Woodland caribou calf mortality in insular Newfoundland

Shane P. Mahoney, H. Abbott, L.H. Russell and B.R. Porter

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Between 1979 and 1984 mortality in woodland caribou (*Rangifer tarandus terraenovae*) calves was studied on Newfoundland island. From three herds 220, 1-3 day old calves were outfitted with mortality sensing radio-collars. Calves were usually relocated at least once a day during their first three weeks of life, less frequently thereafter. The chief cause of death was predation by black bears (*Ursus americanus*) and lynx (*Lynx canadensis*). Wolves (*Canis lupus*) are absent from Newfoundland.

S.P. Mahoney, H. Abbott, L.H. Russell and B.R. Porter, Newfoundland and Labrador Wildlife Division, P.O. Box 8700, St. John's, Newfoundland, A1B 4J6.

Introduction

Predation especially on juvenile cohorts, has long been considered a major determinant of population size and rate-of-growth in ungulates generally and caribou specifically (Murie 1944; Allee et al. 1949). Determining the causes and rates of such mortality is therefore crucial to understanding and managing such populations.

Caribou (*Rangifer tarandus*) calves die from a variety of causes including wind chill, desertion, birth defects, disease and predation (Kelsall 1968: Bergerud 1971; Miller and Broughton 1974) and may be predisposed to such mortality by low birth weight resulting from poor maternal nutrition (Skogland 1984). Amongst North American populations predation has often been reported as the most significant mortality agent by far (Miller and Broughton 1974: Bergerud 1980) although episodic losses to wind chill can be severe (Miller 1974). Where predation has been implicated, wolves (*Canis lupus*) have traditionally been viewed as the principal agent of execution (Bergerud 1980).

Bergerud (1971, 1983) reviewed the population dynamics of insular Newfoundland caribou populations and reported that from 1900 - 1930 herds were led to a precipitous decline and thereafter maintained at low levels by a combination of overharvesting and poor recruitment. He concluded that lynx (*Lynx canadensis*) predation was primarily responsible for the high juvenile mortality which often reached 70 percent. This conclusion was derived from necropsies of dead calves, by observation of a pattern in calf recruitment which coincided with the lynx population cycle and from experimental manipulation (trapping) of lynx numbers which showed inverse correlations between lynx abundance and calf survival.

Bergerud (1971) further reported a higher mortality rate for male than female calves between birth and six months of age. He attributed this to a prejudice in lynx predation stemming from differences in calf behavior. Male calves were reportedly more exploratory and routinely wandered farther from their dams thus proferring greater opportunity to stalking lynx.

These conclusions regarding mortality rates were based exclusively upon surveys of herd structure, specifically the percent calves amongst observed caribou groups. No direct means of assessing mortality was available at that time. In this study I report findings from these same populations using radio-telemetry to assess rates and causes of juvenile mortality.

Material and Methods

Study Area.- The study area (Fig.1) lies within the Newfoundland Labrador Barrens section of the Boreal Forest Regions of Canada (Rowe 1972). Situated in south-central insular Newfoundland the area encompasses approximately 10,000 km^2 and, excepting its northern fringe where forest is

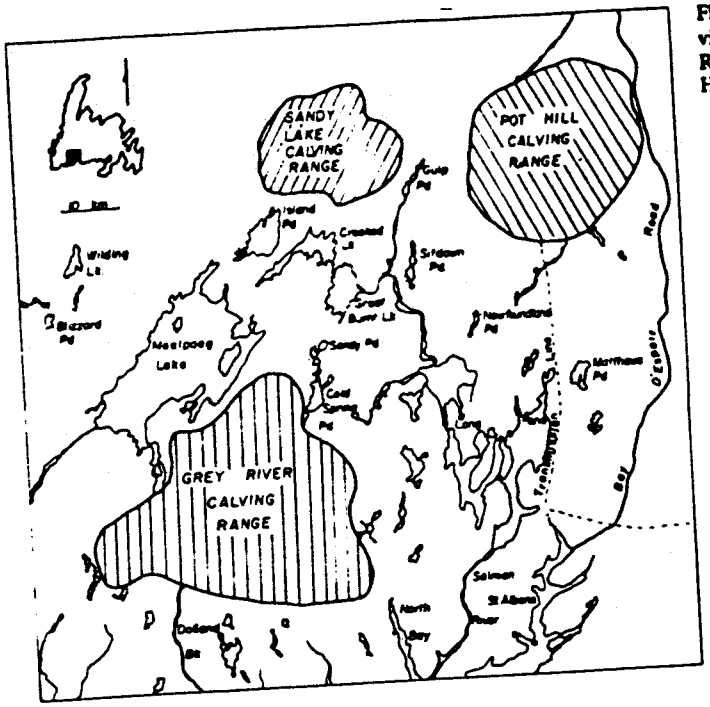

Fig. 1. Study area and calving grounds of the Grey River, Sandy Lake and Pot Hill caribou herds.

common, is primarily Maritime Barrenland as described by Damman (1964). The area has generally low relief with elevational differences rarely exceeding 300 m.

Primarily underlain by peat soils the three dominant vegetation communities are: (1) Spruce–fir forest (2) *Kalmia–Cladonia* heaths and (3) moss–sedge wetlands (Damman 1964). The habitat mosaic is best characterized however as extensive barrenland with Krumholz spruce and *Kalmia* heaths common on better drained sites and *Scirpus* dominating the shallow fens and bogs. These habitats are derivations primarily of the area's maritime climatic conditions and fires in the historical past.

The region is characterized by cool summers (mean monthly temperature June – September 11° C) and relatively mild winters. Winter precipitation may come as snow or rain and therefore snowfall is variable but normally 330 cms will fall during a normal year. The frostfree period averages 170 days, usually extending from April 20 to October 20. Fog is common throughout the year especially in early summer when the maximum mean fog days per month may reach seven.

Besides lynx other predators in the study area which might capture caribou calves include black bears (*Ursus americanus*), red fox (*Vulpes vulpes*) and bald eagles (*Haliaetus leucocephalus*). Wolves have been absent from Newfoundland for over 60 years (Cameron 1958).

Study Populations.– Three caribou populations are identified within the study area, the Grey River, Sandy Lake and Pot Hill. The most recent census in November 1987 produced the following estimates respectively: 10,108 ± 25%, 4,602 ± 26% and 3,444 ± 27%. The total area population was estimated at 17,713 ± 15%.

The three herds have distinct calving areas but show considerable overlap in distribution at other times of the year, especially during summer as a result of northward migration of the Grey River herd and again in winter

when significant portions of all populations drift southwards.

The areas chosen for calving are generally open, providing good surveillance and escape terrain. The Grey River herd might choose areas proferring even better advantages in this regard but perhaps comprimises somewhat between these advantages and those of forage availability. From mid-summer to late September all three herds disperse into forested habitat resulting in the majority of animals being found in the northern one third of the range. In winter the herds choose areas of low snow depth, preferring exposed hilltops inland and costal headlands to the south.

Radio-tagging and monitoring.- Between 1979 and 1984, 225 1-3 day old caribou calves were captured and outfitted with mortality-sensing radio transmitters (Telonics Inc. Mesa, Arizona). Calves were observed from helicopter and their ages initially estimated on the basis of running speed and agility. Calves too young to walk and those capable of outrunning a man were excluded for radio-collaring purposes as were all calves showing signs of disease or physical impairment.

Once captured, calves were sexed, and had ear tags and radio transmitters applied. One hundred and thirty-four calves were weighed and measured. Calf age was further assessed at this time using conditions of the hooves and umbilicus. Handling time for individual calves was generally less than 5 minutes. Once released, reunion of radiocollared calves with their dams was usually verified either immediately or within 24 hours.

Radio signals from instrumented calves were usually monitored daily and sometimes as much as three times per day, weather permitting, during their first 3 weeks of life and thrice weekly thereafter until 6-8 weeks of age. Older calves were generally monitored on a bi-monthly basis. Monitoring was conducted from a variety of aircraft but most commonly a Bell 206b Jet Ranger helicopter or DeHavilland Beaver or Cessna 185 fixed wing aircraft were used. Once detected, mortality signals were pinpointed from the air and the collar retrieved using helicopter and/or ground tracking.

Causes of mortality.- We distinguish between the following causes:

a) To differentiate between predation and scavenging; carcasses were examined for the type, size and location of wounds and especially the occurrence of hemmorhages or frank blood. Tissue trauma induced before death was the most important criterion.

b) Several criteria in addition to scats, hair and tracks, were used to differentiate between predators. Bears typically consumed the entire skeleton, muscle tissue and viscera but discarded large sections of skin. Usually the entire pelt was intact except for the one large incision through which entry to the body cavity was secured. Sometimes the skullcap remained attached to the pelt having been neatly pryed along its suture lines from the skull proper; the brains were invariably consumed. Bears showed a preference for the cartilaginous tissues of the face, consuming the ears and nose even when other portions of the carcass were (infrequently) left intact. As well bears were not observed to bury calf remains. Bears frequently defecated near the kill and sometimes tracks were discernable. The radio-collars themselves never bore tooth marks or significant blood stains as a result of bear predation.

Lynx typically did not leave tracks or scats and never skinned the calf or left large sections of pelt intact. Usually only small shards of well-cleaned bone and the radio-collar were located. Exceptions to this were when sections of the carcass (and sometimes the collar) were neatly buried. Lynx were not known to consume their kill in the open; invariably remains of the kills were found within or immediately adjacent to protective cover. The radiocollars of lynx-killed calves sometimes bore clear canine punctures and were heavily blood stained.

Fox predation was suspected after a radio-collar and some calf remains were retrieved from an active fox den. The remains were insufficient however to ascertain the method of handling.

c) Calves were assumed abandoned when recovered without sign of trauma or obvious infection. Such calves were usually found curled in the sleeping position with their stomachs entirely or practically empty.

d) Calves were diagnosed as having died of pathophysiological disorder if the above

symptoms were absent and if signs of disease were apparent. In the relevant cases examined substantial aqueous faecal discharge was noted in the anal region and down the back legs. These animals were found lying on their sides; their stomachs contained only fragments of vegetation.

e) Some calves died during the winter months when retrieving the carcass was difficult and often delayed. For this report these mortalities are simply described as "winter death". Symptoms often included poor physical condition and small body size, attributes which might result from forage stress per se or secondarily so as a result of neurological disorder caused by the parasite *Elaphostrongylus cervi*.

f) Drowning victims were discovered either on lakeshores or in small steep-sided bog ponds. Invariably the lungs of such animals were water-filled. No signs of impairment or trauma were otherwise noted.

These mortality categories are based upon examinations of both radio-collared and non-instrumented calves.

Results

Causes of mortality.- Over all years 225 calves were radio-collared and 52 (23.1%) died within their first 12 months of life (Tab.1). Forty-eight (21.3%) calves died for reasons other than desertion (N=4;1.7%). Predation claimed 40 (17.7%) calves. 4 (1.7%) died over winter (possibly from disease and/or starvation) and 4 (1.7%) calves died as a result of accidents, disease and illegal hunting.

The proportional mortality (rounded by computer to the nearest integer) attributable to each of these factors is shown in Fig. 2. Predation accounted for 78% of all deaths. Lynx and black bear were each responsible for 35% with the remaining 8% falling to a combination of fox (2%) and unknown predators (6%). The next largest category of "natural" mortality occured as winter death (8%). Desertion by the cow resulted in the death of 8% of the calves but we assume that all such mortality was capture reduced.

Chronology of mortality.- Of the 52 recorded mortalities 23 (44.2%) occurred within the first 2 weeks and a total of 32 (61.5%) within the first 4 weeks. Thereafter an abrupt decline in the rate of mortality took place. Between 4 and 8 weeks post-collaring just 7 (13.4%) deaths were recorded and only 13 (25%) more over the next 10 months. This mortality pattern was largely a product of the overbearing influence of predation on calf survivorship. Thus of predator killed calves 17 (42.5%) died within the first 2 weeks and 25 (62.5%) within the first 4 weeks (Fig.3).

Both lynx and black bear showed a strong preference for younger aged calves (Fig.4). Lynx began predating on caribou within 1 day of radio-collaring and took 12 (66.6%) of their calves in the first 4 weeks and 10 (55%) within the first 2 weeks. Lynx normally did not kill calves older than 12 weeks of age. Exceptions to this involved calves of between 10 and 12 months of age which were of small size and suspected poor health when killed (pers. files). These calves however, were not part of the radio-collared sample used in this study.

Black bears killed their first calf 5 days after radiocollars were operational and by 4 weeks had taken 72% of their total. While bears were similar to lynx in their preference for young calves they differed in being capable predators of older calves and even adult caribou (pers. files).

Factors influencing vulnerability.- Of the 225 calves radio-collared 121 were males, 102 were females and for 2 calves the sex was not recorded (Tab. 2). The sex ratio of

Tab. 1. Causes of death amongst 225 radio-collared caribou calves in Newfoundland 1979-1984.

	Predation				Desertion	Drowning	Winter	Poaching	Infection	Total
	Bear	Lynx	Fox	Other						
Number	18	18	1	3	4	2	4	1	1	52
Percent	8	8	0.4	1.3	1.7	0.8	1.7	0.4	0.4	23

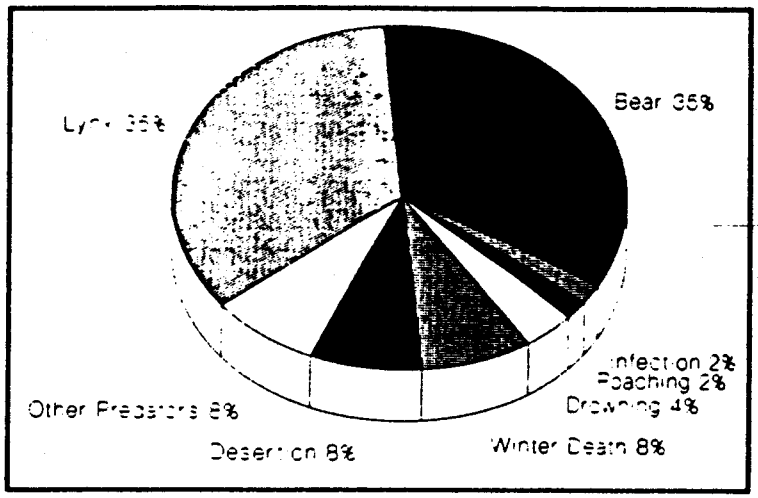

Fig. 2. Causes of death amongst newborn caribou calves in Newfoundland.

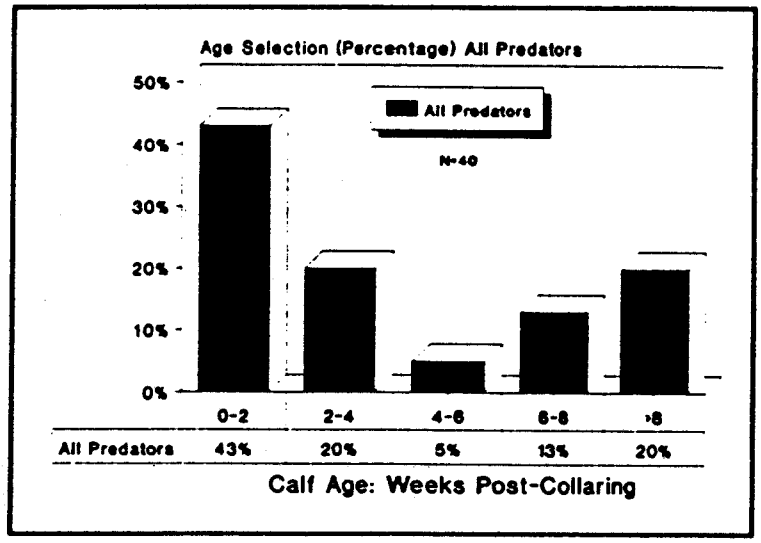

Fig. 3. Schedule of predation on newborn caribou calves in Newfoundland.

all mortalities, excluding those resulting from desertion, was 26 males: 21 females. This ratio did not suggest any sex related vulnerability in the pattern of first year mortality ($p=>.05$).

The sex ratio of calves dying from predation showed a more substantial male bias, 25 males: 15 females. This ratio however was also non-significant ($p=>.05$). Similiar results were recorded when the sex ratio of kills made by black bears, 11 males: 7 females, and lynx, 12 males: 6 females, were tested separately.

Calf weight at the time of radio-collaring did not appear to influence predator choice. The mean weight-at-collaring of calves surviving to 1 year of age, 8.17 kg (N=114, $s^2=4.07$) was not significantly different ($p=>.05$) from that of calves dying from predation, 8.44 kg (n=20, $s^2=4.61$). The mean weights of calves killed by bears ($\bar{x}=8.12$) and lynx ($\bar{x}=8.87$) were quite similar.

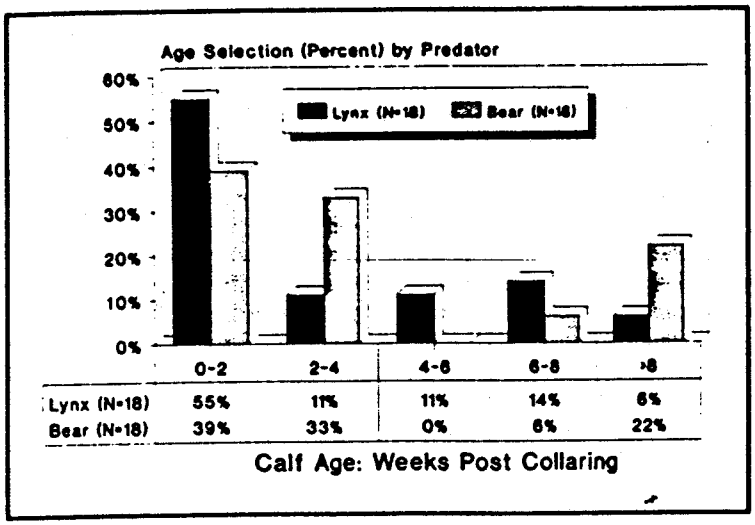

Fig. 4. Calf age: Weeks post collaring.

Tab. 2. Relationship between sex and first year mortality (desertion excluded) amongst caribou calves in Newfoundland.

	Calves collared			Calves dying			Differences in Vulnerability by sex[1]
	Male	Female	Unknown	Male	Female	Unknown	
All calves	121	102	2	26	21	1	N.S.
Calves killed by all predators				25	15		N.S.
Bear killed calves				11	7		N.S.
Lynx killed calves				12	6		N.S.

1. Chi Square, $p<.05$.

Discussion

The hypothesis has been proposed that predation rather than forage is the most consistent factor limiting the growth of caribou herds and that predation on juveniles can be especially important in this regard (Bergerud 1980, 1983). Where predators exist mortality amongst calves is reported to normally attain or exceed 50% (Bergerud 1980). For the herds studied here Bergerud (1971, 1983) estimated that 70% of calves died in the first 6 months of life due almost exclusively to predation by lynx.

This study supports the idea that predation is a key element in the mortality regimen of juvenile caribou. Fully 78% of all deaths were ascribed to this factor. The overall mortality rate however (23%) was quite low and was in fact less than that reported for some herds unexposed to predation but apparently subject to food shortage (Skogland 1984). Given the relatively high survivorship of calves reported here, predation, though of obvious importance, would not depress or stabilize caribou numbers assuming normal patterns of productivity and adult survival. Early forms of mortality such as birthing complications or lethal congenital defects were of course not assessed and would have to be added to these estimates. Such losses would however be small.

This discrepancy between current and past mortality rates is very large and an obvious question is whether it reflects real world dynamics or is an artifact of differing methodologies. Bergeruds's (1971) estimate of mortality was determined by interpolating the

results of herd classifications conducted at calving time and again in the fall. The recorded difference in the ratio of calves : 100 females over this time period was assumed to approximate the mortality rate. In our study such classifications were also conducted and will be used to independently assess calf mortality. Cursory examination however suggests a much higher mortality estimate if this method is used versus the information from radio-collared animals.

A real difference between mortality rates then and now might have resulted from substantial increases in caribou numbers and/or a decrease in the lynx population. Certainly since the 1960's the caribou herds in question have increased tremendously and lynx populations, due to increased trapping effort, have declined (Newfoundland and Labrador Wildlife Division files). Nevertheless an interesting question to model would be whether lynx could impact moderate to high density caribou populations given lynx's daily food requirements and extreme preference for calves of less than four weeks of age, and given the swamping effect of the restricted caribou calving season.

Further regarding lynx predation it is interesting that no calves were observed with the *Pasteurella multocida* infections which Bergerud (1971) earlier described. From 1957 through 1964 dead and moribund calves were commonly recovered with large neck abscesses, developed as a result of non-fatal attacks by lynx and immediate post-attack infection with *P. multocida*. During our investigations we handled approximately 80 dead calves (52 of which were radiocollared) some of which had been killed by lynx but were still defended by the female on our approach, but not a single one displayed these symptoms.

During the present study black bears accounted for as much calf mortality as did lynx, signifying a major difference from earlier work. Bergerud (1971) had not considered black bear predation during his investigations but undoubtedly some of the mortality he ascribed to lynx was caused by black bear. Bears, both grizzly (*Ursus arctos*) and black, have recently gained prominence as ungulate predators (Schlegel 1976; Franzmann et al. 1980; Adams et al. 1988). Black bears, however, have not generally been considered a predator on caribou. Mahoney (1981, 1982) first reported such a relationship during earlier appraisals of the present study. Since that time the phenomenon has been reported for other caribou herds in insular Newfoundland (Mahoney et al. 1989), in Labrador (Brown 1986) and elsewhere (McCollough pers. comm.).

The adult sex ratio amongst lightly hunted caribou populations is normally around 60 females : 40 males while at birth the ratio is approximately even (Bergerud 1980). This change is assumed to result from greater mortality amongst males as a result of predation and intraspecific strife. Although the rates of mortality on male and female calves in this study were not statistically different a clear male bias in predation was observed. It may be that a statistically significant relationship does exist but that the sample size recorded here is simply insufficient to express it.

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Ecology of wolves associated with the Bluenose caribou herd

Peter L. Clarkson and Ilme S. Liepins

Clarkson, P.L. and Liepins, I.S. 1990. Ecology of wolves associated with the Bluenose caribou herd. – Trans. 19th IUGB Congress, Trondheim 1989. (Only abstract).

Movements, pack structure, reproduction, and predation were determined for wolves (*Canis lupus*) associated with the Bluenose caribou (*Rangifer tarandus*) herd (n=120,000) in the western Northwest Territories. The wolves used two different movement strategies to find prey and selected a den location which would optimize their access to caribou. Natural and hunter/trapper wolf mortality occurred. Wolves preyed mostly on caribou; however, moose (*Alces alces*) and muskox (*Ovibos moschatus*) were also taken.

P.L. Clarkson and I.S. Liepins, Department of Renewable Resources, GNWT, Inuvik Northwest Territories, Canada.