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# CALVING DISTRIBUTION, INITIAL PRODUCTIVITY AND NEONATAL MORTALITY OF THE PORCUPINE CARIBOU HERD, 1983

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Key Words: Caribou, Porcupine herd, calving distribution, productivity, neonatal mortality, predation, post-calving movements, Arctic-Beaufort, north slope

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Abstract: A 3 year study by the Alaska Dept. of Fish and Game and the U.S. Fish and Wildlife Service of the Porcupine caribou herd's calving distribution, initial productivity and neonatal mortality was initiated in 1983. Frequent relocation surveys of 23 cadio-collared adult female caribou (Rangifer tarandus), aerial reconnaisance surveys, and transects during late spring migration and throughout the calving season identified calving distributions on the coastal plain and foothills extending from the Sadlerochit River in Alaska to the Firth River in Canada. A major calving concentration occurred in the lower foothills and adjacent coastal plain along the Jago River. Another concentration of calving occurred on the coastal plain and foothills between the Kongakut River and Komakuk Beach. In 1983 the calving distribution of the Porcupine caribou herd was similar to that observed in 1976, 1978 and 1979, and was 8 of 11 years in which concentrations of caribou calved in the Jago River foothills area. The peak of calving occurred on 4 June and there was no discernable variation in calving chronology from west to east. Eighteen of 23 (78%) radio-collared females produced calves. Initial productivity based on aerial composition transects over calving concentrations was measured at 74 calves/100 cows. During 4-8 June 69 calves were captured at coastal plain and foothills sites the Jago concentration area, and fitted with mortality sensing in Radio frequencies of these calves were monitored at radio-transmitters. least daily and visual checks were made every 48 h during 4 June - 2 July. Monitoring was less intense during the remainder of July and continued on a monthly basis through 1983. Eighteen productive radio-collared adult females were monitored as a control group on 1-3 day intervals during 29 May - 2 July. During 4 June - 3 August, 17 study calves died. Six calves died as a result of study-induced abandonment. The mortality rate of remaining calves was 17.5%. Categories of natural mortality included: predator kills (45.5%); probable natural abandonment (27.3%); and undetermined-predation/ excluded (9.1%) and predation/scavenging involved-predator/ scavenging scavenger undetermined (18.2%). During 29 May to 2 July, 5 (27.8%) of the control calves died. Differences in geographic distribution of study and control groups may have contributed to the higher mortality of control calves. Golden eagles (Aquila chrysaetos) killed 3 study calves and were observed feeding on unmarked calves on several occasions. Brown bears (Ursus arctos) probably killed 2 study calves and were observed killing and/or feeding on unmarked calves on 11 occasions. Natural mortality was greatest among study calves captured on coastal plain areas (21.9%) than foothills groups (12.9%). A majority of mortalities (60%) occurred in foothills areas, however, as most of the study calves captured on the coastal plain moved into the foothills. The relative low initial mortality rate of study calves during 4 June - 2 July agreed with comparative herd composition data between peak of calving and early July which also indicated a high survival of calves. During 7-30 June 1982 a natural mortality rate of 45% was measured in radio-collared calves captured on the coastal plain south of Herschel Island. Factors associated with spring migration and geographical distribution of calving may have influenced calf mortality rates in 1983 and 1982. An additional 4 mortalities of undetermined causes were confirmed in the study group from 1 August to 10 December 1983.

Calving distribution, initial productivity and neonatal mortality of the Porcupine Caribou Herd, 1983.

Much of the coastal plain portion of the Arctic National Wildlife Refuge (ANWR) was opened to a limited oil and gas exploration program by the Alaska National Interest Lands Conservation Act (ANILCA) of 1980. If significant potential for petroleum resources are indicated, Congress may pass additional legislation to open ANWR to further exploration, leasing and Caribou from both the Porcupine and Central Arctic herds development. utilize portions of the coastal plain of the ANWR for calving, post-calving aggregations, and insect relief activities during the spring and summer (USFWS 1982). Parturient female caribou and post-parturient females with young calves are sensitive to disturbance associated with human activity (de Vos 1960, Lent 1964, Bergerud 1974, Cameron et al. 1979, Davis and Studies conducted annually since 1974 have shown that Valkenburg 1979). female caribou with young calves avoid the Prudhoe Bay oil field and adjacent Trans-Alaska Pipeline corridor (Cameron and Whitten 1976, 1980). It has been suggested that displacement of parturient female caribou and females with young from traditional areas may cause increased calf mortality which could ultimately contribute to population decline (Bergerud 1976, Calef and Lent 1976, Klein 1980).

Mortality factors and rates associated with potential displacement habitats need to be assessed to make predictions regarding calf survival and herd productivity if traditional calving habitats are further explored and developed for petroleum production. Consequences of displacement from traditional insect relief areas and preferred forage areas, and the overall impacts of human/industrial disturbances also need to be evaluated. This study focuses on determining annual calving distribution, initial productivity, and neonatal caribou calf mortality on the calving grounds and post-calving areas of the Porcupine caribou herd.

A review of current literature indicates that no significant climate-related mortality of new-born calves has been reported for the study area (USFWS 1982.) Previously reported densities of wolves (Canis lupus) and brown bear have been relatively low, compared to calving areas of other caribou herds in northern Canada and Alaska. Little data exists regarding current predator densities, movements, and distribution in the study area (USFWS 1982). Approximately 200 immature golden eagles have been reported in the study area during the calving season (Roseneau per. comm.). Some observations of predation on caribou calves by brown bears and golden eagles in the study area have been reported (Calef and Lortie 1973, Roseneau and Curatolo 1976). Information is not available on the incidence of still births or the occurance of diseases such as brucellosis and pneumonia among caribou in the study area.

Based on cow:calf ratios, Calef and Lortie (1973) reported a calf mortality rate of 17% for the Porcupine Herd between mid-June and late July. Similar calf mortality rates have been reported for other large herds during this period (Bergerud 1980). Using aerial survey techniques, Miller and Broughton (1974) were able to identify categories of calf mortality factors for the Kaminuriak Herd in northern Canada. The most common technique used to evaluate caribou calf mortality is aerial survey to measure the chronology and over-all magnitude of caribou calf The mortality on an annual basis (Kelsall 1968, Davis et. al. 1980). gregarious nature of parturient and post-parturient females and the relatively high level of calving synchrony exhibited by migratory caribou, contribute to the utility of aerial survey methods (Bergerud 1974, Dauphine and McClure 1974). The achievement of accurate calf mortality estimates, however, is often complicated by difficulties in identification of age and sex classess from the air and by frequent mixing of barren females and non-productive yearlings with productive females (Miller and Broughton Another problem is that comparative cow-calf ratios developed from 1974). aerial survey data do not provide information on causes of mortality or the spatial and temporal distribution of that mortality.

Intensive searches for calf carcasses using helicopters for low-level flight over calving and post-calving areas have provided data on causes and spatial distribution of neonatal caribou calf mortality (Miller and Broughton 1974, Miller et al. 1983). However, this technique only provides data on mortalities that are found and does not provide an inference base for overall calf mortality within a given year. Recently, techniques using expandable neck collars with attached mortality sensing radio-transmitters have produced improved data on neonatal mortality rates and factors for several species of ungulates (Cook et al. 1967, 1971, Logan 1972, Beale and Smith 1973, Garner et al. 1976, Schlegel 1976, Franzmann and Peterson 1978, Franzmann et al. 1980, Ballard et al. 1981, Bjarvall and Franzen 1981).

The feasibility of using mortality sensing radiotransmitters with expandable neck collars on neonatal caribou calves of the Porcupine Caribou Herd was tested during 1982 (Mauer et al. 1983). Test results indicated that the technique was feasible, and movements of individual neonates could be followed to detect and locate mortalities in a timely manner which enables collection of information relative to cause of death. The test also confirmed that the technique provided means to obtain detailed data on the chronology and geographic location of mortalities and that potential exists for inferences on over-all mortality rates of calves in the population. The feasibility study identified logistical requirements and strategies necessary to successfully collect caribou calf mortality data using radio telemetry techniques.

ANILCA requires the evaluation of potential adverse effects that oil and gas exploration, production, and development on ANWR might have upon the Porcupine caribou herd. In addition, if petroleum development on ANWR is allowed, more information on caribou distribution and habitat use during the calving and post-calving periods is needed to formulate recommendations for leasing schedules, placement of facilities, and other mitigative measures. In particular, causes and patterns of calf mortality need to be examined with emphasis on differences among areas or habitat types, in order to assess the possible effects of displacement from development sites.

Based upon the results of the feasibility study, a 3 year investigation of caribou calving distribution, initial productivity, and neonatal calf mortality was initiated in 1983 as a joint project between the Arctic National Wildlife Refuge, U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game. Objectives for this study are as follows:

# A. Primary

- 1. Delineate distribution of the Porcupine caribou herd calving as part of a continuing effort to collect baseline information on wildlife resources in the portion of ANWR open to petroleum exploration; identify any annual consistencies in calving distribution and/or common characteristics among separate calving areas.
- Determine initial calf production and extent, causes, and chronology of mortality among neonatal calves (i.e., 4-6 weeks postpartum).
- 3. Measure variation in calf mortality and calf mortality factors between core and peripheral areas and/or between different habitat types or localities.

# B. Secondary

- 1. Provide productivity data for analysis of herd status.
- Identify characteristics (i.e., habitat, snow ablation patterns, topography, etc.) of core and peripheral calving areas and/or calving areas in different habitat types or localities.
- 3. Provide additional collared caribou for concurrent studies of overwinter calf survival and seasonal movements.
- 4. Provide incidental observations of other species as part of the overall ANWR baseline studies, including casual or incidental locations of radio-collared muskoxen and bears.

This study is being conducted concurrently with studies of the status (population size, and trend), overwinter calf mortality, and winter distribution of the Porcupine Caribou Herd. Adult caribou collared in conjunction with those studies aid in the conduct of this investigation. Collectively this study is a part of a comprehensive environmental inventory and assessment of the potential petroleum developement area of ANWR. This report presents preliminary findings of the 1983 field season.

# Methods and Materials

# Study Area

The study area consists of the north slope of ANWR and may extend east to the Blow River in Canada and south to the southern slopes of the Brooks Range, depending on annual variations in caribou distributions. In 1983, the study area extended from the Kaktakturuk River on the west to the Firth River in Canada on the east, and from the continental divide in the Brooks Range on the south to the Beaufort Sea coast on the north.

Most study activities occurred on the coastal plain and foothills portions of the area described above. Descriptions of the physical environment, climate, geology, vegetation, and other wildlife resources of the study area are found in U.S Fish and Wildlife Service (1982). Logistical operations were based at Kaktovik, Alaska.

#### Age Determination

The new hoof measurement described by Haugen and Speake (1958) for aging neonatal white-tailed deer (Odocoideus virginianus) fawns was investigated for use in aging neonatal caribou calves. In late April, 3 known age reindeer calves of а captive reindeer herd at the University of Alaska-Fairbanks campus were repeatedly measured for new hoof length. Each distal hoof on both forelegs was scribed to standardize the measurements and calves were measured daily from 21 April-17 May. In late May, 6 caribou calves were captured from the Delta caribou herd and transported to the University of Alaska-Fairbanks by Alaska Department of Fish and Game personnel. Each calf was examined and an estimated age was determined using criteria described by Miller (1972). Each caribou calf had the distal hoof of both forelegs scribed as above and University personnel measured new hoof length intermittently until late June. Regression analysis was used to determine the relationship between new hoof length and age in reindeer and caribou calves.

# Calving Distribution and Initial Productivity

General calving distribution was determined primarily by locating all radio-collared adult female caribou in the Porcupine Herd during late May and early June. All radio-tracking was conducted from aircraft equipped with standard tracking equipment (Telonics, Mesa, AZ.). Radio-tracking flights during calving distribution surveys were usually at altitudes greater than 1,000 m AGL. Low altitude (20-100 m AGL) aerial searches were also conducted to identify calving caribou.

Low-level transects were flown in fixed-wing aircraft over the areas where collared cows were located. Strong, easterly winds blew almost every day during calving period, and groundspeed consequently varied greatly between east and westbound flight lines. In areas of low caribou density, essentially all caribou within approximately 300 m of the flight line were counted and classified. In high density areas, and especially on downwind transects, only partial counts of caribou could be obtained, and only newborn calves and adults were classified.

Transects were also flown by helicopter to determine age/sex composition of caribou in an area of particularily high density. During these helicopter transects, all caribou within approximately 400 m of each flight line were counted and classified. In addition to determining caribou distribution and density, these surveys also provided data on initial productivity on the calving grounds. Observations of antler shedding (Lent 1965, Epsmark 1971), udder distention (Bergerud 1964), and calves at heel of radio-collared cows and unmarked cows in certain areas provided information on the progression of calving.

High altitude radio-tracking flights over the northern part of the winter range, and over the mountains and coastal plain east of the calving areas were conducted to determine the distribution of bulls and yearlings during calving. These surveys were coordinated and data were exchanged with Canadian Wildlife Service personnel who were concurrently monitoring the distribution and movement patterns of bull caribou during spring migration.

# Neonatal Mortality

Caribou calves were captured from a high density area of calving females located in the lower foothills and adjacent coastal plain along the Jago River in the Arctic National Wildlife Refuge (Fig. 1). Two calf capture sites were selected in the lower foothills portion of the high density area near VABM Bitty, 1 on the east side of the Jago River (foothills-east) and 1 on the west side (foothills-west). Two capture sites were also selected on the coastal plain portion of the high density calving area (coastal plain-north and coastal plain-south). These sites were located between the Jago and Okpilak Rivers approximately 20 km south of Barter Island.

Caribou groups were approached by helicopter (Hughes 500 D) with a capture crew of 3 persons aboard. The helicopter landed approximatedly 200 m from the caribou and 1 person took a sitting position on the left skid. The helicopter then proceeded towards the group and a calf was selected for capture. Selection from groups was standardized (calf on extreme right) to minimize sampling bias for slower, younger, and/or weaker calves.

The selected calf was pursued by flying approximately 1 m above the ground. When the helicopter was within 2-3 m of the running calf, the person on the skid stepped off to the side, ran, and grasped the calf. Sterile surgical gloves were worn by personnel handling captured calves and were discarded after each handling. When a calf was captured, the helicopter landed and the remaining members of the capture crew assisted in processing the calf.

Captured calves were sexed (Bergerud 1961), weighed, and measured for total body length, right hind foot length, and new hoof length (Haugen and Speake 1958). Characteristics of the umbilicus (moist, dry, absent), and hooves (degree of wear), were noted as described by Miller and Broughton (1974). Each calf was examined for abnormalities and fecal samples were collected from those calves with scours.

expandable white elastic collar supporting a mortality sensing An transmitter (Telonics Inc., Mesa, Az.), weighing approximately 114 g was installed around the neck of each calf. Mortality mode for transmitter units was a doubling of normal pulse rate following a 1 hour motion free period. Estimated battery life was 15 months. Each collar was constructed from 3.75 cm wide elastic band. Adjustment of the initial collar size at installation was achieved by fastening the left and right ends of the elastic collar band together with aluminum "pop" rivets. Three separate expansion folds per collar were sewn with incremental amounts of cotton thread stitching. Each expansion fold provided an additional 7 cm of collar Maximum expansion circumference of each collar was 53 cm. circumference. Collars were constructed to breakaway after the last expansion fold was used.

Helicopter-supported ground observers were used to observe reunion of cow-calf pairs following release of calves captured in portions of the foothills areas. The helicopter capture crew noted cow/calf reunions on the coastal plain area and frequent aerial relocations using fixed-wing aircraft were used to monitor reunions during the capture operation.

Aircraft (PA-18) equipped with standard radio tracking equipment were used to monitor instrumented calves, locate mortalities, determine calf locations, and movements. In those cases in which the capture crew did not observe an immediate reunion of the calf with its dam, aerial relocation and visual checks were made at 1-3 hour time intervals following release. All calf radio frequencies were monitored for mortality signals at least once daily and visual locations or locations to caribou group were made for each calf every other day from 4 June to 2 July 1983. Relocation surveys were conducted on a monthly basis from July through November 1983. All visual and group locations were plotted on a 1:250,000 scale topographic map.

All mortalities were investigated as soon as possible using a helicopter for access. Each carcass and mortality site was examined for information on the cause of death. Photographs were taken to document mortality sites. Evidence of predators/scavengers at the carcass site were noted and collected. Each carcass was placed in a plastic garbage bag, labeled, and frozen for later study. Laboratory necropsies were performed on carcasses when sufficient remains were present. In cases where only hair and bones remained, measurements of weight, right hind foot length, and new hoof length were recorded whenever possible. The location of retrieved carcasses was plotted on 1:250,000 scale topographic maps. Criteria for determining the category (Cook et al, 1971) and the cause of each mortality (Table 1) descriptions of and developed from predator kills were feeding characteristics in the literature (Murie 1948, Thompson 1949, Johnson 1951, Borg 1961, Atwell 1954, Mech 1970, Wiley and Bolen 1971, Alford and Bolen 1972, Cole 1972, White 1973, Miller and Broughton 1974, Bolen 1975, Henne 1975, Miller 1975, Mysterud 1975, Buskirk and Gipson 1978).

Carcasses of unmarked calves encountered during this and other field studies were also examined as opportunity allowed. The locations of predators observed on the calving grounds were noted and observations of interactions between caribou and predators were recorded. Concurrent field studies of brown bear ecology on the coastal plain of ANWR also provided additional information relative to this study (Phillips 1984, Garner et al. 1984).

The mortality rate of calves from the 23 radio-collared control cows were compared to the mortality rate of the study calves. The control females were radio-tracked in late May and early June 1983 as they arrived on the calving grounds and their locations were plotted on 1:250,000 scale topographic maps. Parturition status was determined by low-level aerial observations of the presence/absence of young, antler shedding (Lent 1965, Epsmark 1971), and udder distention (Bergerud 1964). Following parturition, productive members of the control group were monitored on a 24-72 hr basis until approximately 2 July.

# Results and Discussion

Age Determination

New hoof length measurements (NHL) on 3 reindeer calves were linearly related to age in days (Fig. 2) and the correlation coefficient was statistically significant (p < 0.01, n = 112). The relationship between new hoof length and age in days for 6 caribou calves (to 18 days estimated age) was also significant (p < 0.01, n = 32), however there was more



neonatal caribou calves.	
Criterion	Category
I. Carcass lacks sign of being bitten, chewed,	I. Predation-excluded
or disturbed by predators.	
1. Milk curds absent in abomasum and	1. Starvation
intestinal tract. Lack of mesentery	
and subcutaneous fat. Rumen may be	
packed with vegetation.	<b>-</b> • • • • •
a. No reunion with dam observed	a. Probable study-
following release and subsequently	induced
observed unattended by dam prior	abandonment
to death.	
b. Reunion with dam observed following	b. Probable natural
release but later observed unattended	abandonment
by dam prior to death.	<b>•</b> -
<ol><li>Milk curds present or absent from</li></ol>	2. Exposure
abomasum or intestinal tract.	
Mesentery and subcutaneous fat present	•
Absence of any signs of starvation.	
<ol><li>Disease syndrome present, or disease</li></ol>	<ol><li>Disease</li></ol>
syndrome noted at capture.	
4. None of the above.	<ol><li>Undetermined</li></ol>
II. Carcass bitten, chewed, and/or partially	II. Predation/scavenging
eaten.	involved.
A. Lack of blood in wounds, lack of frothy	A. Scavenging
blood in nares and trachea, no bruises	
surrounding tooth marks, or no	
subcutaneous hemmorrhages present.	
<ol> <li>Bones gnawed and chewed, feeding</li> </ol>	1. Mammalian
pattern generally not restricted	scavenger(return
to the upper portion of carcass.	to I.1 to
2. Bones not chewed, feeding limited to	determine
upper portions of carcass.	cause of death)
3. Neither of the above, or some	<ol><li>Avian scavenger</li></ol>
characteristics present from both.	(return to I.1 to
-	determine cause of
	death)
B. Blood in wounds, frothy blood in nares	B. Predation
and trachae bruises surrounding wounds	
and sub-cutaneous hemmorrages present.	
1. Debilitating physical disorder, or	1. Predator kill &
disease syndrome present.	other factors.
2. No debilitating physical disorder or	2. Predator kill.
disease syndrome present.	
a. Talon wounds on back and sides of	a. Golden eagle
body. Talon wounds on neck. Only	kill.
upper portion of carcass fed upon.	
Ribs broken off at backbone. Leg	
bone usually intact.	
b. Teeth wounds on neck, sides or	b. Mammalian
legs. Carcass fed upon extensively.	predator.
hones chewed and carcass parts	Freedoor.
scattered.	
o Extensive traums to servers large	c. Brown hear
C. Excensive clauma to Carcass, Large	C. DIOWH DEGI.
brokon on crushod Skull arushod	
Droken of crushed, Skull crushed.	
In older calves, rumen not consumed.	d Undetermined
a. Mone of the above.	u. Undetermined
	predator.

# Table 1. Criteria for determining category of observed mortalities of

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Fig.2 Relationships between new hoof growth (mm) and age in days of 3 captive reindeer calves and 6 captive caribou calves, University of Alaska-Fairbanks, 1983.

variation in these data ( $\mathbb{R}^2 = .48$ ). Several sources of error were evident in both instances. Inconsistency between measurements taken by different individuals is probably the largest source of variation. Ideally, one individual should make all measurements, however this was not possible due to other commitments by project personnel. Average growth rates of new hoof lengths in reindeer and caribou were not identical (Fig. 2). Caribou new hoof length average growth rate was 0.68 mm per day, while average growth rate for reindeer was 0.41 mm per day.

Age determination in the 69 study calves (Table 1) was calculated using a combination of the results of the above NHL calibration test and the general physical criteria described for white-tailed deer (Haugen and Speake 1958), elk (<u>Cervus canadensis</u>, Johnson 1951), and caribou (Miller 1972). The growth rate for caribou calves in general, and based upon the physical characteristics of the 69 captured calves, an initial NHL of 7.0 mm was assumed for the study calves. In cases where there was not general agreement between estimated age according to NHL and estimated age based on umbillicus/hoof wear criteria, the latter method superceded the NHL estimates and final age estimate was based on the umbillicus/hoof wear criteria.

# Calving Distribution and Initial Productivity

The 1983 spring migration of female caribou followed traditional routes in the Richardson Mountains, across the Old Crow flats and along the southern flanks of the Brooks Range, and down the Firth River valley. The arctic foothills zone and the northern perimeter of the Brooks Range were heavily used during the final westward movements. All parturient radio-collared cows were in the foothills and coastal plain between the Malcolm and Hulahula Rivers on 29 May. Collared cows west of the Aichilik River did not move farther west during the peak calving period (3-5 June). Cows east of the Aichilik continued to move westward until calving. There was a substantial northward movement of cows onto the coastal plain along the Jago River during 30 May - 1 June.

The highest density of calving caribou was in the lower foothills (<u>Eriophorum</u> tussock tundra) on either side of the Jago River (40-300 m elevation). Although calving activity extended nearly to the Beaufort Sea coast, the density of calving caribou dropped off sharply, north of the high density area. The coastal plain between the Kongakut River delta and Komakuk Beach also had a high density of caribou during calving. Scattered calving activity occurred at low density adjacent to these high density areas and extended west to the Sadlerochit River, east to the Firth River, south to the northern base of the Brooks Range and north to the Beaufort Sea coastline (Fig. 1).

A southerly flow of warm air over the Brooks Range from 30 May to 2 June caused a rapid snowmelt in the foothills that also extended to some coastal plain areas. Both high density calving areas were snowfree and well-drained during peak of calving. In contrast, extensive areas of the coastal plain between the Kongakut and Jago River deltas were mostly snow-covered. Caribou density within this region was generally low, and cows with calves were usually found in small, snowfree areas. In general it appeared that most parturient cows were moving towards the northwestern part of the calving grounds. However, some cows remained east of the Kongakut River until the beginning of the post-calving movement period.

Table	1. Phys	lcal c	haracter	istics an	id surviva	il related ob	servations	of radiocoll	ared caribou	ı calves, /	Arctic National W	ildlife Refuge, 1983.
Calf no.	Date	Sex	Weight (kg)	Length (cm)	Hind foo length(c	ot New hoof em)length(mm)	Umbilicus condition	Hoof condition <sup>a</sup>	Estimated age <sup>b</sup>	Handling time(min)	Cow-calf reunion <sup>C</sup>	Status
_	4 June	- F4	5.7	80	33.0	7.1	Moist	M/Hd	1	12	No	Dead (5 June)
5	4 June	í.	6.1	81	32.4	7.4	Dry	PH/W	г	11	Yes(>3.52-7.77)	Alive (16 Oct)
ו יח	4 June	Σ	6.0	83	33.0	7.3	Moist	PH/W	г	6	Yes(>3.25-7.68)	Unknown/collar cast(28 Oct)
4	4 June	Б	5.2	72	31.0	7.3	Moist	PH/W	1	4	Yes(<4.18)	Alive(19 Oct)
2	4 June	Σ	8.4	87	36.0	9.2	Drv	AH/W	4	4	Yes(>8.43-49.95)	Unkown/collar cast(31 July)
9	4 June	Γ×	6.0	81	33.4	8.1	Absent	AH/W	2	4	Yes(<2.77)	Mortality signal (19 Oct)
7	4 June	ı	I	73	32.3	7.2	Dry	AH/W	1	e	Yes(>2.78-6.97)	Dead $(16 \text{ Oct})$
8	4 June	٤	7.2	83	33.9	8.9	Moist	PH/W	e,	4	Yes(<2.60)	Alive (16 Oct)
6	4 June	i	7.5	88	34.2	8.3	Dry	AH/W	ñ	e	Yes(<2.60)	Alive (17 Oct)
10	4 June	Ψ	7.4	77	34.0	9.1	Dry	AH/W	4		Yes(<2.47)	Alive (17 Oct)
11	4 June	Σ	7.9	78	36.0	7.7	Dry	AH/W	2	S	Yes(<2.85)	Alive (7 July)
12	4 June	Ψ	6.3	76	33.2	7.7	Absent	AH/	2	4	Yes(<3.78)	Alive (23 July)
13	4 June	Σ	8.5	87	35.2	9.2	Moist	AH/W	ñ	8	Yeв(<3.65)	Alive (7 July)
14	4 June	Ē	7.8	81	34.0	8.5	Dry	AH/W	ñ	4	Yes(<3.65)	Dead (30 July)
15	4 June	Ēr,	6.5	77	35.5	8.2	Moist	AH/W	٣	4	Yes(>7.45-22.2)	Alive (7 July)
16	4 June	Бц	7.7	88	35.5	8.7	Moist	AH/W	'n	t	Yes(<2.93)	Alive (iu Bot)
17	4 June	Σ	7.1	77	32.5	9.1	Dry	AH/W	4	4	Yes(⊲0.08)	Alive (24 Oct)
18	4 June	Σ	7.1	74	33.0	8.4	Absent	W/HW	e	e	No	Dead (6 June)
19	4 June	1	6.2	77	33.0	7.7	Absent	AH/W	2	4	Yes(<2.73)	Alive (7 July)
20	4 June	Σ	9.3	82	35.0	9.5	Absent	AH/W	'n	3	Yes(<0.08)	Dead (3 Aug)
21	4 June	Ē	7.3	84	34.0	8.5	Absent	AH/W	e	e	Yes(>3.30-18.00)	Alive (16 Oct)
22	4 June	Σ	6.6	73	32.3	8.4	Dry	AH/W	ñ	8	Yes(<3.35)	Alive (24 Oct)
23	4 June	ſĽı	5.7	76	32.5	7.2	Absent	AH/W	г	7	Yes(>3.27-17.85)	Alive (16 Oct)
24	4 June	Ľ4	5.6	75	30.5	7.5	Dry	AH/W	7	e.	Yes(<3.32)	Alive (24 Oct)
25	4 June	ы	6.7	82	34.5	7.5	Dry	M/HA	2	Э	Yes(<3.23)	Mortality signal(16 Cct)
26	4 June	ы	5.8	81	35.0	7.2	Moist	AH/W	1	e	Yes(>2.45-16.70)	Alive (26 Oct)
27	4 June	Σ	5.7	77	33.0	0.6	Moist	AH/W	e	e.	Yes(>2.17-16.48)	Alive (24 Oct)
28	4 June	Ēų	8.4	83	33.5	9.1	Dry	1	4	e	No	Dead (6 June)
29	4 June	Σ	8.2	84	34.0	10.2	Absent	AH/W	ŝ	4	Yes(<0.02)	Alive (7 July)
30	4 June	ы	6.1	78	32.0	8.9	Dry	AH/W	4	ñ	Yes(>1.77-16.30)	Alive (24 Oct)
31	5 June	fta	7.2	77	35.5	9.8	Moist	AH/W	e	4	Yes(<0.03)	Alive (16 Oct)
32	5 June	24	7.3	81	38.0	0.6	Absent	AH/W	4	4	Yes(<0.02)	Alive (24 Oct)
33	5 June	Σ	7.4	82	33.5	8.2	Dry	AH/W	e	e	No	Dead (6 June)
34	5 June	ы	6.3	77	32.0	7.8	1	AH/W	2	4	No	Dead (6 June)
35	5 June	Σ	7.8	82	34.0	8.4	Moist	AH/W	e	e	Yes(<0.02)	Dead (16 Oct)
36	5 June	£4	9-9	80	33.5	8,3	Absent	AH/W	ŝ	°.	Yes(<0.01)	<b>Alive (16</b> Oct)
37	5 June	<u>54</u>	7.2	82	34.0	0.0	Absent	AH/W	4	Ś	Yes(<5.40)	Alive (24 Oct)

Table	1. Contin	nued.										
Calf	Date	Sex	Weight	Length	Hind foo	t New hoof	Umbilicus	Hoof	Estimated	Handling	Cow-calf rounterC	Status
.0I			(8x)		Tengruto	m/rengru/mm/	COULTLAND	- not l tono	aga	r Tme/amth	- mornnar	
38	5 June	×	7.8	78	36.0	9.3	Absent	AH/W	4	1	Yes(5.45)	Alive (19 Oct)
39	5 June	Σ	5.1	72	31.0	0.6	Moist	PH/W(slight)	ĥ	4	Yes(≺0.02)	Dead (6 June)
40	5 June	W	7.4	80	35.0	8.0	Moist	AH/W	2	4	Yes(<5.27)	Alive (24 Oct)
41	5 June	EL	6.0	77	33.5	7.8	Moist	AH/W	2	4	Yes(<0.02)	Alive (16 Oct)
42	5 June	£	7.6	84	34.0	9.1	Moist	AH/W	ñ	e E	Yes(<0.02)	<b>Alive</b> (24 Oct)
43	5 June	X	6.6	76	33.0	7.3	Part Dry	AH/W	Ч	e	Yes(<0.02)	Alive (23 July)
44	5 June	£4	6.7	83	35.0	7.0	Moist	AH/W	-	e	Yes(<0.02)	Alive (7 July)
45	5 June	<u>آ</u> عد	7.1	86	35.0	8.7	Moist	AH/W	Э.	e	Yes(<0.02)	Alive (24 Oct)
46	5 June	Σ	7.2	82	32.0	8.5	Dry	AH/W	m	e	(Na)	Alive (24 Oct)
47	5 June	ы	6.4	76	33.0	7.7	Dry	I	2	2	Yes(>3.13-47.23)	Alive (24 Oct)
48	5 June	۲.	7.3	87	32.0	8.1	Molst	AH/W(slight)	2	2	Yes(<3.08)	Alive (16 Oct)
49	5 June	Ē	5.4	76	31.0	8.8	Absent	AH/W	4	e	Yes(>3.06-45.77)	Alive (24 Oct)
50	5 June	Ē	8.2	84	34.0	8.2	Dry	AH/W	e S	4	Yes(<3.02)	Dead (7 June)
51	5 June	fra	6.7	77	33.0	8.8	Absent	AH/W	4	e	Yes(<2.95)	Dead (13 June)
52	5 June	ы	8.3	85	35.0	8.9	I	AH/W	4	4	Yes(<2.95)	Alive (24 Oct)
53	5 June	X	7.4	83	34.0	9.4	Moist	AH/W	e	4	Yes(<2.87)	Alive (7 July)
54	5 June	X	7.5	84	34.5	8.3	Moist	AH/W	e,	e E	Yes(<0.08)	Alive (24 Oct)
55	5 June	X	8.1	88	35.0	8.6	Dry	AH/W	e	e E	Yes(<0.08)	Alive (7 July)
56	5 June	24	6.8	83	35.0	8.0	Moist	AH/W(slight)	5	e	Yes(Na)	Alive (24 Suit)
57	5 June	X	4.9	75	30.0	7.4	Moist	PH/W(slight)	1	2	Yes(Na)	Dead (13 June)
58	5 June	¥	7.5	75	33.0	9.1	Bloody	PH/W(slight)	1	e	Yes(<0.08)	Alive (7 July)
59	5 June	X	7.7	86	36.0	8.8	Molst	AH/W	e	4	Yes(<2.00)	Dead (21 June)
60	5 June	¥	ı	86	34.0	8.1	Dry	PH/W	5	4	Yes(<1.95)	Unknown/collar cast(18 Oct)
61	5 June	X	8.0	83	33.0	8.1	Absent	AH/W	7	m	Yes(<0.05)	Alive (24 Oct)
62	7 June	54	4.8	77	32.0	7.3	Dry	AH/W	Ч	5	Yeв(≂0.02)	Dead (23 June)
63	7 June	Ψ	6.2	78	32.5	7.6	Bloody	PH/W(slight)	г	4	No	Dead (8 June)
64	7 June	£	5.9	79	32.5	8.5	Bloody	AH/W(slight)	1	4	No	Dead (9 June)
65	7 June	<b>F</b> 44	8.1	87	37.0	8.4	Moist	W/HA	e	ŝ	Yes(<16.92)	Dead (10 June)
<b>6</b> 6	7 June	íч	7.1	73	31.5	8.7	Absent	W/HA	e	ო	Yes(<0.02)	Alive (7 July)
67	8 June	Ē.	6.2	77	32.5	8.4	Absent	W/HV	e	4	Yes(<0.05)	Unknown/collar cast(28 Oct)
68	8 June	۲щ	5.1	89	32.0	8.4	Dry	AH/W	e	4	Yes(<0.05)	Dead (16 Oct)
69	8 June	Ψ	9.1	8'4	33.0	8.3	Dry	AH/W	e	4	No	Dead (11 June)
Ma	le averao	8 đ	7.30	80.43	33.69	8-54			2.77			
			5 2 3	CY V0	22 55	0 21			7 53			
9 - -	male aver 1	ages	0°0	80.37		47.0 8 34			5 5 T	3 95		
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Composition data from transects indicated that yearlings contributed considerably to the high density in the southern part of the Jago River foothills area and on the coastal plain between the Kongakut River and Komakuk Beach. Based on the density of calves along transects, the Jago hills were by far the most important calving area, followed by the Kongakut River-Komakuk Beach area.

All adult bulls, a 2-year-old cow, and most radio-collared yearlings were south of the Brooks Range luring calving. Because female yearlings were not likely to have calves, no attempt was made to obtain visual relocations of yearlings on the calving grounds. Signals from approximately half of the 35 collared yearling females were heard during overflights of the calving grounds. All of these were near the mountains or east of the Aichilik River, which is consistent with the distribution of yearlings based on transect data. Four of 5 radio-collared 2-year-old females were on the calving grounds; 1 was in the southern part of the Jago foothills and 3 were found near Komakuk Beach. None were parturient.

The 1983 calving distribution of the Porcupine caribou herd was similar to that observed in 1976, 1978, and 1979, when high densities of calving also occurred in the Jago foothills and east of the Kongakut River (USF&WS 1982). In 1972, 1975, 1977, and 1981, concentrations of calving also occurred in the Jago foothills area. Thus, 8 of the past 11 years have had high density calving in the Jago foothills. One difference in the calving distribution of 1983 over that of recent years was the northern extension of calving concentrations onto the coastal plain areas as well as low density calving occurring to the coastline in some areas (Fig. 1). The rapid snow melt on the calving grounds immediately prior to peak of calving may have influenced this northern extension of calving.

Peak of calving occurred on approximately 4 June in the high density calving area of the Jago foothills. The chronology of calving for radio-collared females ranged from 30 May to 19 June, with 83% of the calves being born during the period of 30 May to 10 June (Fig. 3). The peak of calving may have been slightly earlier in 1983 than the average (5-9 June) reported for other years (U.S. Fish and Wildlife Service 1982). Difficulty in classifying adults during transect surveys prevented the determination of synchrony across the entire calving area. No obvious differences occurred in calving chronology between eastern (Kongakut/Komakuk) and western (Jago foothills) concentration areas. However, based on estimated ages at capture, there may have been a 1 day delay in peak of calving between the Jago foothills area (mean estimated age at capture 2.6 days) and areas on the coastal plain near Barter Island (mean estimated age at capture 2.7 The apparent uniformity of calving chronology in 1983 across the days). calving grounds was in contrast to that of 1982 when calving peaked earlier in leading (western or northern) groups and was later in following (eastern or southern) groups (Whitten and Cameron 1983).

There were 23 radio-collared 3+-year-old cows in the Porcupine herd during the summer of 1983, of which 22 were on the calving grounds (Fig. 4). The remaining collared cow arrived at the Firth River delta on 13 June; antler development and absence of a distended udder indicated she had not been pregnant. Four other adult cows on the calving grounds were evidently not pregnant. Five cows gave birth, but lost their calves within 2 to 7 days, and 13 cows still had viable calves at the end of June. Initial





productivity of radio-collared females was 78%. A summary of productivity status for radio-collared female caribou in 1983 is provided in Appendix Table A-1.

Composition surveys by helicopter on 6 June showed an average of 74 calves/100 cows and 24 yearlings/100 cows among 1,777 caribou counted. There were no bulls in this high density calving area. Density was higher in the southern portion of the survey area (the central Jago hills), due in part to a higher yearling/cow ratio; however, the lower calf ratio to the south suggested that barren cows near the mountains may also have contributed to higher density. In 1982, initial productivity for the Porcupine herd was an estimated 81% in an area of high density calving (Whitten and Cameron 1983). Bergerud (1980) reported an average initial productivity of 82% for 8 major North American herds. The 1983 productivity is slightly less than this reported average, however, sampling intensity was low and this estimate may not represent actual productivity.

Calf Capture

On 4 June 1983, 30 calves (# 1-20 in the foothill east area and # 21-30 in the foothill west area) were captured, processed, and released. An additional 30 calves were captured on 5 June 1983 (# 31-45 in the coastal plain north area and # 46-60 in the coastal plain south area). Both subgroups occurred within the overall area of high density calving (Fig. 1). Between 5 and 8 June 1983, 9 calves (# 61, 64 and 67 in the foothills east area, # 65 in the foothills west area; # 62, 63, 68 and 69 in the coastal plain north area; and # 66 in coastal plain south area) were captured, processed, and fitted with radiocollars that had been removed from mortality victims occurring among the initial sample of 60 (Table 1).

Cumulative time required for capture operations was 6 h, 40 min (3 h 35 min - 4 June; 3 h 5 min - 5 June and average processing time was 3.9 min. The use of ground observers to confirm reunion of cow/calf pairs was partially successful. When calves were captured from groups of caribou it was not possible to identify the dam whose calf was captured. Some reunions occurred in excess of 3 h post-capture, making it impractical to observe reunions and also achieve sampling goals during the peak of calving time interval. An alternative method using aircraft to periodically relocate each radio-collared calf and make visual observations during the first 24 hours was successful in documenting reunions and/or cases of study induced abandonment.

The estimated age of captured calves averaged 2.8 days (Table 1). A total of 30 male and 36 female calves were captured (the sex of 3 calves was inadvertently not recorded), which gives a sex ratio of 46 males: 54 females (Table 1). Sex ratios (at birth) of 53 males : 47 females (Kelsall 1968) and 51 males: 49 females (Skoog 1968) have been reported for Canadian and Alaskan caribou herds. The average weight for all calves captured was 6.9 kg (Table 1), which was 0.9 kg greater than the average weight of 23 calves measured from the same herd in 1982 (Mauer et al. 1983).

Neonatal Calf Mortality

Between 4 June and 3 August 1983, 17 calf mortalities were detected and investigated (Table 2). Case histories for each mortality are included in



the Appendix. Probable study-induced abandonment (6 cases) accounted for 35.3% of mortality among study calves. Probable natural abandonment was determined in cases of starvation due to desertion by the dam following an observed reunion. Since 2 cases of probable natural abandonment occurred within 24 hr of capture, it is possible that those abandonments may have been study-related.

Table 2. Probable causes of mortality for 17 of 69 radio-collared caribou calves between 4 June - 3 August 1983.

Carres setween , same o magast 1900,	Number of	Calf <b>#</b> 's	% Total
Category	calves		<u>mortality</u>
I. Predation-excluded deaths			
1. Starvation			
a. probable study-induced abandonment	4	18,63,64,69	23.5
b. probable natural abandonment	2	34,50	11.8
2. Exposure			
3. Disease syndrome			
4. Undetermined cause of death	1	28	5.9
II. Predation and/or scavenging involved			
1. Scavenging involved			
a. avian scavenger			
i. probable study-induced abandonmer	nt		
ii.probable natural abandonment-gull	.s 1	39	5.9
iii. disease syndrome			
iv. undetermined cause of death			
b. mammalian scavenger			
i. probable study-induced abandonmen	it		
ii.probable natural abandonment			
iii. disease syndrome			
iv. undetermined cause of death			
c. undetermined scavenger			
i. probable study-induced abandonmen	it		
ii.probable natural abandonment			
iii. disease syndrome			
iv. undetermined cause of death	1	14	5.9
2. Predation involved			
a. avian predator			
i. predisposed to predation			
- golden eagle	1	33	5.9
ii.not predisposed to predation			
- golden eagle	3	57,59,65	17.6
b. mammalian predator			
i. predisposed to predation			
ii.not predisposed to predation			
- brown bear	2	51,62	11.8
c. undetermined predator			
i. predisposed to predation	1	1	5.9
ii.not predisposed to predation			
3. Undetermined if predation or scavenging			
i. predisposed to predation/scavengi	ng		
ii.not predisposed to predation/			
scavenging	1	20	5.9
Totals	17		100.1

Most calves captured from foothills areas were from large groups of cows and calves; whereas calves captured from coastal plain areas were from small groups of cows and calves or single cow/calf pairs. There was a tendency for the dams to more readily flee from the capture site when calves were taken from large groups than from small groups or single cow/calf pairs. Thus, on coastal plain areas, the capture crew observed reunions of cows and calves immediately following release in 18 instances versus 3 for the foothill groups. Mortality cases indicate that probable study-induced abandonment occurred with equal frequency among foothills groups (n=2) and coastal plain groups (n=2). However, there were 3 cases of probable natural abandonment in the coastal plain groups and in 2 cases both calves died These calves had abandonment-related within 1 day following capture. symptoms and the reunions observed by the capture crew could not be confirmed through aerial relocation and observation. Although there were less immediate reunions observed in the foothills groups, those groups had a lower abandonment rate (study-induced and natural-3) the coastal plain groups (6). Apparently a majority of dams that fled the capture site ultimately returned and successfully reunited with their young.

Excluding confirmed cases of study-induced mortality, the natural mortality rate for the remaining sample group of 63 calves was 17.5%. These mortalities can be partitioned into 4 mortality categories (Table 3). Predation accounted for approximately half the observed mortality, with golden eagles and brown bears being the predators involved in these Predation/scavenging was involved in 2 mortalities but mortalities. insufficient evidence at the carcass site did not permit identifying the cause of death. Natural abandonment accounted for 27.3% of observed mortality among sample calves. This rate is higher than the proportion of detected mortality attributed to natural abandonment for calving grounds of the Kaminuriak (21%) and Beverly (6%) caribou herds in Canada (Miller and Broughton 1974, and Miller et al. 1983 respectively). Apparently natural abandonment of calves occurs for a number of possible reasons: young females lack experience and may tend to abandon their young to join other migrating adults; disturbance by predators on the calving grounds may result in some permanent separations; and physiological disorders such as mastitis may lead to abandonment or starvation of the calf (Miller and Broughton 1974). Lent (1961) documented only 1 (1\$) case of study-induced abandonment resulting from a capture and ear-tagging study of neonatal caribou calves.

Mortality category	Number of calves	Proportion (%) of sample calves	Proportion (%) of natural mortality
Probable natural abandonment	3	4.8	27.3
Undetermined-predation/			
scavenging excluded	1	1.6	9.1
Undetermined-predation/ scavenging involved	2	3.2	18.2
Predation	5	7.9	45.5
a. golden eagle	3	4.8	27.3
b. brown bear - probable Totals	2 11	<u>3.2</u> 17.5	<u>18.2</u> 100.1

Table 3. Proportion of observed natural mortalities occurring among neonatal caribou calves on the Arctic National Wildlife Refuge. 1983 Golden eagles killed 4 study calves (Tables 2 and 3) during the study, however, 1 calf was abandoned and predisposed to predation.. In addition, golden eagles killed 2 unmarked calves (see mortality case histories-Appendix) and were observed feeding on other calf carcases; however, it was not possible to obtain access to these carcass sites to determine if these calves were scavenged or killed by eagles.

A partial compilation of golden eagle sightings by field personnel working in the northern part of the Arctic National Wildlife Refuge in 1983 contains 51 observations totaling 60 birds (23 adults, and 18 immatures and 9 unidentified age) during 14 May to 4 August. In previous years a preponderance of immature eagles has been observed (D. Roseneau, pers. comm.). Most golden eagle sightings were made during June (28) and were most often recorded in areas associated with caribou concentrations. No attempt was made to systematically survey golden eagle distributions and determine abundance. These sightings are biased by observer effort and location and do not represent abundance and distribution of golden eagles on the coastal plain of ANWR.

Abandonment-related mortality rates among the original sample of 60 calves was 10%, while it was 33% among calves collared with radios removed from dead calves. Replacement of collars was halted when this anomaly was detected. Reasons for the elevated abandonment rate among re-collared individuals are undetermined; however, scent may have caused the dam to reject its young.

Probable predation of study calves by brown bears was determined in 2 cases. In addition, 3 unmarked calves were killed by brown bears (see mortality case histories - Appendix). During 4-16 June, brown bears were observed killing or feeding upon unmarked calves in 11 different cases which involved a total of 11 calves (P. Miller pers. comm., G. Garner pers. comm., M. Phillips 1984). Of 25 brown bears captured in the foothills and coastal plain of ANWR during 8-16 June, 7 had either dried blood or fresh blood on their muzzle. Data gathered during concurrent studies of radio-collared brown bears indicates that bears appear to move towards areas of caribou concentration and frequent calving grounds during calving and post-calving season (Garner et al. 1983, 1984, Phillips 1984). It is apparent that caribou calves are important food items to some brown bears during the calving season; however, the magnitude of predation by brown bears on caribou calves is not known.

One unmarked calf drowned on 4 June 1983 in a meltwater drainage having perpendicular ice walls. The dam crossed the drainage successfully, however when the calf followed it was unable to climb out of the water and subsequently drowned.

There was no documented wolf predation of study calves. One black wolf was observed on 9 June 1983 being chased by the dam of a study calf in the foothills near the Okerokovik River. The observation was made from the radio-tracking aircraft (PA-18) flying towards the cow/calf pair at approximately 200 m AGL. The observation began when the wolf was seen running directly away from the female caribou. After running a short distance (50 m), the cow stopped the pursuit and allowed her calf to approach her. The wolf continued to run at a moderate speed directly away from the caribou. It is possible that the approaching aircraft caused the Wolf to flee from the cow and calf at the time the observation was initiated. An active wolf den was located near Whale Mountain on the Kongakut River. At least 4 wolves, believed to be associated with this den were observed on several occasions on the coastal plain and in the foothills between the Kongakut River and Demarcation Bay, a distance of 25-35 km from the den (Phillips 1984).

Between 4 June and 3 August, 76.5% of the observed mortalities for study calves occurred within the first 9 days (Fig. 5). Six of these mortalities were study-induced, therefore 63.6% of the detected natural mortality occurred within the first 9 days of the study. Natural mortality was concentrated in calves that were estimated to be 12 days of age or less (Fig. 6). The 2 mortalities occurring in late July - early August occurred in mountains and foothills south of the coastal plain during emigration from the coastal plain and adjacent foothills of ANWR. Note that these 2 calves were last monitored on 6 July and both were in large aggregations that were emigrating from the coastal plain. They were not monitored again until late July. Therefore, timing of actual mortality is between 6 July and 3 August. All other mortalities occurred on the coastal plains or adjacent foothills during calving and post-calving aggregations.

Mortality rate (excluding study-induced mortality) were higher (21.9%-7 mortalities of 32 calves) among calves originally captured on coastal plain areas (18.8%-coastal plain north, 25.0%-coastal plain south), than mortality (12.9%-4 mortalities of 31 calves) among calves captured in the foothills areas, (10%-foothills east, 18.2%-foothills west). Most of the natural mortality of the study group, however, occurred in foothills and mountain areas (60%) compared to (40%) on the coastal plain. This was primarily due to movement of most of the coastal plain-south group to the foothills soon after capture. All documented golden eagle kills occurred in the foothills region. The 3 cases of probable natural abandonment occurred on coastal plain areas. Only one undetermined mortality occurred on the coastal plain.

Of the 18 productive females in the control group, 5 lost their calves between 30 May to 21 June (see Appendix). Chronology of this mortality was 1 June, 11 June, 16 June, 17 June, and 21 June and is in general agreement with the chronology of mortalities among study calves (Fig. 5). Assuming that all lost calves died, the calf mortality rate for the control group was 27.8%. The mortality rate for the study group (excluding study-induced mortality) between 4 June-3 August was 17.5%. These mortality rates are significantly different ( $X^2 = 3.82$ , df = 1, 0.05 < P < 0.10), however, small sample size may bias these data. Also, the majority of control cows did not calve in the areas where study calves were captured (Fig. 3) and may have been exposed to different mortality risks in these areas.

Comparison of estimated initial productivity of 74 calves/100 cows with limited composition data collected during early July 1983 (72-74 calves/100 cows) indicates a high initial calf survival rate (Whitten 1984). Similar comparisons in an earlier year (1972) indicated a decline of 17% of calves between peak of calving and early July (Calef and Lortie 1973). This decline agrees with the observed natural mortality rate (17.5%) of study calves during 4 June to 3 August 1983. More extensive composition data are necessary to improve the validity of these comparisons.

During 7-30 June 1982 a natural mortality rate of 45% was measured among 23 study calves which were captured and processed on the coastal plain south of





Herschel Island, Yukon Territory (Mauer et al. 1983). This rate was considerably higher than the 1983 rate of 17.5%. In the first 10 days after capture, 50% of the 1982 mortality occurred, while 81% occurred in the same period in 1983 (Mauer et al. 1983). In 1982 33% of study calf mortality occurred during late June when there was a rapid westward movement of cows and calves (Mauer et al. 1983). Rapid movement also occurred during late June 1983 in both eastern and later in western directions, however, no calf mortality were increase in apparent. Logistical limitations encountered in 1982 precluded establishment of conclusive mortality categories, however, golden eagles were associated either as a predator or as a scavenger in 75% of the natural mortalities in 1982. In 1982, calving occurred in extreme eastern and southeastern portions of the herd's traditional calving grounds (approximately 160 km from 1983 study areas). Geographic distribution of calving, post-calving movement patterns, and other factors may have influenced mortality rates between the 2 years.

# Movements

Following capture there was a gradual southward shift of most study calves towards the upper foothills near the northern base of the Brooks Range (Figs. 7 and 8). This movement was consistent, directional, and coincided with increasing group size and net movement rates (Fig. 9). Most calves captured in the coastal plains-south area moved south and mixed with general distributions of the foothills study groups (Fig. 7). Those study calves which moved towards the coast did so at a slower rate and with less consistency in direction of movement. The coastal distributions tended to show lower net movement rates (4.12 km/24 hrs) than the foothills distributions (6.55 km/24 hrs) during 8-26 June. A similar relationship was observed among coastal and foothills distributions of the control cows.

Beginning 20 June, movement rates of foothills and mountain distributions increased two-fold or more, and direction of movement shifted to the east (Figs. 8 and 9). On 24 June, there was a rapid, general evacuation of the mountains and foothills, spreading onto the coastal plain along the Egaksrak and Kongakut Rivers (Fig 7 and 8). Movement continued across the Kongakut River and proceeded into Canada by 2-3 July. On 4 July, the herd shifted directions 180° and moved rapidly back into Alaska. Some groups went into the foothills and northern mountains, while the majority remained on the coastal plain. During this same period, considerable numbers of caribou also remained on the coastal plain from the Niguanak River to the Egaksrak These groups generally included the study calves which had shown a River. previous affinity to coastal areas. A mixing of groups again occurred between 4-6 July as large groups containing the original foothills study calves moved westwards. During 6-8 July, there were numerous, rapid movements of large groups on the coastal plain between the Jago and Aichilik Rivers. Many caribou moved to coastal fringes, and some groups were seen on ice pans on the lagoons. Harassment by mosquitos was apparent during this period. After 8 July, large numbers of caribou moved eastward along the coastal plain and entered Canada on 10 July. Other groups moved higher into the mountains in a southeasterly direction up the Aichilik and Egaksarak river valleys. Some scattered groups remained on the coastal plain and foothills through July and August.

Periodic radio-telemetry surveys during August, October, November, and December indicated general herd distributions in traditional fall and winter







areas of Alaska and Canada. It was not possible to locate all frequencies and/or detect, locate and investigate mortalities rapidly enough to collect conclusive data on causes of subsequent mortalities. During the period of 5 August to 8 December 1983, 4 mortalities were confirmed, (Appendix 1) and 4 other mortality signals were received but not investigated on the ground. A total of 17 calf frequencies were not received during this period and their status is unknown. In 4 cases radio-collars wre found dropped from the calf as a result of fraying of the elastic at rivet points. This may have been aggravated by failure of some collars to expand properly with increased neck size.

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\_\_\_\_\_ Date: 29 Feb. 1984 Approved by:

Gerald W. Garner Supervisory Wildlife Biologist, Arctic National Wildlife Refuge APPENDIX ANWR Progress Report Number FY84-12

History	
Case	
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Calf No: 1 Captured: 4 June 1983	Sex: female Location: foothills, east of Jago River
Weight: 5.7 kg Umbilicus condition: moist Hoof condition: partially hardened/worn Health status: appeared healthy at capture Processing time: 12 min Cow-calf reunion: No reunion observed. Calf release.	Total length: 80.0 cm Right hind foot length: 33.0 cm New hoof length: 7.1 mm Estimated age at capture: 1 day old observed unattended by dam 5.8 hours following
Signal monitored: 5 times/ 2 day period Mortality detected: 5 June 1983 Carcass collected: 5 June 1983 Carcass weight: 3.2kg Total length: Right hind foot length: 32.5 cm New hoof length 7.2 mm	Number of visual relocations: 2 Location: near capture site Distance from capture site: Response time: 6.1 hours
Carcass condition and disposition: 60% consu attached, skinned s hind leg but ribs they rema subcutane Avian sca	med. Skeleton intact, limbs articulated and hide remainder of carcass including head & neck are nd hide is missing, all viscera removed, back and flesh removed, lower portion of ribs are missing are not broken, tendons are stripped of flesh but in as string-like, puncture wound with ous hermorrhages on right mandible (behind eye). its and scavengers (Jaegers) present.
Necropsy findings:	

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Predation and scavenging involved, undetermined predator, avian scavenger (Jaeger), starvation, probable study-induced abandonment, predator kill and subsequently scavenged by birds. Mortality category:

Cow-calf reunion: Reunion not observed by capture crew. Calf observed unattended by dam Location: foothills, east of Jago River m Estimated age at capture: 1 day old 33 times/ 134 day period Number of visual relocations: 16 October 1983 Location: Upper Kongakut River Right hind foot length: 32.3 cm New hoof length: 7.2 cm Total length: 73 cm 6.97 hours after release and was attended 27.8 hours after release. Sex: appeared healthy at capture Hoof condition: hard/worn Umbilicus condition: dry Processing time: 3 min 33 4 June 1983 Signal monitored: Health status: Captured: Calf No: Weight:

Distance from capture site: 106 km Response time: Right hind foot length: Mortality detected: Carcass collected: Carcass weight: New hoof length Total length:

Over 2 weeks old, only bone fragments and hair were found near collar and transmitter. Carcass condition and disposition:

Necropsy findings:

Mortality category: Predation/scavenging involved. Predator/scaveger-probable mammalian.

Calf No: 14 Captured: 4 June 1983	Sex: female Location: foothills east of Jago River
Weight: 7.8 kg Umbilicus condition: dry Hoof condition: hard/worn Health status: appeared healthy at capture	Total length: 81 cm Right hind foot length: 34 cm New hoof length: 8.5 mm
Processing time: 4 min Cow-calf reunion: Reunion not observed by captu following release.	Estimated age at capture: 3 days Ire crew. Calf observed attended by dam 3.65 hr
Signal monitored: <u>30</u> times/ <u>56</u> day period Mortality detected: <u>30</u> July 198 <u>3</u> Carcass collected: <u>31</u> July 198 <u>3</u> Carcass weight: Total length: Right hind foot length: New hoof length	Number of visual relocations: 5 Location: Pagilak River Distance from capture site: Response time:
Carcass condition and disposition: 97% consume scattered.	l, rib cage and leg bones and lower jaw found Bear scats (5) in the vicinity.
Necropsy findings:	

Mortality category: Predation/scavenging involved. Predator/scavenger probable brown bear.

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Case H
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Calf No: 18 Captured: 4 June 1983	Sex: male Location: foothills east of Jago River
Weight: 7.1 kg Umbilicus condition: absent Hoof condition: hard/worn Health status: appeared healthy at capture Processing time: 3 min	Total length: 74cm Right hind foot length: 33.0 cm New hoof length: 8.4 mm Estimated age at capture: 3 days
and 18.3 hrs. following release.	
Signal monitored: 5 times/ 2 day period Mortality detected: 6 June 1983 Carcass collected: 6 June 1983 Carcass weight: 6.3 kg. Total length: 83.5 cm Right hind foot length: 34 cm New hoof length 6.5 mm	Number of visual relocations: 2 Location: Near capture site Distance from capture site: Response time: 43 min

Lying on right side - no signs of trauma, carcass intact. No caribou in the area. Carcass condition and disposition:

Vegetation in abomasum and rumen, milk absent. All other internal organs normal. No marks on carcass, no trauma. Necropsy findings:

Mortality category: Predation excluded, starvation, probable study induced abandonment.

Captured: 4 June 1983 Calf No: 20

Location: foothills, east of Jago River

Sex: male

35.0 cm

Estimated age at capture: 5 days old Capture crew observed reunion immediately after release. Right hind foot length: New hoof length: 9.5 mm Total Length: 82 cm appeared healthy at capture Umbilicus condition: absent Hoof condition: hard/worn Processing time: 3 min COW-CALT reunion: Weight: 9.3 kg Health Status:

⊅ Number of Visual relocations: Distance from capture site: Table Mtn. Response time: Location: times/ 60 day period 3 August 1983 Right hind foot length: 33 Mortality detected: Signal Monitored: Carcass collected: New hoof length: Carcass weight: Total length:

Carcass condition and disposition: No carcass was found. Collar partially torn.

Necropsy findings:

Mortality category: Predation/scavenging involved. Predator/scavenger undetermined.

Capture crew did not observe reunion. Calf observed with dam 16.3 hr Location: foothills west of Jago River 2 Estimated age at capture: 4 days Number of visual relocations: 33.5 cm Location: Near capture site Distance from capture site: Right hind foot length: New hoof length: 9.1 mm Response time: 20 min Total length: 83 cm Sex: female day period Health status: appeared healthy at capture following its release. 2 5 times/ 6 June 1983 36.8 cm 6 June 1983 Umbilicus condition: dry New hoof length: 9.0 mm Right hind foot length: 3 min Carcass weight: 9.0 kg 4 June 1983 ഹ Total length: 90 cm Mortality detected: Carcass collected: Cow-calf reunion: Signal monitored: Processing time: Hoof condition: Weight: 8.4 kg 28 Captured: Calf No:

Carcass condition and disposition: Intact, lying on right side, cow with antlers and udder Necropsy findings: All internal organs normal, milk curds and vegetation in abomasum. standing over carcass. No indication of trauma.

Mortality category: Predation excluded, undetermined cause-natural.

Calf No: 33	jex: male
Captured: 5 June 1983	ocation: coastal plain south of Barter Island.
Weight: 7.4 kg	otal length: 82 cm
Umbilicus condition: dry	light hind foot length: 33.5 cm
Hoof condition: hard/worn	lew hoof length: 8.2 mm
Health status: scouring - otherwise appeared nor	nal
Processing time: 3 min	istimated age at capture: 3 days
Cow-calf reunion: Capture crew did not observe r	eunion. Calf observed unattended by cow twice
prior to death.	
Signal monitored: 3 times/ 2 day period	Number of visual relocations: 2
Mortality detected: 6 June 1983	Location: Near capture site
Carcass collected: 6 June 1983	Distance from capture site:
Carcass weight: 1.7 kg	desponse time: 7 hrs
Total length:	
Right hind foot length:	
New hoof length: 8.6 mm	
Carcass condition and disposition: 75% consumed,	, viscera removed, tongue and right eye removed
head and vert	cebrae attached, ribs broken. Small wounds
with hemorrh	age in throat region, lower maxilla broken, hind
legs and sacr	rum missing.
Necropsy findings:	
Mortality category: Predation involved, probable abandonment.	e golden eagle kill, probable study-induced

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Calf No: 34	Sex: female
Captured: 5 June 1983	Location: coastal plain south of Barter Is.
Weight: 6.3 kg	Total length: 77 cm
Umbilicus condition:	Right hind foot length: 32.0 cm
Hoof condition: hard/worn	New hoof length: 7.8 mm
Health status: scours - otherwise appeared he	althy.
Processing time: 4 min	Estimated age at capture: 2 day
Cow-calf reunion: Capture crew observed reunio	Dn.
Signal monitored: 2 times/ 1 day period Mortality detected: 6 June 1983 Carcass collected: 6 June 1983 Carcass weight: 5.8 kg Total length: 87 cm Right hind foot length: 32.5 cm New hoof length: 6.9 mm	<pre>1 Number of visual relocations: 0 Location: Near capture site. Distance from capture site: Response time: 11 min</pre>
Carcass condition and disposition: Intact, ly	ing on right side, no visible indication of
trauma. A	single cow within area and 2 other caribou.
Necropsy findings: Bruised lumbar region and	right rib cage. Lungs clouded and bloody.
Abomasum and rumen packed	with vegetation, no milk present. All other
internal organs and struct Mortality category: Predation excluded, pneum injuries due to rejection abandonment.	ures normal. onia probable, capture related injuries or by cow, starvation, probable natural

Mortality Case History	
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Calf No: 35 Captured: 5 June 1983	Sex: male Location: coastal plain west of Barter Island.
Weight: 7.8 kg Umbilicus condition: moist Hoof condition: hard/worn Health status: appeared healthy at capture Processing time: 3 min	Total length: 82 cm Right hind foot length: 34.0 cm New hoof length: 8.4 mm Estimated age at capture: 3 days
Cow-calf reunion: Capture crew observed reunio Signal monitored: <u>31</u> times/ <u>133</u> day period Mortality detected: 16 October 1983	n. Number of visual relocations: 7 Location: East fork of Sheenjek River
Carcass collected: Carcass weight: Total length: Right hind foot length: New hoof length	Distance from capture site: 168 km Response time:
Carcass condition and disposition: No carcass Necropsy findings:	remains, collar intact but had tooth marks.
Mortality category: Predation/scavenging invol	ved. Predation/scavenger undetermined.

Mortality Case History	
alf No: 39 aptured: 5 June 1983	Sex: male Location: coastal plain south of Barter Is.
eight: 5.1 kg mbilicus condition: moist oof condition: partially hard/worn slightly ealth status: appeared healthy at capture	Total length: 72 cm Right hind foot length: 31.0 cm New hoof length: 9.0 mm
rocessing time: 4 min ow-calf reunion: Capture crew observed reunic	Estimated age at capture: 3 days n.
ignal monitored: 2 times/ 1 day period [ortality detected: 6 June 1983 [arcass collected: 6 June 1983 [arcass weight: 4.1 kg [arcass weight: 78 cm [ight hind foot length: 31.5 cm [ew hoof length: 7.8 mm	Number of visual relocations: 0 Location: Near capture site. Distance from capture site: Response time: 38 min
arcass condition and disposition: Lying on riskinned ope skinned ope glaucous gu	ght side, 10% of carcass consumed, rump n, sacrum flesh partially removed. Two 11s seen feeding on carcass. No cow in
<pre>lecropsy findings: Slight congestion in lungs. Stomach and intestines not fortality category: Scavenging involved, avair abandonment.</pre>	Liver, heart, kidneys and bone marrow normal present. scavengers (gulls), probable natural

Cow-calf reunion: Capture crew observed reunion. Calf observed with dam 3 hrs after release. Location: coastal plain south of Barter Is. 2 Estimated age at capture: 3 days Number of visual relocations: 34.0 cm Location: Near capture site. Distance from capture site: Right hind foot length: New hoof length: 8.2 mm Total length: 84 cm Response time: Sex: female 4 times/ 2 day period
7 June 1983 Health status: appeared healthy at capture Right hind foot length: 35.0 cm Carcass collected: 7 June 1983 Hoof condition: hard/worn Umbilicus condition: dry 7 New hoof length: 6.6 mm Processing time: 4 min Carcass weight: 7.2 kg Captured: 5 June 1983 Total length: 88 cm Mortality detected: Signal monitored: Weight: 8.2 kg 50 Calf No:

No cow Carcass condition and disposition: Intact - no external indication of trauma. in vicinity.

Necropsy findings: No wounds on carcass. Vegetation in rumen and abomasum - no milk present. All other internal organs normal.

Mortality category: Predation excluded, starvation, probable natural abandonment.

crushed. Two immature golden eagles observed at carcass. Location: coastal plain south of Barter Is. Round puncture wounds 11.4 to 22.7 mm diameter through skin of thoracic 90% consumed, hair, skin and banes scattered, skull Location: Lake south of VABM Bitty. ო 4 days Number of visual relocations: 33.0 cm Distance from capture site: Estimated age at capture: Right hind foot length: New hoof length: 8.8 mm Response time: 110 min Total length: 77 cm Cow-calf reunion: Calf attended by dam 2.95 hours after release. Sex: female Scouring - otherwise appeared healthy. Signal monitored: 13 times/ 9 day period Carcass condition and disposition: Mortality detected: 13 June 1983 13 June 1983 Right hind foot length: 36 cm Umbilicus condition: absent region. Hoof condition: hard/worn New hoof length: 10.1 mm Processing time: 3 min Carcass weight: 3.3 kg Captured: 5 June 1983 Carcass collected: Necropsy findings: Health status: Weight: 6.7 kg **rotal length:** 5 Calf No:

Predation involved, mammalian predation (bear probable) and scavenging

by golden eagles.

Mortality category:

Mortality Case History	
Calf No: 57 Captured: 5 June 1983	Sex: male Location: coastal plain south of Barter Island.
Weight: 4.9 kg Umbilicus condition: moist Hoof condition: partially hard/worn slightly Health status: appeared healthy at capture Processing time: 2 min Cow-calf reunion: Capture crew observed reunio	Total length: 75 cm Right hind foot length: 30.0 cm New hoof length: 7.4 mm Estimated age at capture: 1 day
Signal monitored: <u>12</u> times/ <u>9</u> day period Mortality detected: <u>13</u> June 198 <u>3</u> Carcass collected: <u>13</u> June 1983 Carcass weight: <u>4.5</u> kg Total length: Right hind foot length: <u>33</u> cm New hoof length: <u>8.4 mm</u>	Number of visual relocations: 4 Location: Distance from capture site: Response time: 1.5 hr
Carcass condition and disposition: Head and ne consumed.	ck intact, viscera removed, 20% of carcass One immature golden eagle at carcass.
Necropsy findings: Skull fractured below right Puncture wounds and subcuta skull and on right & left s	eye, jaws broken at point of articulation. neous hemorrhages on right and left sides of capula. Flesh removed from right rib cage.
Montality ostacomy: Dradation involved goldan	בפסקום לווא ה

olved, golden eagle kill. Ì Mortality category:

Calf No: 59 Captured: 5 June 1983	Sex: male Location: coastal plain south of Barter Is.
Weight: 7.7 kg Umbilicus condition: moist Hoof condition: hard/worn Health status: appeared healthy at capture. Processing time: 4 min Cow-calf reunion: Calf observed with dam 2 hrs	Total length: 86 cm Right hind foot length: 36.0 cm New hoof length: 8.8 mm Estimated age at capture: 3 days after release.
Signal monitored: <u>22</u> times/ <u>17</u> day period Mortality detected: 21 June 1983 Carcass collected: 21 June 1983 Carcass weight: 5.6 kg Total length: Right hind foot length: 39 cm New hoof length: 14.5 mm	Number of visual relocations: 2 Location: Foothills east of Jago River. Distance from capture site: Response time: 1.27 hr
Carcass condition and disposition: 65% consume skeleton co from carcas not fed upo golden eagl	d, tongue missing, left eye and ear missing, nnected by skin, rumen and intestines l-2 m s, internal organs removed, right side of head n. Cow observed near carcass. Two immature es feeding on carcass.
Necropsy findings: Puncture wounds (3-9mm dia) region. 3 ribs on left sid Hemorrhage in nasal cavity	on right scapula and hide of shoulder e removed (broken off near vertebrae). and around left side of skull.

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Mortality category: Predation involved, golden eagle kill.

Calf No: 62 Captured: 7 June 1983	Sex: female Location: coastal plain south of Barter Is.
Weight: 4.8 kg Umbilicus condition: dry Hoof condition: hard/worn Health status: appeared healthy at capture. Processing time: 5 min Cow-calf reunion: Capture crew observed reuni (transmitter not activated	Total length: 77 cm Right hind foot length: 32 cm New hoof length: 7.3 Estimated age at capture: 1 day on - subsequent monitoring not possible prior to release).
Signal monitored: times/ 16 day perio Mortality detected: 23 June 1983 Carcass collected: 24 June 1983 Carcass weight: 1.5 kg Total length: Right hind foot length: 32.5 cm New hoof length: 6.5 cm	d Number of visual relocations: 0 Location: Near capture site Distance from capture site: Response time: 24 hr
Carcass condition and disposition: Lying on missing. missing. side of contrushed. present.	eft side. Upper maxilla, rostrum and nose Flesh and internal organs removed from right urcass, 80% consumed. Right zygomatic arch Tongue, ears and eyes removed. Bird scats
Necropsy findings:	
Montality category: Predation involved (prob	this hundrin hear) artan granaans

Predation involved (probable brown bear), avian scavengers and (probable golden eagle and ravens). Mortality category:

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Location: coastal plain south of Barter Is. Cow-calf reunion: No reunion observed. Calf observed unattended by dam after release. Mortality category: Predation/scavenging starvation (sacrifice) excluded, probable 32.5 cm Estimated age at capture: 1 day Number of visual relocations: Sacrificed by project investigators when Location: Near capture site Distance from capture site: Right hind foot length: New hoof length: 7.6 mm abandonment/starvation was apparent. Total length: 78 cm Response time: Sex: male Necropsy findings: Abomasum empty - organs normal. day period Health status: appeared healthy at capture Hoof condition: partially hard/worn times/ 1 Carcass condition and disposition: 8 June 1983 Right hind foot length: 33.5 cm 8 June 1983 Umbilicus condition: bloody New hoof length: 8.5 mm Processing time: 4 min Carcass weight: 5.4 kg Calf No: 63 Captured: 7 June 1983 Total length: 81 cm Mortality detected: Carcass collected: Signal monitored: Weight: 6.2 kg

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study-induced abandonment.

Sacrificed by project investigators when abandonment Location: foothills near Jago River. Cow-calf reunion: Capture crew did not observe reunion. Calf was abandoned by dam. 0 Estimated age at capture: 1 days Number of visual relocations: 32**•**5 cm Location: Near capture site. Distance from capture site: was apparent and starvation imminent. Right hind foot length: New hoof length: 8.5 mm Total length: 79 cm Response time: Sex: female Necropsy findings: Abomasum empty - all other organs normal. 2 times/ 2 day period
8 June 1983 Health status: appeared healthy at capture. Carcass condition and disposition: Right hind foot length: 32.5 cm Hoof condition: hard/worn (slt) 8 June 1983 Umbilicus condition: bloody Processing time: 4 min. New hoof length: 7.5 mm Carcass weight: 5.5 kg Captured: 7 June 1983 Total length: 80 cm Signal monitored: Mortality detected: Carcass collected: Weight: 5.9 kg 64 Calf No:

Mortality category: Predation/scavenging excluded, starvation (sacrifice), probable study induced abandonment.

Tongue and 1 eye Bird feathers and droppings present. No caribou Left side of rib cage intact. Left side of rib Puncture wounds and hemorrhage above left eye and below left ear. Right Capture crew did not observe reunion. Calf observed with dam 16.5 hours Location: foothills near Jago River. Ч Estimated age at capture: 3 days Number of visual relocations: 37.0 cm Location: Near capture site. 80% consumed, flesh and viscera removed. Distance from capture site: Right hind foot length: New hoof length: 8.4 mm Total length: 87 cm 2 hr Response time: Sex: female 2 day period removed. side of rib cage intact. Health status: appeared healthy at capture. in area. cage partially missing. Carcass condition and disposition: after release. times/ 9 June 1983 9 June 1983 Right hind foot length: 38 cm Umbilicus condition: moist Hoof condition: hard/worn New hoof length: 7.8 mm Processing time: 5 min Carcass weight: 3.7 kg Captured: 7 June 1983 7 Mortality detected: Carcass collected: Necropsy findings: Cow-calf reunion: Signal monitored: Weight: 8.1 kg Total length: 65 Calf No:

Mortality Case History

Scavenging involved-gulls. Mortality category: Predation involved-golden eagle kill.

Calf No: 68	Sex: female
Captured: 8 June	Location: coastal plain S. of Barter Island.
<pre>Weight: 5.1 kg Jmbilicus condition: dry Hoof condition: hard/worn Health Status: scouring-otherwise appeared nor Processing time: 4 min Cow-calf reunion: Not observed by capture crew</pre>	Total Length: 89 cm Right hind foot length: 32.0 cm New hoof length: 8.4 mm mal. Estimated age at capture: 3 days old.
Signal Monitored: <u>25</u> times/ <u>130</u> day period Mortality detected: <u>16 Oct. 1983</u> Carcass collected: 29 Oct. 1983 Carcass weight: fotal length: Aight hind foot length: New hoof length:	Number of Visual relocations: 2 Location: Upper Firth River Distance from capture site: Response time: 13 days
Carcass condition and disposition: Only partia	lly intact skeleton remaining. Located in small
stream bed	smbedded in ice. 80\$ of carcass missing.

Mortality category: Predation/scavenging involved.

Necropsy findings:

Location: coastal plain south of Barter Is. ർ Rumen and abomasum packed with vegetation, no milk present. All other Calf was observed unattended by ----0N Estimated age at capture: 3 days Number of visual relocations: 33 cm Carcass condition and disposition: Intact, no external indication of trauma. Location: Near capture site. Distance from capture site: Right hind foot length: 8.3 mm 6 hr Total length: 84 cm attending cow at carcass site. New hoof length: Response time: male Capture crew did not observe reunion. Sex: dam @ 13 and 47 hr after reunion. day period appeared healthy at capture. m Signal monitored: 4 times/ Mortality detected: 11 June 1983 Carcass collected: 11 June 1983 Right hind foot length: 35.5 cm Hoof condition: hard/worn New hoof length: 10.0 mm Umbilicus condition: dry 4 min Carcass weight: 7.5 kg Captured: 8 June 1983 Fotal length: 87 cm Necropsy findings: Cow-calf reunion: Signal monitored: Processing time: Weight: 9.1 kg Health status: 69 Calf No:

internal organs normal.

Mortality category: Predation/scavenging excluded, starvation, probable study-induced abandonment.

Estimated age at capture: Right hind foot length: Sex: undetermined New hoof length: Total Length: Location: day period times/ 4 June 1983 4 June 1983 unmarked 01 Umbilicus condition: Carcass collected: Signal Monitored: Cow-calf reunion: Processing time: Hoof condition: Health Status: Captured: Calf No: Weight:

Location: southeast of VABM Bitty Number of Visual relocations: Distance from capture site: Response time: New hoof length: 7.3 mm Right hind foot length: Mortality detected: Carcass weight: **Fotal length:** 

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Brown bear feeding on carcass. Upper portion of head, mid-back and all viscera were missing. Carcass warm. Carcass condition and disposition:

Necropsy findings:

Mortality category: Predation involved - brown bear kill.

	Sex: male Location:	Total Length: Right hind foot length: New hoof length: Estimated age at capture:	d Number of Visual relocations: Location: near VABM Willa Distance from capture site: Response time:	n bears on 2 calf carcasses (unmarked 02 & 03). All viscera and lower portion of rib cage 15% carcass consumed.	nds on shoulders. Shoulders are also bruised. uises on neck and behind left ear.
Mortality Case History	alf No: unmarked 02 aptured:	<pre>sight: mbilicus condition: oof condition: salth Status: rocessing time: ow-calf reunion:</pre>	ignal Monitored: times/ day perio ortality detected: 5 June 1983 arcass collected: 5 June 1983 arcass weight: 5.3 kg otal length: 76 cm ight hind foot length: 34 cm ew hoof length: 7.5 mm	arcass condition and disposition: Three brow Calf dead. missing.	ecropsy findings: Skull broken and large wou Wound below right eye. Br

Mortality category: Predation involved-brown bear kill.

Sex: female Location:	Total Length: Right hind foot length: New hoof length: Estimated age at capture:	day period Number of Visual relocations: Location: near VABM Willa Distance from capture site: Response time:	<pre>on: Calf still alive. Appears to be scouring. Three be were on carcasses (unmarked 02 and 03). Carcass int sacrificed.</pre>
Calf No: unmarked 03 Captured:	Weight: Umbilicus condition: Hoof condition: Health Status: Processing time: Cow-calf reunion:	Signal Monitored: times/ Mortality detected: 5 June 1983 Carcass collected: 5 June 1983 Carcass weight: 6.3 kg Total length: 89 cm Right hind foot length: 35 cm New hoof length: 8.8 mm	Carcass condition and dispositic

Lumbar region bitten as well as neck and head. Left scapula punctured. Abomasum full of mulk curds.

Necropsy findings:

Mortality category: Predation involved-brown bear kill.

Mortality Case His	story
Calf No: unmarked 04 Captured:	Sex: undetermined Location:
Weight: Jmbilicus condition: Hoof condition: Health Status: Processing time: Cow-calf reunion:	Total Length: Right hind foot length: New hoof length: Estimated age at capture:
Signal Monitored: times/ day Aortality detected: 9 June 1983 Carcass collected: 9 June 1983 Carcass weight: 6.9 kg Fotal length: 81 cm Right hind foot length: 35.4 cm New hoof length: 8.2 mm	y period Number of Visual relocations: Location: upper Okerokovik River Distance from capture site: Response time:
Carcass condition and disposition: Car upor from	cass lying on left side. Only right side had been fed n. Cow standing over carcass. Golden eagle sitting 30 m m carcass. Eagle casting near carcass.
Necropsy findings: Puncture wounds beh Bruise on left shou	ind rib cage on left side. Abomasum full of milk curds. lder. Right lung missing.
Mortality category: Predation involved	-golden eagle kill.

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Sex: undetermined Location:	Total Length: Right hind foot length: New hoof length: Estimated age at capture:	day period Number of Visual relocations: Location: S. VABM Bitty Distance from capture site: Response time:	15% of carcass missing. Puncture wound at rear of right orbit. Hole into body cavity right rib cage. Subcutaneous hemmorrhages around wounds.	onsumed. Milk curds in abomasum.
Calf No: unmarked 05 Captured:	Weight: Umbilicus condition: Hoof condition: Health Status: Processing time: Cow-calf reunion:	Signal Monitored: times/ Mortality detected: 13 June Carcass collected: 13 June Carcass weight: 9.9 kg Total length: Right hind foot length: 39 cm New hoof length: 15.9 mm	Carcass condition and disposition:	Necropsy findings: Lung partially

Mortality category: Predation involved-probable golden eagle kill. Two eagles nearby on another dead calf (#51).

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June       June</td>	S       6       7       8       9       10       11       12       13       14       15       16       17       18       19       20       21       25       7       8       9       10       11       12       13       14       15       16       17       18       19       20       21       25       25       25       26       27       28       23       26       27       28       21       16       17       18       19       20       21       23       24       25       26       27       28       27       28       27       28       27       28       27       28       27       28       20       11       12       13       14       15       14       15       16       17       18       19       20       21       23       23       24       25       25       26       27       28       27       28       27       28       27       28       27       28       27       28       27       28       27       28       27       28       27       28       27       28       27       28     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June     June       14     15       15     16       14     15       15     16       16     17       17     18       18     19       20     21       19     20       21     18       19     19       20     21       11     11       12     14       13     19       20     21       14     11       15     16       16     11       17     11       18     19       20     21       19     11       20     21       20     21       21     14       21     20       21     20       21     20       21     20       21     21       21     21       22     22       23     24       24     24       25     22       26     21       27     28       28     29       29     20       21     20       21     20       21 </td <td>June     June       14     15       15     16       14     15       15     17       16     17       17     18       19     20       21     20       21     18       19     20       21     20       22     20       23     20       24<!--</td--><td>June     June       14     15     16       17     18       18     19       20     21       21     20       21     21       21     21       22     23       23     20       24     20       25     23       26     21       27     23       28     20       29     20       21     21       21     22       23     23       24     14       25     23       26     21       27     23       28     29       29     20       29     20       29     20       29     20       29     20       20     21       21     20       21     21       21     21       22     23       23     24       24     24       25     23       26     21       27     28       28     29       29     21       29     21       21     21    &lt;</td><td>Jue     Jue       14     15     16       14     15       16     17       18     19       20     21       21     22       23     24       11     11       12     11       13     11       14     12       15     16       16     17       18     19       20     21       21     22       23     24       11     11       12     11       14     11       15     12       16     17       18     19       20     21       21     22       23     24       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11    <tr< td=""><td>June     June       14     15     16     17     18     19     20     21     23     24     25       11     11     11     11     11     11     12     23     24     25       11     11     11     11     11     11     11     12     23     24     25       11     11     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11     11       12     12     12     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11       11     11     11<td>V     14     15     16     17     18     19     20     21     25     26       V     - 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    -     -     -     -     -     -     -     -     -       V     -     -     -     -     -     -     -     -     -     -       0     -     -     -     -     -     -     -     -     -     -       1     -     -     -     -     -     -     -     -     -     -       1     -     -     -     -     -     -     -     -     -     -       1     -     -     -     -     -     -     -     -     -       1     -     -     -     -     -     -     -     -     -     -       1     -     -     -     -     -     -     -     -     -     -       1     -     -     -     -     -     -     -     -     -       1     -     -     -     -     -     -     -     -     -     -       1     -     -     -     -</td><td>X     I.4     I.5     I.6     I.7     I.8     I.9     Z0     Z1     Z2     Z3     Z4     Z5     Z6     Z7       I     I     I.6     I.7     I.8     I.9     Z0     Z1     Z2     Z3     Z4     Z5     Z6     Z7       I     I     I.6     I.7     I.8     I.9     Z0     Z1     Z2     Z3     Z4     Z5     Z6     Z7       I     I     I     I     I     I.6     I.7     I.8     I.9     Z0     Z1     Z3     Z4     Z5     Z6     Z7       I     I     I     I     I     I     I     I.6     I.7     I.8     I.9     Z0     Z1     Z3     Z4     Z5     Z6     Z7       I     I     I     I     I     I     I     I     I     I.7     I.9     I.9&lt;</td><td>VX         June         June           0         1         14         15         16         17         18         19         20         21         23         24         25         26         27         28           1</td><td>Ide       June       June       June       June       June         0       1       1       16       17       18       19       20       21       23       24       25       26       27       28       29         1       1       1       1       10       1       10       1</td></td></tr<></td>	June     June       14     15     16       17     18       18     19       20     21       21     20       21     21       21     21       22     23       23     20       24     20       25     23       26     21       27     23       28     20       29     20       21     21       21     22       23     23       24     14       25     23       26     21       27     23       28     29       29     20       29     20       29     20       29     20       29     20       20     21       21     20       21     21       21     21       22     23       23     24       24     24       25     23       26     21       27     28       28     29       29     21       29     21       21     21    <	Jue     Jue       14     15     16       14     15       16     17       18     19       20     21       21     22       23     24       11     11       12     11       13     11       14     12       15     16       16     17       18     19       20     21       21     22       23     24       11     11       12     11       14     11       15     12       16     17       18     19       20     21       21     22       23     24       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11       11     11 <tr< td=""><td>June     June       14     15     16     17     18     19     20     21     23     24     25       11     11     11     11     11     11     12     23     24     25       11     11     11     11     11     11     11     12     23     24     25       11     11     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11     11       12     12     12     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11       11     11     11<td>V     14     15     16     17     18     19     20     21     25     26       V     -     -     -     -     -     -     -     -     -     -       V     -     -     -     -     -     -     -     -     -     -       0     -     -     -     -     -     -     -     -     -     -       1     -     -     -     -     -     -     -     -     -     -       1     -     -     -     -     -     -     -     -     -     -       1     -     -     -     -     -     -     -     -     -       1     -     -     -     -     -     -     -     -     -     -       1     -     -     -     -     -     -     -     -     -     -       1     -     -     -     -     -     -     -     -     -       1     -     -     -     -     -     -     -     -     -     -       1     -     -     -     -</td><td>X     I.4     I.5     I.6     I.7     I.8     I.9     Z0     Z1     Z2     Z3     Z4     Z5     Z6     Z7       I     I     I.6     I.7     I.8     I.9     Z0     Z1     Z2     Z3     Z4     Z5     Z6     Z7       I     I     I.6     I.7     I.8     I.9     Z0     Z1     Z2     Z3     Z4     Z5     Z6     Z7       I     I     I     I     I     I.6     I.7     I.8     I.9     Z0     Z1     Z3     Z4     Z5     Z6     Z7       I     I     I     I     I     I     I     I.6     I.7     I.8     I.9     Z0     Z1     Z3     Z4     Z5     Z6     Z7       I     I     I     I     I     I     I     I     I     I.7     I.9     I.9&lt;</td><td>VX         June         June           0         1         14         15         16         17         18         19         20         21         23         24         25         26         27         28           1</td><td>Ide       June       June       June       June       June         0       1       1       16       17       18       19       20       21       23       24       25       26       27       28       29         1       1       1       1       10       1       10       1</td></td></tr<>	June     June       14     15     16     17     18     19     20     21     23     24     25       11     11     11     11     11     11     12     23     24     25       11     11     11     11     11     11     11     12     23     24     25       11     11     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11     11       12     12     12     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11       11     11     11     11     11     11     11     11     11       11     11     11 <td>V     14     15     16     17     18     19     20     21     25     26       V     - 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    7     27       7     27       <td< td=""><td>S     16     17     18       June     June       5     16     17     18       10     17     18     19     20       21     23     24       11     11     11       12     13     20       14     14     17     11       17     18     19     20       21     22     23     24       23     24     17     11     11       17     11     11     11     11       18     19     20     21     22       24     19     20     21     23       24     19     10     11     11     11       19     11     11     11     11     11       11     11     11     11     11     11       11     11     11     11     11     11       11     11     11     11     11     11       11     11     11     11     11     11       11     11     11     11     11     11       11     11     11     11     11     11        11     11</td><td><math display="block"> \begin{array}{cccccccccccccccccccccccccccccccccccc</math></td><td>5       16       17       18       19       20       21       23       24       25       26         1       1       1       1       1       1       1       1       1       1       1       1       23       24       25       26         1</td><td>5       16       17       111&lt;</td><td>5       16       17       18       19       20       21       23       24       25       26       27       28         7       1</td><td><math display="block"> \begin{array}{cccccccccccccccccccccccccccccccccccc</math></td></td<></td>	5     16     June       5     16     17     18       7     18     19     20       7     21     22       7     21       7     21       7     21       7     21       7     21       7     20       7     21       7     21       7     22       7     23       7     20       7     21       7     20       7     21       7     20       7     21       7     21       7     21       7     21       7     21       7     21       7     21       7     21       7     21       7     21       7     21       7     21       7     21       7     21       7     21     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\begin{array}{cccccccccccccccccccccccccccccccccccc</math></td><td>5       16       17       18       19       20       21       23       24       25       26         1       1       1       1       1       1       1       1       1       1       1       1       23       24       25       26         1</td><td>5       16       17       111&lt;</td><td>5       16       17       18       19       20       21       23       24       25       26       27       28         7       1</td><td><math display="block"> \begin{array}{cccccccccccccccccccccccccccccccccccc</math></td></td<>	S     16     17     18       June     June       5     16     17     18       10     17     18     19     20       21     23     24       11     11     11       12     13     20       14     14     17     11       17     18     19     20       21     22     23     24       23     24     17     11     11       17     11     11     11     11       18     19     20     21     22       24     19     20     21     23      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Table A-1. (Continued). Cow # and Mav

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ARCTIC NATIONAL WILDLIFE REFUGE COASTAL PLAIN RESOURCE ASSESSMENT

# 1983 UPDATE REPORT BASELINE STUDY OF THE FISH, WILDLIFE, AND THEIR HABITATS

Section 1002C Alaska National Interest Lands Conservation Act

Edited by Gerald W. Garner and Patricia E. Reynolds



U.S. Department of the Interior U.S. Fish and Wildlife Service Region 7 Anchorage, Alaska February 1984

