DENSITY DEPENDENT RESPONSES IN MANDIBLE LENGTH, CALVING DATE, AND RECRUITMENT IN THREE ALASKAN CARIBOU HERDS

Patrick Valkenburg, Alaska Department of Fish and Game, 1300 College Road, Fairbanks, AK 99701

Kenneth W. Pitcher, Alaska Department of Fish and Game, 333 Raspberry Road, Anchorage, AK 99518

Daniel J. Reed, Alaska Department of Fish and Game, 1300 College Road, Fairbanks, AK 99701

Earl F. Becker, Alaska Department of Fish and Game, 333 Raspberry Road, Anchorage, AK 99518

James R. Dau, Alaska Department of Fish and Game, P.O. Box 689, Kotzebue, AK 99752

Douglas N. Larsen, Alaska Department of Fish and Game, P.O. Box 689, Kotzebue, AK 99752

James L. Davis, Alaska Department of Fish and Game, 1300 College Road, Fairbanks, AK 99701

Abstract: In this paper we review evidence for density-dependent responses in Alaskan caribou. Over 3,000 mandibles from Western Arctic, Nelchina, and Alaska Peninsula caribou from the early 1950's through 1989 were analyzed. Evidence of density-dependent responses includes data on age at first reproduction for Delta, Denali, and Macomb Herd caribou, and changes in peak calving dates for Western Arctic, Porcupine, Central Arctic, Fortymile, and Nelchina caribou. At present, the evidence for density-dependent population regulation in Alaska caribou is inconclusive. Until recently, high or declining caribou populations have been unavailable for study using modern methods.

INTRODUCTION

Most of Alaska's caribou (Rangifer tarandus granti) herds have a history of marked population fluctuations. Wolf predation (Bergerud 1974, 1983), overhunting (Bergerud 1974, Van Ballenberghe 1985), destruction of the winter ranges by fire (Leopold and Darling 1953), severe winter weather (Van Ballenberghe 1985), and emigration (Skoog 1956, 1968), by acting either alone or in concert, have all been proposed as mechanisms for population declines. Recently, several authors have proposed density-dependent resource limitation as the primary mechanism limiting further growth of the George River Caribou Herd in northern Quebec and Labrador (Couturier et al. 1988, Messier et al. 1988). The role of density-dependent resource limitation in the declines of Alaskan caribou remains unknown.

In this paper, we examine new evidence for density related responses in body size as represented by mandible length, and review previous data on calving dates and recruitment in the Fortymile, Nelchina, and Western Arctic Caribou Herds.

METHODS

During the 1960s biologists collected mandible measurements from about 3,000 caribou, primarily from the Fortymile, Nelchina, Western Arctic, and northern Alaska Peninsula Herds. We recently compared those data with mandible measurements from caribou taken during the 1980s in the Fortymile, Nelchina, and Western Arctic Herd. We used

an analysis of variance technique with age as a blocking variable and the Student-Newman-Keuls (SNK) comparison procedure (Sokal and Rohlf 1969). Only adults (females >2 and males >4) were compared. Historical data on the time of peak calving and recruitment (calves:100 cows in summer and fall) were obtained from the literature and from Alaska Department of Fish and Game files.

RESULTS

Fortymile Herd

The Fortymile data set, though small, suggests there is no difference in mandible length of males or females between the 2 collections (Table 1). There was wide variation in the reported peak calving dates of the Fortymile Herd in the late 1950s as the herd approached 50,000 animals (Table 2). It appears that peak calving dates during the 1980s are the earliest reported. Recruitment of Fortymile caribou was low in the 2 years for which data are available in the late 1960s and early 1970s when the herd was declining, and relatively higher in the late 1970s and 1980s when the herd was increasing (Table 2).

Table 1. Mandible length, peak calving date, and recruitment in the Fortymile Caribou Herd during recent population fluctuations.

	Population relatively high and declining (1960s and early 1970s)	Population low and increasing (late 1970s and 1980s)
Mean female mandible length (mm)	277.0 (A = 19)	277.7 (A = 9)
Peak calving dates	21-23 May (1956) 28-29 May (1957) 25 May (1958) 23-27 May (1960) 25-27 May (1974)	22 May (1987) 22 May (1988)
Recruitment[a]		
(calves:100 cows in fall)	19.3+1.1 SE, n=4	32.3+2.0 SE, n=10
(calves:100 cows in summer)	No data	40.0+1.9 SE, n= 9

[a] Marginally significant difference between periods ($0.05 < 0.1$, $t = 2.16$, $df = 12$).

Nelchina Herd

Mean mandible length of females was about 1 cm longer in the 1980s, when the herd was relatively small and increasing, than in the 1960s when it was high and declining (Table 2). The small sample of male mandibles collected in the 1980s precluded comparison. Despite the difference in mandible length of females between the 2 periods, there was no difference in recruitment (Table 2). The scant data on time of calving suggests that peak calving dates may have been a few days earlier during the 1950s when the herd was small than in the early 1970s when it crashed. No data on peak calving dates are

available from the 1980s.

Table 2. Mandible length, peak calving date, and recruitment in the Nelchina Caribou Herd during recent population fluctuations.

	Population relatively high and declining (1960s and early 1970s) (maximum density 2/km^2)	Population low and increasing (late 1970s and 1980s) (density<1/km^2)
Mean female mandible length[a] (mm)	274.7 (n = 99)	285.6 (n = 55)
Peak calving dates[b]	24 May (1957) 27 May (1973)	No data
Recruitment (calves:100 cows in fall)	40.8+3.SE, n = 8	42.6+2.5 SE, ≥=10
(calves:100 cows in summer)	59.8+5.1 SE, n = 5	54.0+6.9 SE, ≥=12

[a] Significant difference between periods ($p < 0.05$).

[b] Data from Bos (1973).

Western Arctic Herd

Mandible length and diastema length of males and diastema length of females was greater in the 1980s sample than in the 1960s sample

(Table 3). Recruitment was also higher in the late 1970s and 1980s than during the 1960s (Table 3). There are no data on peak calving dates during the period of population decline in the late 1960s or early 1970s, but in 1977, at the population low, calving was the latest recorded (Table 3).

DISCUSSION

Fortymile Herd

The Fortymile data are minimal for both body size and recruitment. No evidence for density-dependent responses is apparent. Davis et al. (1978) believed that the herd reached its peak in 1961, and there are no data on recruitment for the critical period of the initial decline. Recruitment in the early 1970s was low but by then may have been more a function of a low caribou:wolf ratio than food limitation.

Nelchina herd

Interestingly, the Nelchina Herd for which there is relatively good data for both body size and recruitment shows only a possible relationship between density and body size. Recruitment was relatively good during both the high and the low density periods. Furthermore, there was no apparent relationship between snow depth during the previous winter in the high-density period (Fig. 1) as might be expected if cows had been food stressed during gestation

Table 3. Mandible length, peak calving date, and recruitment in the Western Arctic Caribou Herd during recent population fluctuations.

	Population relatively high and declining (1960s and early 1970s) (maximum density 1.0/km^2)	Population low and increasing (late 1970s through mid-1980s) (density 0.3-1.0/km^2)
Mean female mandible length (mm)	263.3 (n = 1,002)	269.9 (n = 7)
Mean female diastema length, (mm)	96.6(n = 976)	106.7 (n = 7)
Mean male mandible length, (mm)	281.1 (n = 355)	297.9 (n = 106)
Mean male diastema length, (mm)	104.4 (n = 331)	120.1 (n = 106)
Peak calving dates	26 May (1960) 5 June (1961)	8-10 June (1977), 6-8 June (1978), 2 June (1981), 6 June (1982), 4 June (1988), 8 June (1989)
Mean recruitment		
(calves:100 cows in fall)5	38.3+3.1 SE, n = 3	50.6+3.0 SE, n = 5
(calves:100cowg in summer),	43.7+2.0 SE,n = 3	58.8+3.4 SE, n = 4

[a] Significant difference between periods ($P < 0.05$).

[b] Significant difference between periods ($0.02 < P < 0.05$, $t = 2.73$, $df = 6$).

[c] Significant difference between periods ($0.01 < P < 0.02$, $t = 3.41$, $df = 5$).

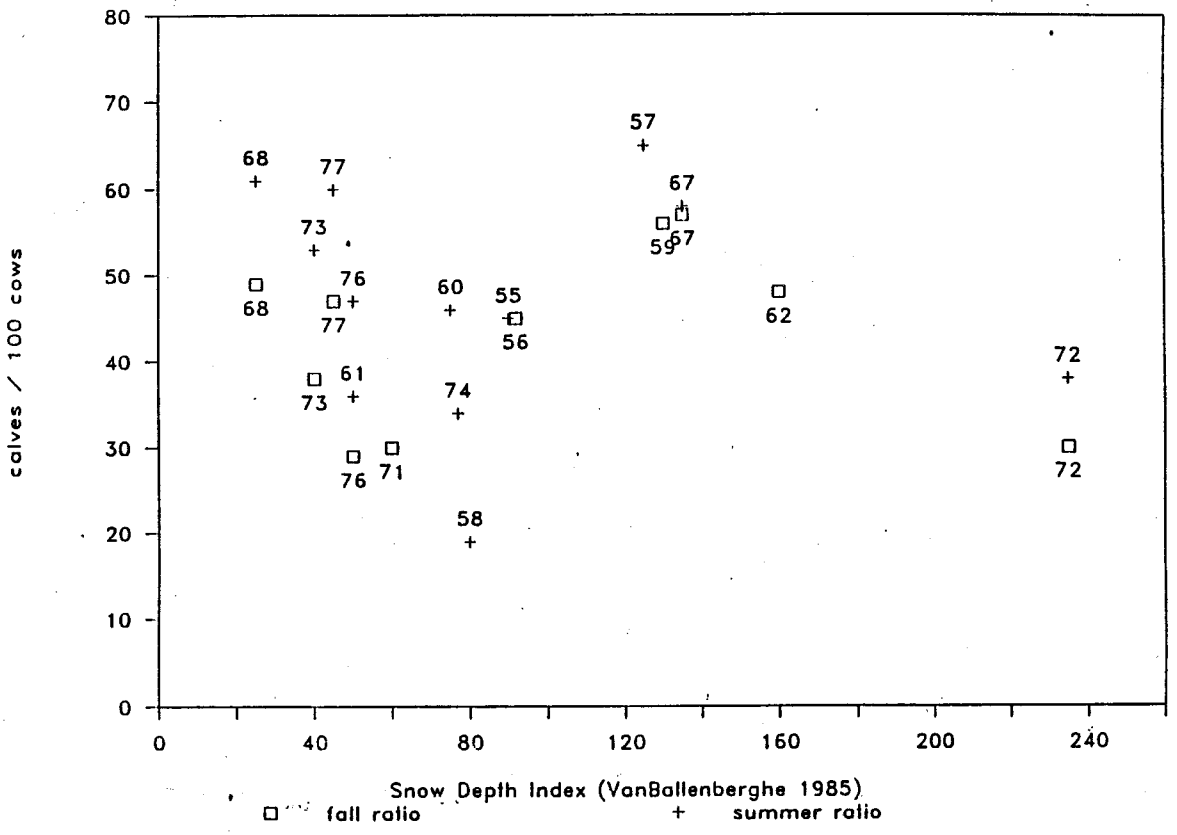

Fig. 1. Summer and fall calf:cow ratio as a function of snow depth in the previous winter in the Nelchina Herd, 1955-1977.

(McEwan and Whitehead 1972, Rehbinder 1975- as cited in Espmark 1980, Skogland 1985). We are not suggesting that calf mortality was unimportant during the Nelchina decline, only that it apparently did not occur in summer in the years when summer and fall composition data were available. It therefore appears likely that direct

mortality of calves from winter weather, perhaps in combination with wolf predation, contributed more to the population decline than food limitation. However, the smaller bodied calves that may have been present because of food limitation in the 1960s could have been at a disadvantage in bad winters.

Western Arctic Herd

The Western Arctic Herd was the only herd in which both body size and recruitment appear to show a response to density. It is not likely that wolves played a significant role in the lower recruitment seen during the 1960s because wolves have never been documented to be abundant on the calving grounds, and because of the relatively large size of the herd (about 75,000) even at its population low in 1977.

CONCLUSIONS

Mandible measurements appear to be useful for determining changes in body size that may be associated with resource limitation. Whether changes in mandible length occur early enough to be useful for predicting declines in herd size may depend on the rate of population increase prior to the peak and whether other factors limit population growth before changes in body size are detected.

LITERATURE CITED

Bergerud, A. T. 1974. Decline of caribou in North America following settlement. J. Wildl. Manage. 38:757-770.

_____. 1983. The natural population control of caribou. Pages 14-61 in F. L. Bunnell, D. S. Eastman, and J. M. Peek, eds. Symposium on the natural regulation of wildlife populations. Univ. Idaho For. Wildl. and Range Exp. Sta. pp.

Bos, G. N.. 1973. Nelchina caribou report. Alaska Dep. Fish and Game. Fed. Aid in Wildl. Rest. Proj. W-17-4 and W-17-5. Juneau. 25pp.

Couturier, S., J. Brunelle, and G. LaPointe. 1988. Decline of physical condition and decrease of recruitment in the George River Caribou Herd.Pages 35-37 in R.D. Cameron and J.L. Davis, eds. Proc. 3rd North Am. Caribou Workshop. Alaska Dep. Fish and Game Juneau. Wildl. Tech. Bull. No. 8:35-37.

Espmark, Y. 1980. Effects of maternal prepartum undernutrition on mother-calf relationships in reindeer. Pages 485-496 in E. Reimers, E. Gaare, and S. Skjenneberg, eds. Proc. 2nd Intl. Reindeer/Caribou Symp., Roros, Norway, 1979. Direktoratet for vilt og ferskvannsfisk, Trondheim.

Leopold, A. S., and F.F. Darling. 1953. Wildlife in Alaska. Ronald Press Co., New York. 129pp.

McEwan, E. H., and P. E. Whitehead. 1972. Reproduction in female reindeer and caribou. Can. J. Zool. 50:43-46.

Messier, F., J. Huot, D. Le Henaff, and S. Luttich. 1988. Demography of the George River Caribou Herd: evidence of population regulation by forage exploitation and range expansion. Arctic 41(4):279-287.

Rehbinder, C. 1975. Kalvdodligheten i Angesa samebys renhjord. Nord. Vet. Med. 27:241-252.

Skogland, T. 1985. Life history characteristics of wild reindeer (Rangifer tarandus tarandus L.) in relation to their food resources; ecological effects and behavioral adaptations. Papers of the Norwegian State Game Research Institute Series 3, No. 14. Direktoratet for Wildlife and Freshwater Fish, Trondheim. 34pp.

Skoog, R. 0. 1956. Range, movements, population, and food habits of the Steese-Fortymile Caribou Herd. M.S. Thesis. Univ. of Alaska, Fairbanks. 145pp.

_____. 1968. Ecology of the caribou (Rangifer tarandus granti) in Alaska. Ph.D. Thesis. Univ. of California, Berkeley. 699pp.

Sokal, R. R., and F. J. Rohlf. 1969. Biometry. W.H. Freeman and Co. San Francisco. 776pp.

Van Ballenberghe, V. 1985. Wolf predation on caribou: The Nelchina case history. J. Wildl. Manage. 49:711-720.

4th NORTH AMERICAN CARIBOU WORKSHOP

ST. JOHN'S, NEWFOUNDLAND

OCTOBER 31 - NOVEMBER 3, 1989

PROCEEDINGS

Edited by: Charlie Butler and Shane P. Mahoney

Technical Editors: John Blake, Margo Hoban and Brian Tucker

Artist: Frank LaPointe

Newfoundland and Labrador Wildlife Division

February 1991

Citation example:

Eastland, W.G. 1991. Correlations of weather and autumn caribou movements in Butler, C.E. and Mahoney, S.P. (eds.). Proceedings 4th North American Caribou Workshop. St. John's, Newfoundland. pp 143 - 145.