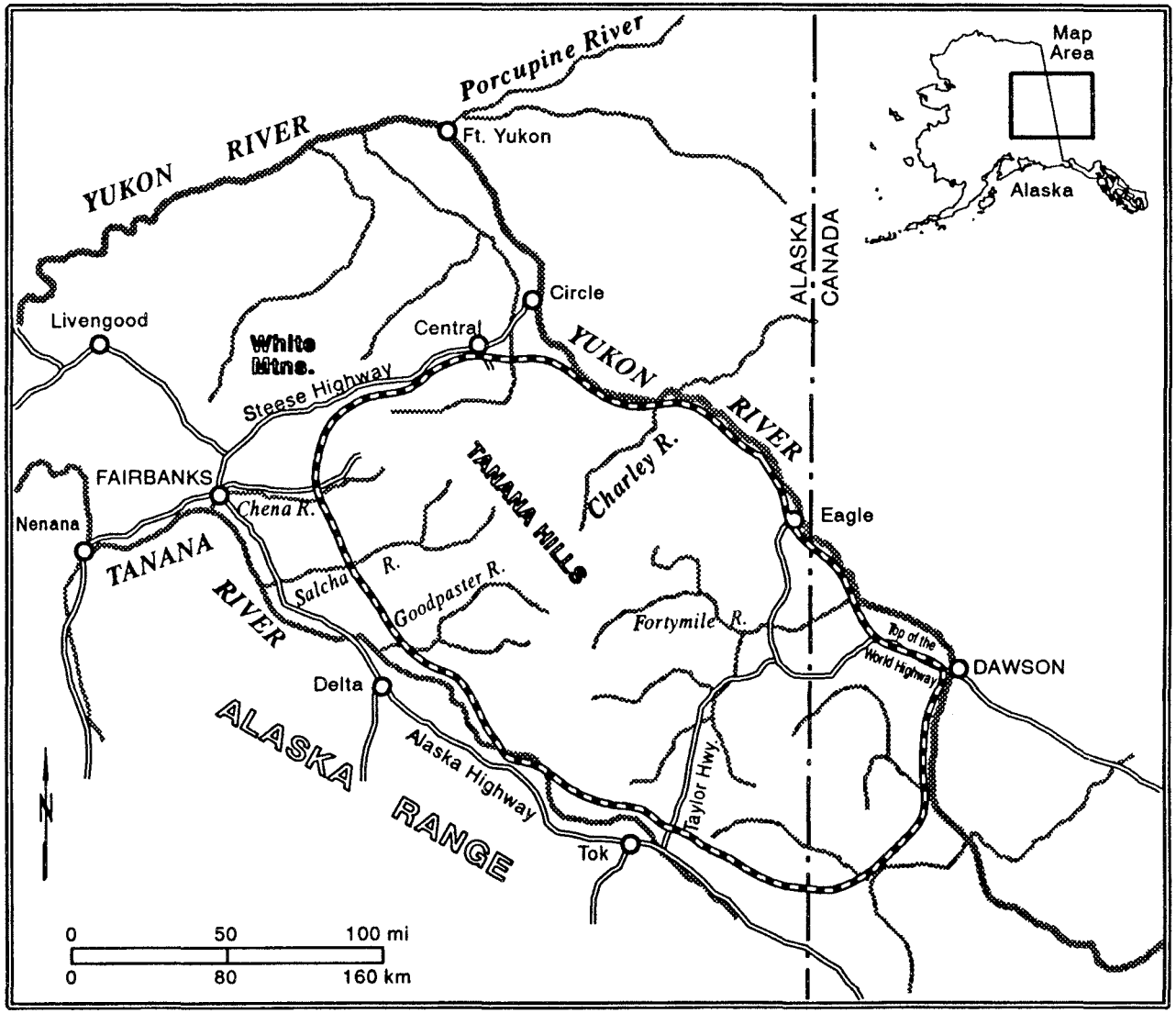

Fig. 1. Range of the Fortymile caribou herd, 1984-94.

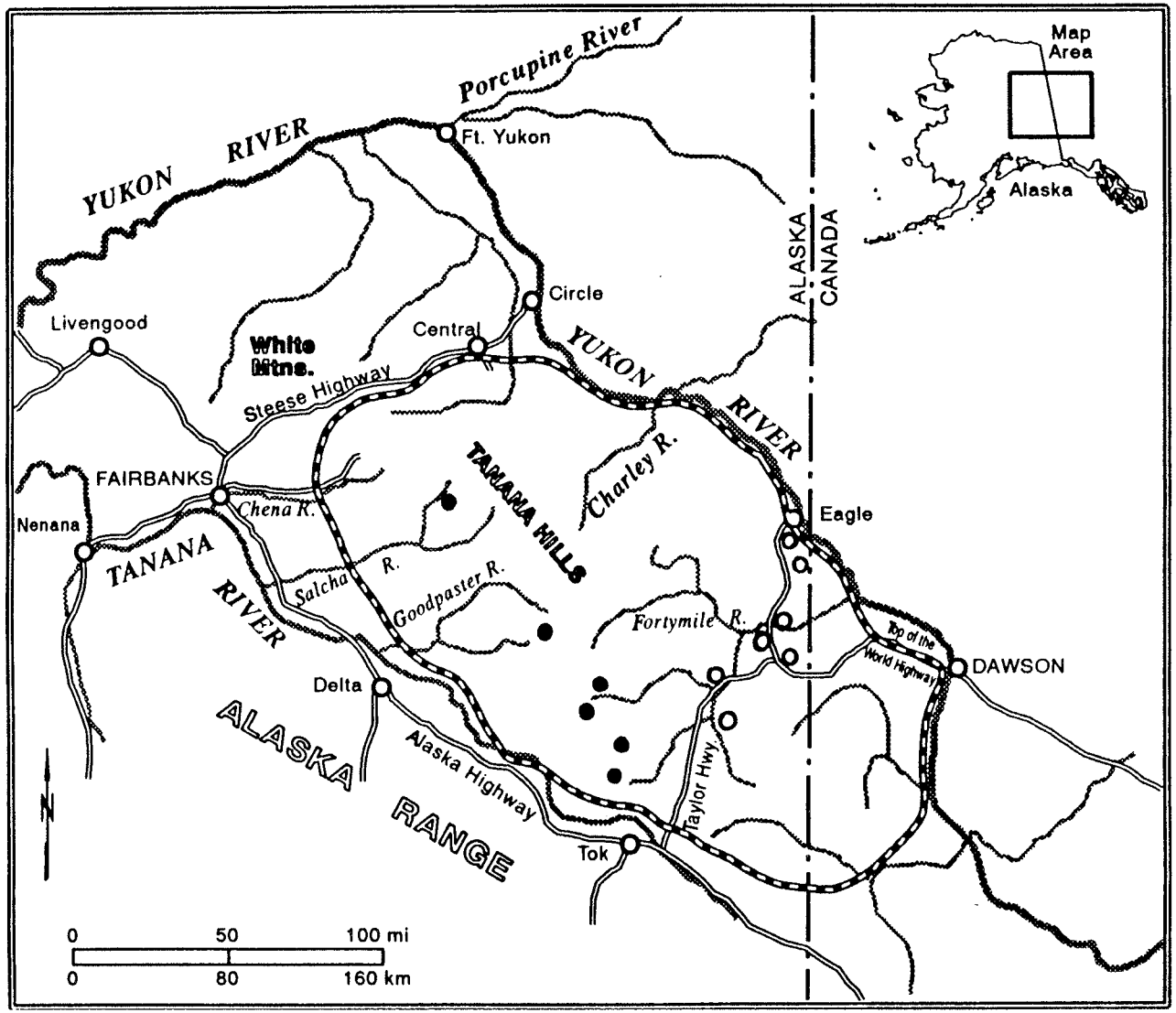

Fig. 2. Caribou fecal sample sites during March and April 1992 (●) and 1993 (○).

Table 1. Estimated numbers, harvest, natural mortality, natality, and recruitment in the Fortymile herd, 1984-93.

Year	Estimate of herd size	Estimated harvest[b] M	F	% mortality of collared females ≥28 months old for year ending 1 Oct (*n*)	% mortality of calves ≤2 days old (*n*)	Natality rate of collared females ≥36 months old (*n*)	Calves:100 females (*n*)[a] mid to late June	Sept to Oct
1984	13,402	430	20	10 (21)	--	87 (23)	45 (2,098)	--
1985	--	420	20	9 (22)	--	100 (19)	48 (2,280)	36 (574)
1986	15,303	360	20	17 (24)	--	95 (21)	--	28 (842)
1987	--	230	20	5 (19)	--	95 (19)	47 (1,860)	37 (1,274)
1988	19,975	650	150	9 (33)	--	95 (20)	36 (946)	30 (770)
1989	--	410	110	19 (27)	--	--	--	24 (1,182)
1990	22,766	320	30	40 (20)	--	88 (16)	--	29 (1,002)
1991	--	500	20	17 (12)	--	91 (11)	25 (1,860)	16 (931)
1992	21,884	380	40	17 (35)	3 (30)	87 (39)	46 (1,773)	30 (1,416)
1993	--	330	10	10 (51)	18 (28)	66 (47)[c]	23 (1,927)	29 (2,095)

[a] *n* = number of females ≥1 year old classified

[b] Some harvest occurred during January, February, or March of the subsequent year, but was included in the autumn tally of the previous year.

[c] During 1993, 5 of 12 (42%) females 3 years old were pregnant, and 26 of 35 (74%) females ≥4 years old were pregnant.

Table 2. Autumn (late Sep-late Oct) weights (kg) of female calves radiocollared in the Fortymile caribou herd, 1990-93.

	1990	1991	1992	1993
	55.8	55.4	50.8	58.1
	56.3	54.4	54.4	48.5
	51.7	54.4	65.3	58.1
	59.4	48.1	50.8	60.3
	53.5	59.0	58.5	57.6
	51.7	61.3	54.0	52.6
	43.1	56.3	52.2	55.4
	55.4	51.7	51.3	51.7
	49.9	57.2	67.2	57.2
	56.7	55.4	60.3	57.2
	49.0	48.5	45.4	61.3
	55.8	41.3	49.9	56.7
	52.6	57.6	51.3	54.0
	47.6	54.4	60.3	55.8
				57.6
Mean	52.8	53.9	55.1	56.1
SD	4.32	5.12	6.28	3.32
SE	1.15	1.37	1.68	0.86

Table 3. Proportions of discerned plant fragments in 13 fecal samples collected from Fortymile caribou during March and April 1992 (n = 6) and 1993 (n = 7). Collection sites are depicted in Fig. 2.

Plant genus or group	Mean % (± SD) of discerned plant fragments		
	1992	1993	Both years
Lichens	72 ± 22	81 ± 4	77 ± 15
Mosses	9 ± 8	7 ± 4	8 ± 6
Ledum	7 ± 5	5 ± 2	6 ± 4
Equisetum	7 ± 14	3 ± 2	5 ± 8
Picea	2 ± 1	2 ± 1	2 ± 1
Grass/Sedges	1 ± 1	1 ± 1	1 ± 1
Forbs	3 ± 5	0	1 ± 4
Dryas	1 ± 3	0	1 ± 2
Salix	0	1 ± 1	1 ± 2

Alaska's Game Management Units

The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manfacturer's excise tax collected from the sales of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program distributes funds to states using a formula based on each state's geographic area and number of paid hunting license holders. Alaska receives a maximum 5% of revenues collected each year. The Alaska Department of Fish and Game uses its funds to help restore, conserve, and manage wild birds and mammals. These funds are also used to educate hunters to develop skills and attitudes for responsible hunting. Federal Aid funds paid for 75% of this study.