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NATURAL MORTALITY OF WESTERN ARCTIC CARIBOU

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JOB PROGRESS REPORT (RESEARCH)

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Project No.: W-21-2 Project Title: Big Game Investigations

Job No.: 3.24R Job Title: Qualitative and Quantitative Aspects of Natural Mortality of the Western Arctic Caribou Herd

Period Covered: July 1, 1980 through June 30, 1981
(limited data through September 1981 included)

SUMMARY

Between April 1979 and July 1981, 93 caribou within the range of the Western Arctic Herd (including the Teshekpuk Herd) were successfully radio-collared. Ten of 38 males and 1 of 55 females lost collars. As of 30 September 1981, 6 male deaths and 2 female deaths were verified. Of the 6 collared males that died, 2 were shot, 1 was probably killed by wolves, 1 was probably killed (or possibly scavenged) by a grizzly bear, and 1 died of unknown causes. One female died during a breached birthing; and 1 apparently died from malnutrition and/or hoofrot infection.

The mean annual mortality rate was 11% (n = 70.4 animal years) for all radio-collared Western Arctic and Teshekpuk caribou, 26% (n = 21.1 years) for males, and 4% (n = 48.3 animal years) for females. The mean annual natural mortality rates (not human-induced mortality) were 13% for males and 4% for females. By comparison, based on estimates of population size, recruitment, and hunting mortality from 1976 to 1980, we calculated an average annual mortality rate for the entire herd of about 9% and a minimum annual herd growth rate of about 14% since 1976. Since 1979, 88% (n = 57) of the collared adult females (3 years old or older) had distended udders in early June, an indication of recent parturition; a minimum of 75% were actually seen with calves. Since 1976, in the herd at large, annual calf mortality from peak calf numbers in June to the following April has averaged 35%.

Wolf predation on caribou has been relatively low since 1977, but wolf numbers appear to be increasing. Other mortality factors are discussed.

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BACKGROUND

The Western Arctic Herd (WAH) was one of several Alaskan caribou (Rangifer tarandus granti) herds that declined during the early 1970's (Davis 1978). Because the WAH was the largest herd in North America, and its decline was numerically most dramatic, its population dynamics and management have been a focus of public and scientific attention since the decline was detected in 1975 (Davis and Valkenburg 1978).

Recent population modeling of the WAH (Doerr 1979, 1980; Davis et al. 1980) and intensified management have demonstrated the need for better biological data. Several studies addressing aspects of the biology of the WAH were initiated in recent years and are providing some of the required data. However, rates of natural mortality and the causes of this mortality have not been adequately determined. Caribou biologists familiar with population demography acknowledge that such data are essential to understanding the population dynamics of any caribou herd. Davis et al. (1980) concluded that natural mortality, particularly predation, contributed greatly to the recent decline of the WAH.

Because empirical data were not available for ongoing modeling and planning, natural mortality rates have been extrapolated from the literature. Rates of natural mortality published in the literature are few, and of limited value, consisting primarily of generalities from studies conducted a decade or more ago under different conditions than now exist in the WAH. Skoog (1968) and Kelsall (1968) suggested annual natural mortality rates of 5-6% for animals older than yearlings when relatively few wolves (Canis lupus) or grizzly bears (Ursus arctos) were present.

Bergerud (1971) found that males had a higher natural mortality rate (9%) than females (4%) in Newfoundland. In a recent review of population dynamics of North American caribou, Bergerud (1978) stated, "The natural mortality rate of adults when there are normal densities of predators has not been determined yet, but it

probably will average 7-13%, depending upon predator densities." Determining actual mortality rates and the extent to which mortality is compensatory is important for management and is requisite to understanding herd population dynamics.

This study is complementary to a concurrent study (National Park Service [NPS] Proposal No. 9100-78-05) designed to determine the seasonal home range use, social structure, and habitat selection of the WAH. The Alaska Department of Fish and Game (ADF&G) is conducting that study through a 3-year contract from NPS. ADF&G is also cooperating with P. Reynolds of the Bureau of Land Management (BLM) in a study of the Teshekpuk Lake Herd. Caribou radio-collared during these 3 studies will increase the total sample size without detracting from the major objectives of individual studies.

OBJECTIVE

To determine the age, sex, condition, and cause of death of adult caribou dying from natural causes (all factors other than human-induced mortality), and to monitor 50 radio-collared caribou to help quantify mortality factors.

PROCEDURES

Quantifying Natural Mortality

The natural mortality rate was estimated primarily using radio-collared caribou. For comparison, we also estimated adult natural mortality using a population model based on estimates of herd size, recruitment, and harvest by humans. Calf mortality was estimated from composition counts conducted during 2 or more of the following times: calving, post-calving migration, autumn, and April. We also searched caribou winter ranges to compare the relative abundance of caribou carcasses and evidence of predators and predation to previous years. Aerial surveys were often multi-purpose, such as simultaneously radio-tracking caribou, searching of wolves and caribou carcasses, and conducting composition counts.

To accomplish several objectives, we radio-collared 34 more caribou during spring 1981 (Table 1). During March 1981, we captured and radio-collared 1 young male and 7 adult female caribou in the Selawik Hills southeast of Kotzebue. All caribou were captured with a shoulder-held net gun (Mountain Helicopters, Greymouth, New Zealand) fired from a helicopter. The net gun propelled a triangular net, 5 m on a side, by means of 3 simultaneously fired 270 g weights. Maximum range of the net was 10 m. In April 1981, we used the net gun and standard Cap-Chur equipment (Palmer Chemical and Equipment Co., Inc.) with M-99, etorphine hydrochloride, (D-M Pharmaceuticals, Inc., Rockfield, MD), to capture 20 adult females, 1 calf, and 5 males on the

Table 1. Radio-collared caribou captured from the Western Arctic Herd and the Teshekpuk Herd, 1981.

Frequency (MHz)	Collar Number	Permanent Accession Number	Location and Date Collared	Age/Sex[1]
150.075	55	102,393	Oumalik R. 4/26/81	Adult F
150.080	54	102,353	Selawik Hills 3/26/81	Adult F
150.165	89	102,394	Oumalik R. 4/26/81	Adult M
150.260	24	102,358	Selawik Hills 3/27/81	Adult F
150.270	25	102,378	Price R. 4/25/81	Adult F
150.280	26	102,351	Selawik Hills 3/27/81	Adult F
150.290	27	102,359	Selawik Hills 3/27/81	Adult F
150.350	99	102,379	Price R. 4/25/81	Young M
150.370	19	102,380	Price R. 4/25/81	Adult F
150.380	13	102,381	Price R. 4/25/81	Adult F
150.390	28	102,382	Price R. 4/25/81	Calf F
150.400	29	102,383	Price R. 4/25/81	Young F
150.410	40	102,384	Price R. 4/25/81	Adult F
150.440	43	102,385	Price R. 4/25/81	Adult F
150.450	44	102,386	Price R. 4/25/81	Adult F
150.460	45	102,356	Selawik Hills 3/26/81	Adult F
150.470	46	102,355	Selawik Hills 3/26/81	Adult F
150.480	57	102,395	Oumalik R. 4/26/81	Adult F
150.520	58	102,387	Price R. 4/25/81	Adult F
150.530	59	102,353	Selawik Hills 3/26/81	Young F
150.540	91	102,396	Oumalik R. 4/26/81	Adult M
150.550	96	102,397	Oumalik R. 4/26/81	Adult M
150.560	98	102,354	Selawik Hills 3/26/81	Adult F
150.570	17	102,388	Price R. 4/25/81	Young M

Table 1. (Continued).

Frequency (MHz)	Collar Number	Permanent Accession Number	Location and Date Collared	Age/Sex
150.620	14	102,389	Price R. 4/25/81	Adult F
150.630	15	102,390	Price R. 4/25/81	Adult F
150.640	12	102,391	Price R. 4/25/81	Adult F
150.650	16	102,392	Price R. 4/25/81	Adult F
150.670	18	102,398	Oumalik R. 4/26/81	Adult F
150.605	30	102,407	Teshekpuk 5/1/81	Adult F
150.610	31	102,408	Teshekpuk 5/1/81	Adult F
151.620	32	102,409	Teshekpuk 5/1/81	Adult F
151.625	33	102,410	Teshekpuk 5/1/81	Adult F
151.630	34	102,428	Teshekpuk 7/5/81	Adult F
151.635	35	102,411	Teshekpuk 5/1/81	Adult F
151.640	36	102,412	Teshekpuk 5/1/81	Adult F
151.650	37	102,413	Teshekpuk 5/1/81	Adult F
151.660	38	102,414	Teshekpuk 5/1/81	Adult F
151.680	39	102,415	Teshekpuk 5/1/81	Adult F
151.690	40	102,416	Teshekpuk 5/1/81	Adult F
151.710	41	102,417	Teshekpuk 5/1/81	Adult F
151.720	70	102,420	Teshekpuk 7/5/81	Adult M
151.730	71	102,421	Teshekpuk 7/5/81	Adult M
151.740	72	102,422	Teshekpuk 7/5/81	Adult M
151.750	73	102,423	Teshekpuk 7/5/81	Adult M
151.760	74	102,424	Teshekpuk 7/5/81	Adult M
151.770	75	102,425	Teshekpuk 7/5/81	Adult M
151.780	76	102,426	Teshekpuk 7/5/81	Adult M
151.790	77	102,427	Teshekpuk 7/5/81	Adult M

[1] Young refers to caribou less than 3 years of age.

coastal plain northwest of Umiat. We also assisted P. Reynolds (BLM) in capturing and radio-collaring 11 females northeast of Teshekpuk Lake in early May, and 8 males and 1 female north and northeast of Teshekpuk Lake in early July 1981. Data from these Teshekpuk caribou were included to increase sample size in determining mortality rates. Details of capturing, injury to animals, and productivity following capture are being summarized and prepared for publication.

From most captured caribou, we recorded standard body measurements, neck circumference, and face length; collected a tooth and fecal sample; and collected blood serum, part of which was frozen and stored and part of which was biochemically analyzed fresh.

We flew 232 hours to monitor radio-collared caribou and search for caribou carcasses (Table 2). Methods used were previously reported (Davis and Valkenburg 1981). Most flying was done in the area of Selawik Flats and Buckland Hills, but we spent 1 day in March and 2 days in September 1981 radio-tracking on the arctic coastal plain between the Colville Delta and Point Lay. In late April, 2 days were spent radio-collaring caribou northwest of Umiat and conducting a sex and age composition survey.

We estimated mortality rates of radio-collared Western Arctic and Teshekpuk caribou with the following estimator derived empirically by W. Gasaway (pers. commun.):

$$\text{percent dying annually} = \frac{a}{b}$$

where

a = number of mortalities tallied among radio-collared animals

b = estimated number of collared animal-years (If the time interval differs from 12 mo, units will not be in years.)

b is estimated as follows:

$$b = \frac{c \cdot d}{e}$$

where

c = mean number of months that collars were transmitting, excluding animals that died

d = total number of radio-collared animals, including animals that died

e = time interval--12 mo for annual mortality

Table 2. Summary of flights conducted for radio-tracking, locating carcasses, and collaring caribou in northwestern Alaska, October 1980-September 1981.

Month	Hours Flown				Total # Flights	Total # Hours Flown
	Bellanca Scout	Cessna 185	Super Cub	Bell 206 Helicopter		
October		2			1	2
November		19	12	20	3	51
December					0	0
January	12				1	12
February					0	0
March	18	21	12	20	8	71
April	35			12	6	47
May					0	0
June		20			6	20
July		6			1	6
August		23			3	23
September						
Totals	65	91	24	52	28	232

This formula underestimates mortality rates when there is both a seasonal peak in mortality near the end of the observation period and radio-transmitter failure during the observation period. However, we know of no better estimator of mortality rates. In fact, calculation of mortality rates of radio-collared animals by dividing the number of collar-months by the number of deaths usually results in overestimates.

Data for the population size and trend model were taken from previous reports (Davis and Valkenburg 1981), the 1980 census, 1980 fall composition counts, and April 1981 composition counts. The WAH was censused in early July 1980 following procedures developed in 1978 (Davis et al. 1979). The presence of 25 radio-collared caribou facilitated locating post-calving aggregations; for example, radio signals led us to 1 group of about 6,000 which may have otherwise been uncounted.

Qualitative Assessment of Natural Mortality

Physical condition and age of caribou that died naturally were compared to a sample of hunter-killed animals. Physical condition was assessed by determining fat content or marrow in the femur (Neiland 1970). Fat content in mandibles and other long bones was compared to content in femurs for future reference. Age was estimated by inspecting tooth eruption and wear (Miller 1974), counting annuli in sectioned incisors (Goodwin and Ball 1979), or a combination of both methods.

RESULTS

Quantifying Natural Mortality

We monitored 93 radio-collared caribou for 845 collar-months (70.4 collar-years) from April 1979 through 30 September 1981. Eight of these died, resulting in a calculated mean annual mortality rate of 11% for all radio-collared caribou. Natural mortality (excluding human induced) accounted for 5 of the 8 deaths, or a mean annual rate of 7%.

Higher mortality occurred among males than females. Six of 38 radio-collared males died during 265 collar-months (21.1 collar-years) of monitoring, resulting in a mean annual mortality rate of 26%. Three of the 6 died from natural causes, so the natural mortality rate for males was 13%. Similar patterns of high male mortality rates have been reported in Canada (Bergerud 1971) and in Alaska (Davis and Preston 1980). Two of 55 radio-collared females died during 580 collar-months (48.3 collar-years) of monitoring. Both died of natural causes, resulting in a natural mortality rate of 4%.

Of the 8 radio-collared caribou that died since inception of this study, 2 males and 2 females died during this reporting year (Table 3). One male was shot by a resident of Point Barrow. The

Table 3. Status of radio-collared caribou in the Western Arctic Herd, September 1981.

Status	Young[1]		Adult		Total
	Male	Female	Male	Female	
Radio functioning	1	1	18	51	71
Killed by humans	1	0	2	0	3
Possibly killed by wolves	1	0	0	0	1
Probably killed by grizzly bears	1	0	0	0	1
Dead unknown cause	0	0	1	0	1
Died giving birth	0	0	0	1	1
Died from disease	0	0	0	1	1
Shed collar	4	0	6	1	11
Missing[2]	2	0	1	0	3
Total	10	1	28	54	93

[1] Young refers to caribou less than 3 years old when collared.

[2] Not located for over 1 year.

other male was found under the snow and had died of unknown causes in the fall before snow fell. One female that died was found on the periphery of the Utukok calving area in June 1981. Necropsy revealed a calf lodged in the birth canal in a breached position. The other female died near the Colville River in mid-August. It was emaciated, a small amount of milk was present in the udder, and a calf was standing over the carcass. We attributed its death to malnutrition, possibly associated with footrot infection (Fusobacterium necrophorum) (Neiland 1972). At least 10 caribou died in a similar way in 1977 and 1980 (Davis and Valkenburg 1981).

Survival of calves from radio-collared females was determined by aerial monitoring during early June (Table 4). A synopsis of WAH calf mortality determined from calf:adult ratios appears in Table 5.

Estimating Natural Mortality Through Modeling

Results of the 1980 aerial photo-census indicate that the WAH is continuing to increase at about 14% per year. The 1980 pre-hunting season estimate of herd size was 140,000. About 138,500 caribou were counted from photographs or, in a few cases, directly from aircraft. Forty-five groups ranging in size from 1 to 30,000 were counted, and 20 of these groups numbered more than 1,000 caribou (Fig. 1). Transect sampling on the arctic coastal plain between Point Lay and the Colville Delta and quadrat sampling from the Brooks Range south revealed only about 1,450 caribou outside the post-calving aggregations (Table 6). We believed the census to be relatively accurate, but due to the large number of aggregations, it is possible that some caribou could have been missed. The 1980 census was probably less accurate than the 1978 census. We did not assign confidence limits to the photo-census because the biases involved in photo interpretation, or estimating size of aggregations which were not located, cannot be quantified (Davis et al. 1979).

Adult mortality rates predicted from our model of population size (Table 7) are similar to estimates of overall mortality derived from radio-collaring. Our observations indicate that mortality did not increase greatly between 1980 and 1981, and the herd should continue to grow.

We constructed hypothetical survivorship curves for male and female caribou based on the calculated mortality rates of radio-collared individuals (Fig. 2). These curves demonstrate the rapidly decreasing proportion of males as age increases, and if a similar mortality pattern continued long enough for the age structure to stabilize, the adult sex ratio would be about 35 to 40 males:100 females. However, as of autumn 1981, an either-sex hunting season was instituted again, and overall mortality of female caribou should increase.

Table 4. Productivity and early survival of calves of radio-collared Western Arctic Herd caribou, 1979-1981.

Date	Number of Females with Radio-collars	Number Seen in June	Number of Adults[1]	Number with Distended Udders (%)	Number with Calves (%)	Calves/100 Females from Aerial Classification (general population)
1979	4	4	4	4(100)	4(100)	65 (n = 2600)
1980	22	18	15	14(93)	14(93)	82 (n = 2166)
1981	41	38	38	32(84)	25[2](66)	82 (n = 2222)
Total	67	60	57	50(88)	43(75)	

[1] Three years of age or older

[2] When relocated on 6 June, 2 females had apparently not calved as indicated by retention of hard antlers and were consequently not included in calculations.

Table 5. Calf survival and mortality in the Western Arctic Herd, 1976-1981.

Cohort Year	Calves/100 Females at Birth	Survival to 1 Month Calves/100 Females (% mortality to 1 month)	Survival to 4 Months Calves/100 Females (% mortality 1 to 4 months)	Survival to 10 Months Calves/100 Females[1] (% mortality 5-10 months)	Total Annual Mortality
1976	73	54 (26)	48 (5)	55 (0)[2]	31%
1977	69	52 (25)	42 (14)	29 (19)	58%
1978	68	63 (7)	48 (22)	50 (0)[2]	29%
1979	65	N.A.	N.A.	53 (18)[3]	18%
1980	82[4]	66 (20)	53 (20)	53 (0)	40%
1981	82[4]	N.A.	N.A.		

[1] This figure is adjusted to compensate for the addition of female yearlings to the adult female segment of the population.

[2] These figures indicate that mortality was not measurable over winter by standard survey methods.

[3] Counts were done too late in spring to accurately estimate calf:female ratios. This figure was calculated using numbers of calves/100 caribou older than calves and by assuming a ratio of 50 bulls/100 females in the population.

[4] Counts occurred in the central calving area where calf:female ratios are high; therefore, mortality was actually lower.

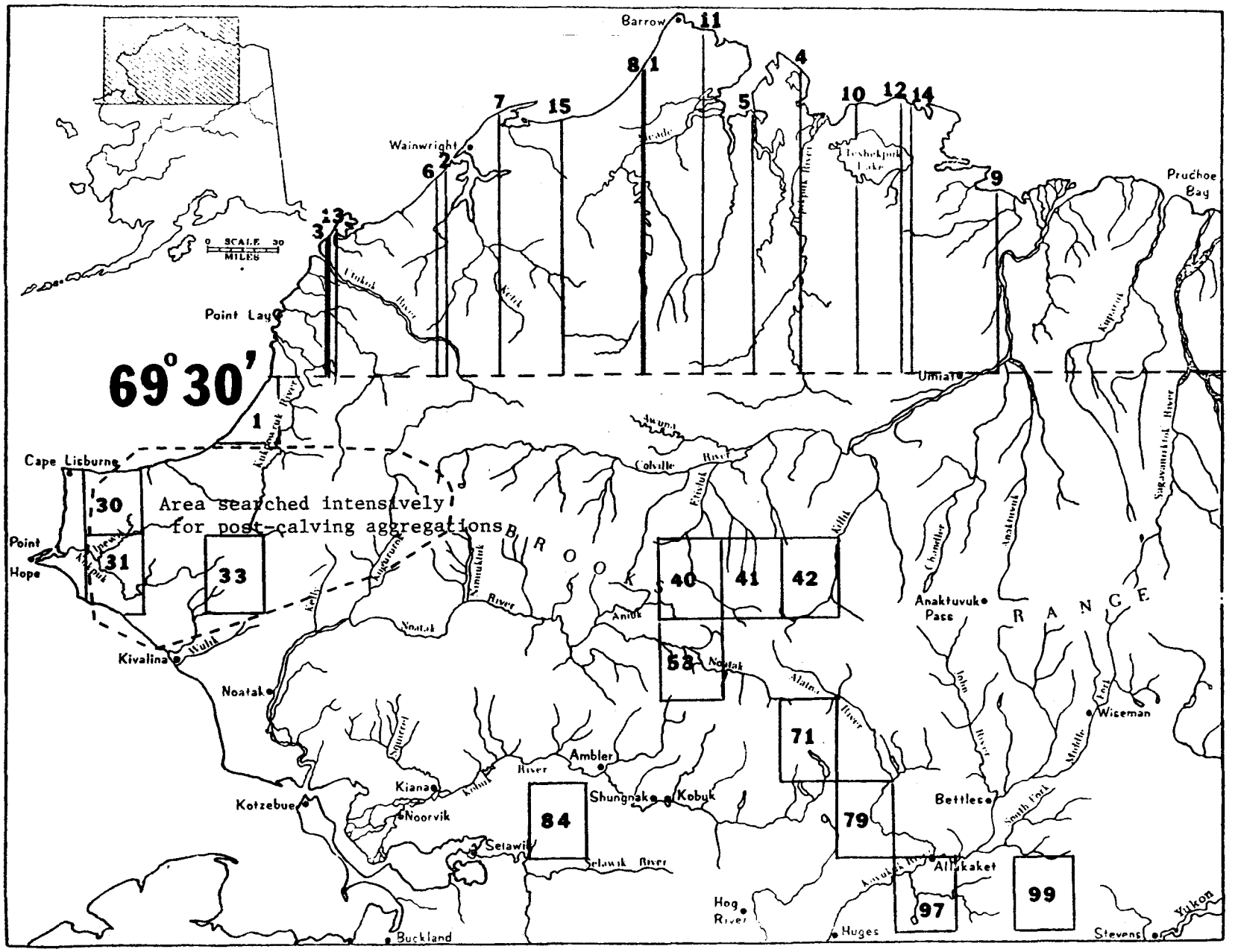

Fig. 1. Distribution of post-calving aggregations and the transects and quadrats sampled during the 1980 Western Arctic Herd caribou census.

Table 6. Estimates of caribou numbers based on transect and quadrat surveys in the range of the WAH, 4-5 July 1980.

Area	Number Transects or Quadrats	Number Caribou Seen	Extrapolated Estimate of Caribou (80% C.I.)	No. mi^2 Surveyed	No. mi^2 in Survey Area
Arctic coastal plain	15	69	1,425 $\pm$ 774	1,217	25,000
South of the arctic coastal plain	12	3	25 $\pm$ 22	13,000	113,867

Table 7. Calculation of adult natural mortality based on estimates of population size, recruitment, and human harvest in the Western Arctic Caribou Herd, 1976-1980.

Year	July Population Estimate	Population Estimate (older than calves)	Recruitment[1]	Expected Population[2] (older than calves)	Human Harvest[3]	Annual Adult Natural Mortality[4] from Previous July to July (%)
1976	75,000[5]	51,750				
1977	90,000[5]	63,450	18,182		3,100	3,382(6.5)
1978	102,000[5]	72,114	12,996	76,446	3,000	1,332(2.1)
1979	113,000[5],[6]	77,744[7]	21,541	93,655	4,000	11,911(16.5)
1980	140,000	94,000	25,915	103,659	5,000	8,959(11.5)
1981	[160,000][8]	[110,000][7],[8]	28,200	122,200	5,000	7,100(6.4)
				Average Annual Adult Natural Mortality = (8.6)		

[1] Recruitment = previous years' July population older than calves + (% calves in spring/ 100-% calves in spring x previous July population older than calves).

[2] Expected population = previous July population (older than calves) plus recruitment.

[3] Calculated from permit returns and estimates of illegal kill.

[4] Adult natural mortality = expected population less July population (older than calves) less human harvest.

[5] From Davis et al. 1979.

[6] This estimate is probably low because calving ground censuses have consistently given lower estimates than use of the aerial photo-direct count-extrapolation technique.

[7] In 1979, the percentage of calves in the herd in July was not determined, so the mean value (31.2%) for other years was used.

[8] Projected estimate based on 14% increase from previous year.

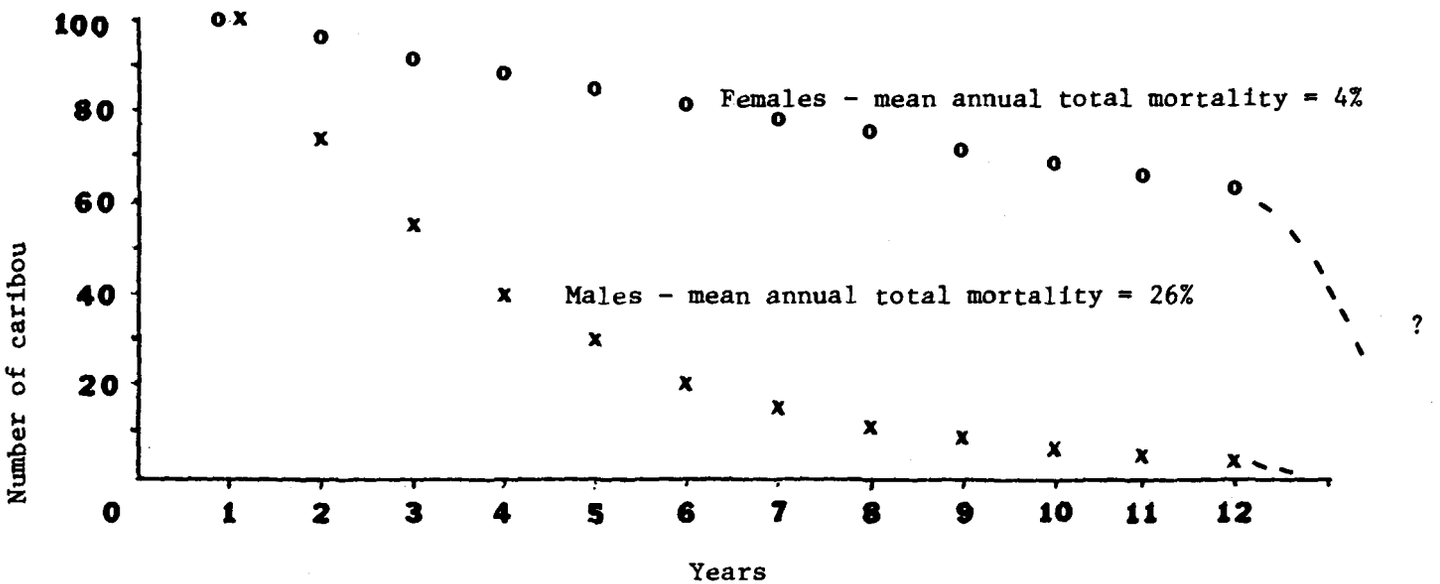

Fig. 2. Hypothetical survivorship curves for Western Arctic caribou based on mortality rates of radio-collared individuals, 1979-1981.

Qualitative Aspects of Natural Mortality

Wolf numbers in the range of the WAH have been at fairly low levels since 1977 (Davis and Valkenburg 1981). Our casual observations during approximately 130 hours flown in the southern winter range near the Selawik Hills and 30 hours flown in the arctic coastal plain winter range indicate that wolf populations are still at low to moderate levels. We saw 18 wolves in 3 packs on winter range south of the Kobuk River, and 2 wolves on the arctic coastal plain north of Umiat. In contrast, in 1979-80 we saw 10 wolves during about the same number of flight hours, but none were seen on the arctic coastal plain. Our general impression from sightings and tracks is that wolf numbers may be increasing. Numbers of wolves taken by hunters and trappers since 1974-75 (Table 8) show a higher reported kill in Game Management Units (GMU) 24 and 26 but a relatively low take in GMU 23. These figures may be of limited value since harvest in any year may depend on local snow conditions and factors other than wolf numbers, including inaccurate reporting.

Since 1977 (Davis and Valkenburg 1978), we have not found enough wolf-killed caribou to determine whether wolves have been selecting for a particular age group or for debilitated caribou (Table 9).

We did not document any other sources of caribou mortality from October 1980 through July 1981. Winter conditions were relatively mild in 1980-81 on the Selawik/Buckland winter range and the arctic coastal plain, although snow was deeper in both areas than in either of the preceding 2 winters. Snow was probably significantly deeper than average in the northern foothills of the Brooks Range, but only about 5,000 caribou were affected.

Windy, cool, and wet weather prevailed in northwest Alaska during July 1981, and it is unlikely that mosquito harassment was as severe as during any of the preceding 5 years. Compared to 1980 (Davis and Valkenburg 1981), we received a few reports of caribou dying during July and August of what appeared to be hoofrot or malnutrition associated with this syndrome (Neiland 1972).

RECOMMENDATIONS

Management activities for the 1981-82 winter should include an intensive effort to document harvest levels and a range-wide survey to estimate wolf numbers.

ACKNOWLEDGEMENTS

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Table 8. Reported take of wolves in the range of the WAH for 1975 through 1981.

Year	GMU 23[1]	GMU 24[2]	GMU 26[3]	Total
1974-75	47	65	6	118
1975-76	144	45	34	223
1976-77	150	55	35	240
1977-78	64	55	38	157
1978-79	48	102	31	181
1979-80	16	49	15	80
1980-81	41	69	42	152

[1] Kobuk River, Noatak River, Selawik River areas.

[2] Upper Koyukuk drainage, central Brooks Range. Up to 20% of these animals are from areas outside the WAH caribou range.

[3] Arctic slope. Although this Unit includes the entire arctic slope east to the Canadian border, more than 90% of the wolves taken came from the area between the Anaktuvuk and Etivluk Rivers.

Table 9. Marrow fat condition, age, and cause of death of caribou found dead or collected in the range of the Western Arctic Herd, 1979-1981

Accession Number	Cause and Date of Death	Tooth Wear Class[1]	Number of Cementum Lines[2]	Sex	Femur % Fat	Mandible % Fat	Tibia-fibula % Fat	Meta-tarsus % Fat	Ulna % Fat	Other % Fat[3]	Comments
102,333	Collected 7/29/80		2	M	39	45	36	40	23		Broken front leg
102,286	Found dead 8/19/80		U	F	16	31	10	10	16		Hoofrot likely
102,285	Collected 7/80	3	U	F	7	7	9	8	0	H 2 M 2	Hoofrot likely
102,284	Collected 7/80	2	U	F	1	8	0	1	10	M 1 H 9	Hoofrot likely
102,283	Found dead 8/15/80	yearl.		F	14	17	14	13			Hoofrot likely
102,429	Wolf kill 3/81			M			78				
102,414	Wolf kill 3/81	2	8	M	86						Central Arctic Herd
102,374	Wolf kill 4/27/81		1	M	80	80					Central Arctic Herd
102,373	Wolf kill 4/27/81	3	8	M	56	29					Central Arctic Herd
102,371	Wolf kill 4/24/81	3		M				87			
102,259	Wolf kill 4/24/81		9	U	69		82	84			May have been hunter kill
102,328	Wolf kill 10/80		8	U			61				Porcupine Herd
102,330	Grizzly kill 11/4/80		2	F		64					
102,335	Winter kill 1/81			M							Hoofrot possible
102,419	Hunter kill 3/27/81		1	F							Pregnant
102,376	Hunter kill 3/81			M							Possible mange on neck
102,375	Hunter kill 3/81		9	F				78	75		Entire carcass unsalvaged
102,336	Hunter kill Spring 1980			F							

Table 9. (Continued).

Accession Number	Cause and Date of Death	Tooth Wear Class[1]	Number of Cementum Lines[2]	Sex	Femur % Fat	Mandible % Fat	Tibia-fibula % Fat	Meta-tarsus % Fat	Ulna % Fat	Other % Fat[3]	Comments
102,258	Hunter kill 4/80	2		M	67-91						Unsalvaged except for tongue
102,257	Hunter kill 3/80	3		F							Unsalvaged except for tongue, pregnant
102,256	Hunter kill 3/80			F							Entire carcass unsalvaged
102,255	Hunter kill 3/80			F	85						Entire carcass unsalvaged
102,254	Hunter kill 3/80	yearl.		U	79		85				
102,253	Hunter kill 3/80	calf		U	88	61	92	95			Site of tent camp with 21 carcasses
102,252	Hunter kill 3/80	3		F	91		94	100			Site of tent camp with 21 carcasses
102,251	Hunter kill 3/80	calf		U	89	89	89	97			
102,250	Hunter kill 3/80		7	U	85		92	87			Site of tent camp with 21 carcasses
102,249	Hunter kill 11/79	yearl.	1	M							
102,247	Hunter kill 3/80	calf		U			73	34	77	H 100 M 79	Shot, then fed on by wolves
102,246	Hunter kill 3/80	3	4	F	91		87	96			
102,245	Hunter kill 3/80	yearl.	1	M	78		77	82			
102,244	Unknown 3/80			F							
102,336	Bear kill 9/80	2		M		65					Radio collar number 62 BKY
102,218	Hunter kill 10/15/79	2		M	73		90	88	66	H 54 M 65	Radio collar number 2 BKY

[1] Wear classes range from 1 (adult dentition but no wear) to 3 (teeth worn to near gum line).

[2] U = unreadable

[3] H - humerus, M - metatarsus.

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